Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind

PREPARED FOR
State of Maine, Governor's Energy Office

DATE
20 March 2025

REFERENCE
0724797

SIGNATURE PAGE

Exploring Approaches to Fisheries’ Coexistence with Floating Offshore Wind

0724797

Alice Sandzén
Partner-in-Charge

Tayebeh Tajalli Bakhsh, Ph.D.
Technical Lead, Project Manager

Hannah MacDonald
Sr Program Manager | Stakeholder Engagement
Gulf of Maine Research Institute

Chas Van Damme
Project Manager | Stakeholder Engagement
Gulf of Maine Research Institute

ERM Consulting & Engineering, Inc.
One Beacon Street
5th Floor
Boston, MA 02108

T +1 617 646 7800

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym	Description
Advisory Board	Maine Offshore Wind Research Consortium's Advisory Board
BOEM	Bureau of Ocean Energy Management
Consortium	the Maine Offshore Wind Research Consortium
ERM	ERM Consulting & Engineering, Inc.
FOW	floating offshore wind
GEO	The Governor's Energy Office, State of Maine
GMRI	Gulf of Maine Research Institute
MW	megawatts
NMFS	National Marine Fisheries Services
NOAA	National Oceanic and Atmospheric Administration
O&G	oil and gas
OCSLA	Outer Continental Shelf Lands Act
Project Team	ERM and GMRI
Roadmap	The Maine Offshore Wind Roadmap

Acronym	Description
TLP	tension-leg platform
WEA	Wind Energy Area
WTG	wind turbine generator

EXECUTIVE SUMMARY

In 2019, Governor Mills established the Maine Offshore Wind Initiative with the goal of identifying opportunities for development in the Gulf of Maine, and determining how the state can best position itself to benefit from future offshore wind projects while minimizing impact on Maine's commercial fishing and maritime industries. In 2021, bipartisan legislation established the Maine Offshore Wind Research Consortium to better understand the local and regional impacts of floating offshore wind (FOW) in the Gulf of Maine.

In 2024, the Bureau of Ocean Energy Management concluded a multi-year planning process informed by government officials and stakeholders to identify lease areas in the Gulf of Maine. Upon spatial analysis, stakeholder input and urging from Maine's Congressional delegation and Governor Mills, Bureau of Ocean Energy Management identified eight lease areas intentionally avoiding many fishing areas in the Gulf of Maine, including the exclusion of Lobster Management Area 1, among others.

As part of Maine's commitment to responsible offshore wind development, the Maine Offshore Wind Research Consortium Advisory Board identified coexistence of FOW projects with fisheries as a priority research topic. In response to this priority, ERM Consulting & Engineering, Inc. (ERM) and the Gulf of Maine Research Institute won a competitive award released by the Maine Governor's Energy Office to explore approaches to fisheries' coexistence with FOW. This report synthesizes research on the interaction between and coexistence of fisheries and FOW, incorporates Maine fishermen's experience and feedback, summarizes recommendations to promote effective coexistence between fisheries and FOW in the Gulf of Maine, and identifies additional research needed to support coexistence practices. The Project explores the potential for coexistence between FOW and fisheries in the Proposed Lease Areas and builds on existing guidelines, regulations, and recommendations aimed at protecting fishing industry, access, and habitats.

To achieve the Project objectives, ERM conducted desktop research, including reviewing global case studies and regulatory frameworks, conducted a technical compatibility assessment of fishing technologies with FOW technologies, and identified preliminary recommendations to promote coexistence. Gulf of Maine Research Institute led three phases of stakeholder engagement to understand fishermen's perspectives on coexistence with FOW technology and solicit and integrate fishermen's feedback on the desktop research, technical compatibility assessment, and preliminary recommendations.

FOW may enhance biological productivity and create refuges for marine organisms, but its large spatial footprint and subsea infrastructure create potential conflicts with fishing operations, including the potential for FOW developments to restrict fishermen's access to certain areas of the ocean and the potential for fishing gear to become entangled with FOW infrastructure. In addition, fishermen are concerned about the economic impacts of FOW on commercial fishing, particularly regarding accessibility and potential gear entanglement.

The compatibility of fishing gear with FOW infrastructure varies depending on the fishing gear type and the FOW technology – both of which are likely to evolve before FOW is commercially developed in the Gulf of Maine. Of the FOW technical components (e.g., platform, mooring, cabling), the mooring type is particularly impactful because it takes up the most space in the water and influences the cabling. For many types of fishing gear, technical compatibility with FOW will require that the inter-array cables are buried. The specific type of FOW technology and the feasibility of these cables being buried will depend on site-specific geological, geotechnical and environmental constraints.

The Project findings highlight the need for additional social, regulatory, and engineering solutions to promote coexistence. Existing case studies can be leveraged for lessons learned and best practices from other industries and geographies, which may be applicable to the Gulf of Maine. Fishermen request transparency and collaboration; they want to have a voice in all phases of FOW development in the Gulf of Maine, including site selection and design. With input from stakeholders there is the potential to optimize wind farm layouts through micro-siting, minimizing spatial conflicts and enhancing compatibility with other ocean users such as fishermen. Establishing adaptive management frameworks and developing compensation protocols is recommended, though fishermen stress that enabling fishing to continue should be prioritized above compensation. Lastly, commercial development of FOW in the Gulf of Maine is still several years in the future and there is an opportunity to incorporate innovative technology and engineer solutions that may promote coexistence of fisheries and FOW.

This research highlights opportunities as well as knowledge gaps and potential topics for future research. There is a need to collect empirical data, which can then be used to support innovation and adaptation to further promote coexistence. Fishermen have unanswered questions about how insurers will handle FOW and what impacts it may have on their coverage, and they are eager for more site-specific information when it is available, including specific details about proposed FOW layouts and designs. This Project underscores the importance of balancing FOW development with the needs of Maine's fishing industry and marine ecosystems. Through collaborative, data-driven and adaptive management, it is possible to promote sustainable energy generation and Maine's fishing industry.

1. INTRODUCTION

As part of Maine's commitment to responsible offshore wind development, the Maine Offshore Wind Research Consortium (the Consortium) has outlined a comprehensive research strategy to address the opportunities and challenges associated with floating offshore wind (FOW) projects in the Gulf of Maine. In alignment with this strategy and recommendations from the Maine Offshore Wind Roadmap's Fisheries Working Group, the State of Maine's Governor's Energy Office (GEO) awarded funding[1] through a competitive process to ERM Consulting & Engineering, Inc. (ERM) and the Gulf of Maine Research Institute (GMRI; the Project Team) to explore ways to maintain compatibility between fishing activities and FOW, specifically in the Gulf of Maine (referred to as the 'Project').

This report outlines the Project's methodology, results, recommendations, and suggested next steps. The Project focuses on understanding the interactions between offshore wind development and existing fisheries in the Gulf of Maine wind energy areas (WEA), supporting the Consortium's broader goal of minimizing impacts on ecosystems and traditional uses while fostering sustainable energy solutions. The Project contributes directly to Maine's efforts to responsibly advance FOW developments, and is informed by a collaborative, stakeholder-driven approach led by GEO and the Maine Offshore Wind Research Consortium's Advisory Board (Advisory Board). The Project's goal is to explore approaches to fisheries' coexistence with FOW in the Gulf of Maine and to effectively engage the fishing industry in this endeavor. There are potential ecological benefits of FOW, including the potential creation of refuges for organisms[2]; however, due to the novelty of FOW, the technical and socioeconomic challenges for commercial fishing must be addressed specifically for the Gulf of Maine. One of the main barriers to coexistence is the potential incompatibility of certain fishing gear with FOW infrastructure due to the risk of gear entanglement with mooring lines, as well as inter-array and export subsea cables. This challenge underscores the need for innovative solutions to ensure safe and productive fishing practices alongside FOW installations. Comprehensive studies and monitoring are essential to assess and mitigate these risks while exploring the extent to which FOW can support

Project and Report Objectives

This report's objective is to collate and synthesize existing knowledge that may be useful in informing coexistence in the Gulf of Maine.

The Project objectives are:

1. To enhance the State's existing understanding of coexistence and fill knowledge gaps.
2. To demonstrate to Mainers how their fishermen's lived experiences and everyday wisdom are driving research.
3. To develop recommendations that work for Maine, allowing for stakeholders to drive adaptation and decision-making.
4. To identify additional research needed to support coexistence practices.

[1] In response to the request for proposal #202310220
[2] https://www.mdpi.com/1996-1073/3/7/1383

or enhance fisheries. Given the novelty of FOW technology, fostering collaboration between developers and the fishing industry is critical. Collaboration will help address concerns, identify areas of mutual benefit, and advance strategies that balance the conservation and improvement of the fishing industry with the sustainable development of FOW in the Gulf of Maine.

The body of this report summarizes the Project Team's research findings; comprehensive technical information, methodology, data analysis, discussions, and conclusions of each step are included in the report appendices. The remainder of this section outlines the methodology used in the study and provides an overview of the report structure.

1.1 METHODOLOGY

To achieve Project objectives, the Project Team conducted desktop research to collate and synthesize existing knowledge, and three phases of stakeholder engagement to solicit and integrate perspectives from fishermen and other ocean users.

The Project Team continuously communicated with GEO and presented the Project approach and interim findings to key stakeholders, including the Advisory Board, at select meetings. These meetings established shared goals, communication frameworks, and a platform to solicit feedback.

GMRI directly engaged with fishermen to align expectations, get input and insight on defining coexistence, share information about FOW technology, and solicit feedback on initial recommendations for fisheries' coexistence with FOW.

ERM compiled pertinent data and information through a literature review and direct consultations with various agencies and decision-makers to identify relevant regulations, FOW technologies, and commercial fishing data related to the Proposed Lease Areas[3] (Proposed Lease Area). ERM also assessed the technical compatibility of the existing FOW technologies and fishing gear currently used in the Proposed Lease Areas and developed initial recommendations based on these assessments. These initial results were shared with stakeholders, including fishermen, the Bureau of Ocean Energy Management (BOEM), the National Oceanic and Atmospheric Administration (NOAA) Fisheries (also known as National Marine Fisheries Services [NMFS]), and the National Renewable Energy Laboratory, to gather feedback, which was subsequently incorporated into this report. In addition, in consultation with GEO and to enhance public outreach, the Project Team submitted abstracts to industry conferences and presented Project updates at the Fishermen's Forum 2024, American Floating Offshore Wind Technical Summit 2024, and the American Clean Power Association Offshore Wind Power 2024.

1.1.1 DESKTOP REVIEW

ERM completed a desktop review of the literature on the topics listed below.

- **Relevant definitions, types, and enabling conditions of coexistence:** A review of case studies across different geographies to identify patterns, lessons learned, and frameworks

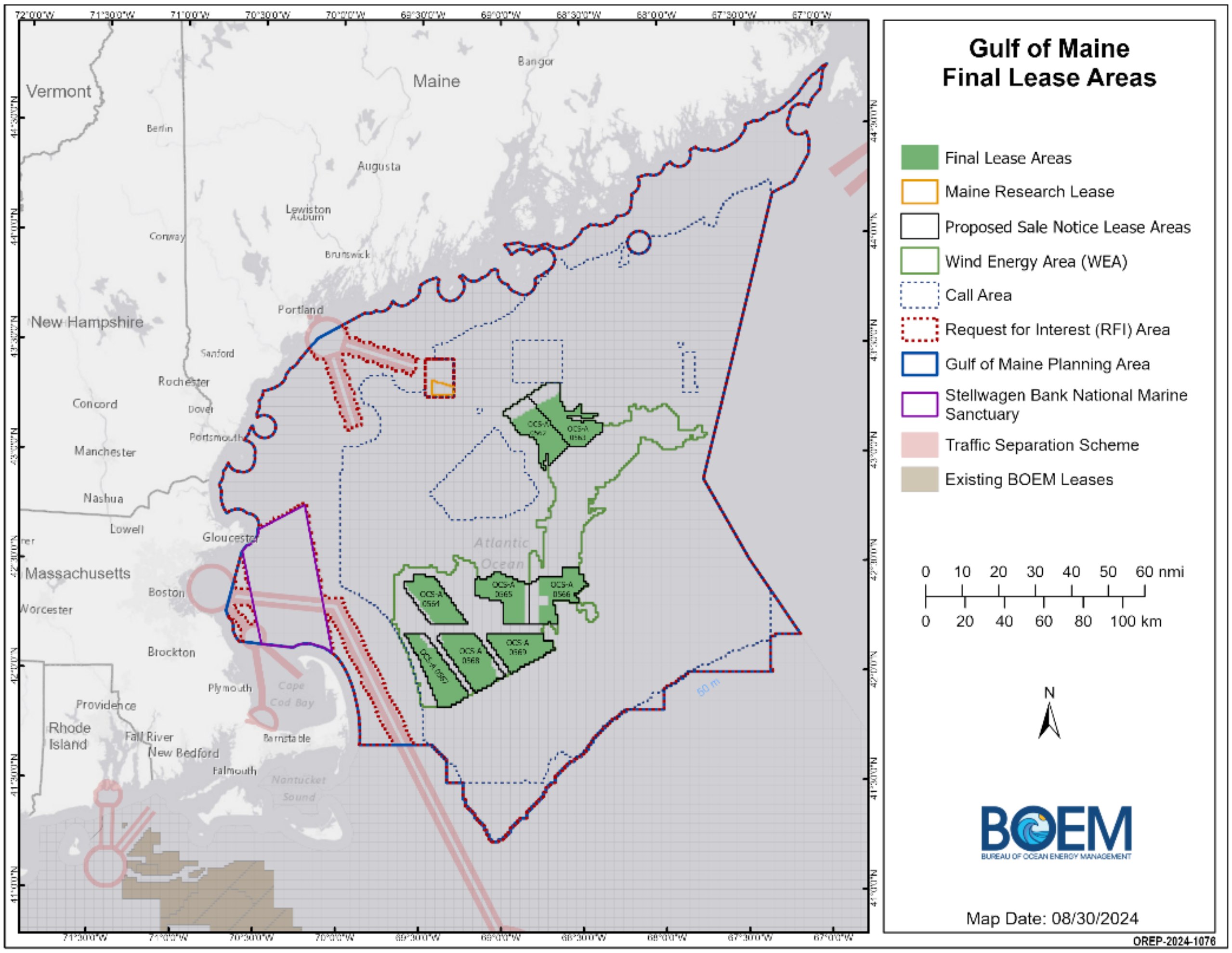
[3] The fisheries data analyzed in this report was developed based on the proposed lease areas (as of April 2024).

that enable successful coexistence between offshore wind development and existing ocean users.

- **Regulatory, legal, and Project requirements:** A review of existing policies, laws, and guidelines to provide insight into overcoming barriers to coexistence by addressing compliance needs and facilitating collaborative solutions that align with the interests of fisheries and offshore wind stakeholders.
- **Existing fishing technology in the Gulf of Maine:** A review of the commercial fishing technologies currently used within the Gulf of Maine offshore wind Proposed Lease Areas (Figure 1) to understand the specific interactions and potential impacts of FOW development on fishing practices.
- **Existing FOW technologies:** A review of current FOW systems used globally and their technical specifications to provide a foundation for understanding how these technologies may interface with other ocean uses.
- **Technical compatibility of fishing and FOW technologies:** An evaluation of the interplay between fishing gear and FOW infrastructure to identify areas of potential conflict and opportunities for mutual adaptation. The preliminary technical compatibility assessment was revised based on feedback received from fishermen during stakeholder engagements.

The desktop review provided a foundational understanding that informed subsequent phases of the Project, including the engagement with stakeholders, the development of coexistence recommendations, and the identification of potential next steps.

FIGURE 1 GULF OF MAINE LEASE AREAS



Note: On September 16, 2024, BOEM published the Final Sale Notice for offshore wind lease in the Gulf of Maine. The final lease areas (shown as green on figure above) are slightly different than the Proposed Lease Areas (shown as black outlines on figure above). The fisheries data analyzed in this report were developed on the Proposed Lease Areas (as of April 2024). Engagement with fishing industry stakeholders occurred in three phases:

1.1.2 FISHERIES STAKEHOLDER ENGAGEMENT APPROACH

Commercial fishermen and fishing industry stakeholders are important ocean users that must be engaged in the potential development of successful FOW projects in the Gulf of Maine. During BOEM's federal siting process commercial fishermen were actively engaged in the siting of Gulf of Maine lease areas; their expertise helped to significantly reduce potential conflicts and the final lease areas were located outside the region's most active fishing grounds. Given FOW's potentially larger spatial footprint compared to fixed-foundation projects, fishermen have concerns about how FOW may impact their operations. Concerns include restricted access to fishing, risk of gear entanglement, impacts on fish habitats, and increased industry competition within a smaller sea area[4]. Characteristics specific to FOW projects (e.g., greater spatial footprint of FOW versus fixed-foundation projects, and sub-surface mooring lines and inter-array cables) may result in new challenges for fishing activity during the operational phases of FOW arrays. In parallel to desktop review, GMRI completed three phases of stakeholder engagement to connect with fishing industry stakeholders. GMRI held focus groups, had one-on-one conversations by phone, Zoom, and in-person, and solicited input through surveys to understand the concerns of those in the fishing industry and the challenges operating in a FOW array poses to their work. This engagement included discussing gear and fishery-specific operational challenges with FOW and soliciting fishermen's feedback on the Project's preliminary findings to inform initial and final recommendations. Ongoing engagement with the fishing industry is key to ensuring Project findings are relevant and practical to implement in the Gulf of Maine.

Engagement with fishing industry stakeholders occurred in three phases:

- Phase 1: Engagement with fishing industry stakeholders to discuss initial understandings, curiosities, and concerns regarding operability in and around FOW arrays (Appendix B), conducted from June to July 2024;
- Phase 2: Engagement with stakeholders to present different FOW technology scenarios – platform, mooring, anchoring, and cabling designs – and to receive feedback on how various gear types used in the Gulf of Maine may operate within FOW designs (Appendix D), conducted from July to August 2024; and
- Phase 3: Engagement to present draft recommendations to fishing stakeholders (Appendix F) and Advisory Board members (Appendix G), conducted from November to December 2024, to consider their feedback, reactions, and opportunities for further research.

A subset of the Advisory Board approved this engagement approach and the questions used in Phase 1 and 2 of engagement. The Advisory Board also approved and elaborated on an initial set of associations and fishermen to participate in this Project. Fishing industry stakeholders are often engaged in other research and management meetings; therefore, to reduce the engagement burden imposed on stakeholders, GMRI prioritized meeting stakeholders on their terms. Further, GMRI employed a 'snowball' method to engage with stakeholders. This is a common approach in engagement work where participants suggest future participants from their networks[5]. In communities where relationships and trust play critical roles, the 'snowball' approach enabled GMRI to leverage existing connections to ensure broad, yet relevant stakeholder engagement.

To analyze and process qualitative data collected throughout all phases of engagement, GMRI employed a thematic analysis approach. This method involved identifying, analyzing, and reporting patterns within the data, allowing the team to organize and describe the data sets in detail. The thematic analysis approach is widely used in social science research and was chosen for its effectiveness in accurately interpreting respondent data in this context[6].

[4] https://kleinmanenergy.upenn.edu/news-insights/offshore-wind-and-the-fishing-industry-the-path-to-co-existence/
[5] Source: Sampling data and data collection in qualitative research. *Nursing & Midwifery Research: Methods and Appraisal for Evidence-Based Practice*, January 2013, 123-140.
[6] Source: Thematic analysis. *The journal of positive psychology*, 12(3), 297-298.

1.2 REPORT ORGANIZATION

The body of this report summarizes the findings from each phase of the Project. Detailed methodologies, data, and comprehensive reports for each phase are provided in the appendices.

Section 2 of this report summarizes types of coexistence based on existing examples, and highlights global regulations and requirements designed to support coexistence. Case studies of different types of coexistence and an overview of relevant regulations are included in Appendix A. This desktop assessment was supplemented by stakeholder engagement to understand fishermen's perspectives, detailed in Appendix B.

Section 3 is a technology assessment that covers:

- Fishing technology used in the Gulf of Maine Proposed Lease Areas (Section 3.1; details provided in Appendix C);
- FOW technology likely to be used in the Gulf of Maine (Section 3.2).
- FOW technology was discussed with fishermen during the second phase of engagement (Appendix D); and
- Preliminary technical compatibility of fishing gear and FOW technologies, and findings were presented to fishermen, and Advisory Board and Tribal representative during the third phase of engagement (see Appendix F and Appendix G respectively).

Section 4 presents recommendations to promote coexistence, synthesizing findings from case studies, global requirements, and feedback provided by fishermen and other stakeholders.

Section 5 outlines potential next steps, providing a roadmap for future work.

2. DEFINING COEXISTENCE

ERM reviewed case studies and regulations to support defining coexistence in the Gulf of Maine; a summary of the results is provided below. This review is detailed in Appendix A and the associated stakeholder engagement is summarized in Appendix B.

2.1 TYPES AND EXISTING CASES

ERM reviewed and categorized 10 case studies on coexistence in different geographies (including the U.S., United Kingdom, the Netherlands, Scotland, and France) from academic literature, reports from multi-lateral organizations, media, and project technical documents, and reviewed and organized the studies by type of coexistence (Appendix A). Appendix A includes a variety of coexistence approaches, incorporating as much geographic diversity as feasible. Most selected cases are for offshore wind projects, but other relevant projects (e.g., offshore oil and gas [O&G]) were also included in this review. As outlined below, case studies specific to floating technology are currently limited but are expected to become available as more FOW projects are developed. Based on academic literature, coexistence is an umbrella term covering four key types, summarized in Table 1.

TABLE 1 TYPES OF COEXISTENCE[7,8]

Type of Coexistence	Definition
Multipurpose	Users occupy the same area, at the same time, and share core infrastructure and services
Symbiotic Use	Users occupy the same area, at the same time, and share peripheral infrastructure or services (onshore or offshore)
Colocation	Users occupy the same area at the same time
Repurposing	Users occupy the same area, but subsequently (one after the other) rather than at the same time

From the case studies, ERM identified common themes related to coexistence and enabling conditions that are relevant to the Gulf of Maine. These themes are explored further in the list below.

Coexistence-first Project Design – Most chosen project sites minimized disruption to local fishing by selecting areas where commercial fishing was already limited or by limiting the construction phase to a short time. Project design often included burying cables and other protective measures to secure project equipment and protect fishing equipment from damage.

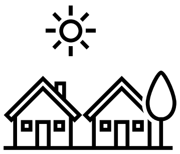
Language – Coexistence is a general, umbrella term, with multiple possible meanings. In contrast to popular literature and less formal discussion, formal case studies, including peer reviewed publication and scientific articles, call out specific types and meanings of coexistence where possible. As FOW projects develop, it is

[7] "Coexistence and nature-inclusive design in Nordic offshore wind farms" (norden.org)
[8] Toward a Common Understanding of Ocean Multi-Use. *Marine Affairs and Policy*, April 2019.

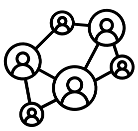
likely that different meanings will be attributed to the general term "coexistence" by stakeholders and, thus, specific types can and should be used when a specific type of coexistence is intended.

Communication – Proactive communication, particularly early stakeholder engagement, is crucial to building trust between stakeholders and industry. The reviewed cases all included engagement and communications around site location, project design and construction, operations, and safety. Many case studies also included industry-to-industry communications between fishing leadership and project developers.

Local Benefits – In the case studies, once a developer understood the concerns and needs of the local fishing industries, they were able to provide local benefits to help address concerns and needs. Local benefits included compensation for lost income and damaged gear, as well as support of new business opportunities to help offset losses during periods of interruption. Opportunities included profit sharing for onshore facilities (e.g., fuel sales), employment of fishermen, and chartering of vessels for impact studies and security/guard patrols.



Cooperation – Coexistence efforts, especially those for multipurpose projects, benefited from the support of federal, state, and local governments, as well as from non-governmental organizations, academia, and industry (e.g., wind, fishing, and others). Developers contributed by funding liaisons and representatives and by supporting government efforts to establish agreements among various stakeholders.



2.1.1 GAPS IN AVAILABLE CASE STUDIES

Three gaps in understanding coexistence specific to FOW were identified from the case study review:

- **Nascent FOW** – Because the FOW industry is relatively new, no academic case studies related to coexistence are available for existing FOW projects. Projects are coming online in different countries (e.g., Norway and Portugal), and comprehensive and systematically documented data on how these projects are managing interaction with fisheries, particularly in the long term, is yet to emerge.
- **Limited existing case studies and academic literature** – There are limited English-language case studies and academic literature on FOW projects. Where possible, ERM supplemented academic case studies with publicly available project information and news articles.
- **Lack of geographic diversity of existing case studies** – English-language case studies tend to focus on North America and the North Sea, particularly in the Netherlands and the United Kingdom. The lack of geographic diversity limits the lessons learned.

These research gaps indicate that future studies that involve engagement with operational and developed projects, as well as expert interviews, are needed to gather information about projects for which there may not be formal case studies or academic literature.

2.2 REGULATIONS AND REQUIREMENTS

As offshore wind energy development expands, it becomes imperative to address the potential conflicts between FOW development and the fishing industry. To do this, ERM reviewed regulations, policies, laws, and literature relevant to offshore wind farms including both FOW, and monopiles, as well as offshore O&G structures, which are discussed in detail in Appendix A, with the list of all relevant references. The review included studies conducted in the U.S. and internationally (FOW developments are currently more common in other regions, such as the North Sea). The review identified three categories of concern: **impacts on the marine environment**, **access to WEAs**, and **financial considerations**. Each of the following subsections summarizes one of these categories, focusing on the relevant concerns from the fisheries, examining regulations both within and outside of the U.S., and presenting gaps and recommendations that were identified through the review of the literature. Additional information for each of these subsections and associated references are provided in Appendix A.

2.2.1 IMPACTS ON THE MARINE ENVIRONMENT

As further outlined in Appendix A, offshore wind farm development has the potential to impact the marine environment in a variety of ways, both positively and negatively. This review found that offshore wind turbines and associated structures may act as artificial reefs and/or fish aggregating devices which can result in the attraction of more fish to the area. In addition, to ensure the safety and security of FOW farms and other vessels navigating adjacent to a FOW farm, the creation of exclusion or safety zones between offshore wind turbines or around an entire offshore wind farm may be necessary (more details on variations in regional approaches can be found in Appendix A). The development of these exclusion or safety zones could have a range of negative and positive impacts on fisheries – exclusion zones would limit fishing access and stock surveys but would also provide additional protection for benthic species and spawning activities.

International and U.S. regulations, laws, and policies have been established to address the potential impacts of offshore wind farms and marine structures on the marine environment. For example, environmental impact assessments and environmental impact statements are required in many countries during the pre-construction phase to better understand how a specific offshore wind farm may impact the marine environment and other socioeconomic resources such as commercial and recreational fisheries. In the U.S., the National Environmental Policy Act requires FOW projects to develop an Environmental Impact Statement to evaluate a project's potential impacts on environmental and socioeconomic resources. BOEM is also legally mandated by the Outer Continental Shelf Lands Act (OCSLA) to safeguard the environment and preserve the natural resources of the outer continental shelf and is obligated to adhere to the National Environmental Policy Act, the Historic Preservation Act, Endangered Species Act, the Marine Mammal Protection Act, and the Magnuson-Stevens Fishery Conservation and Management Act. The specific requirements and recommendations for the pre-construction, construction, operation, and decommissioning phases of an offshore wind farm in the U.S. are defined in a project's Terms and Conditions, which are published in the Record of Decision once the permitting phase is complete.

All the regulations discussed above that pertain to potential offshore wind farm impacts on the marine environment have been developed for fixed-bottom foundation technologies, which are inherently different from many of the proposed FOW technologies. While there are many similarities between FOW technologies and monopile foundations with regard to how they interact with the marine environment, this is one of the primary gaps of existing regulations.

2.2.2 ACCESS TO WIND ENERGY AREAS

The fishing industry is concerned that FOW developments will restrict access to fishing, including within the Gulf of Maine as outlined in Appendix A. FOW development creates challenges for the fishing industry, including:

- Potentially restricting access to traditional fishing grounds;
- Altering navigational routes; and
- Creating safety concerns.

In Maine, there are existing and proposed regulations that protect fishing activities, including the state prohibition of offshore wind developments within state waters (i.e., 3 nautical miles [3.452 miles] from shore) and the exclusion of Lobster Management Area 1 from the Gulf of Maine lease areas.

U.S. federal regulations related to fishing access within, and around, offshore wind farms include OCSLA, which requires offshore wind farms to evaluate their compatibility with other uses such as commercial fishing. OCSLA also requires coordinating agencies, including the United States Coast Guard, U.S. Army Corps of Engineers, NOAA, and NMFS, to make a public interest determination regarding obstructions in navigable waters.

Countries with offshore wind farms near fishing operations have taken different approaches to fisheries access through regulations, laws, policies, or programs tailored to the fisheries. There are international regulations pertaining to safety zones and navigation around offshore wind developments under the United Nations Convention on the Law of the Sea and in the United Kingdom, Sweden, Denmark, Norway, and Germany.

Literature sources recommend buffer zones and limited entry to offshore wind farms, but there is no one-size-fits-all regulatory approach that can be applied to all offshore wind projects, particularly FOW projects. With newer offshore wind technologies, specifically for FOW, there are knowledge gaps across the sector, including for impacts to fishing around FOW projects, safety buffers, and defined exclusion zones around FOW projects.

2.2.3 FINANCIAL CONSIDERATIONS

Financial considerations associated with the coexistence of fisheries and FOW include the cost to safely navigate within or near FOW, insurance, and compensation programs.

The Fishermen's Contingency Fund was established under OCSLA to compensate U.S. fishermen for property and economic loss due to O&G developments; however, there is no analogous fund for offshore wind. Compensation programs are essential to address residual impacts, after all efforts to avoid and minimize impacts to fisheries have been fully exhausted. While there are no current federal regulations within the U.S. related to financial considerations for the fishing industry, the Terms and Conditions for all recent projects have included compensation requirements for recreational and commercial fisheries to support potential gear loss, lost income, new navigational and safety equipment, and increased insurance costs. In addition, Maine has joined 11 Atlantic Coast states in working to implement a regional program for fisheries compensatory mitigation, as part of the Fisheries Mitigation Project[9]. Regulations requiring offshore wind projects to provide monetary and non-monetary compensation to commercial and recreational fisheries exist in Denmark, the United Kingdom, Norway, Sweden, Germany, and the Netherlands and are discussed in detail in Appendix A.

There are knowledge gaps pertaining to how to safely navigate within or near FOW, and to insurance. Recommendations to address these knowledge gaps include implementing best practices for safe fishing operations by investigating gear compatibility, studying and developing insurance models for multi-use marine areas, and considering monetary and non-monetary compensation measures for areas of lost income. There is also a clear need to better understand and improve insurance policies for the commercial fishing industry considering the growing offshore wind industry and the potential changes it may bring to the fishing industry. While further engagement on this issue did not fall within the scope of this Project, Section 5 recommends involving insurance companies in these discussions to provide a better understanding of the implications. Future studies and focused discussions around insurance have the potential to improve relationships and engagement between these industries moving forward.

2.3 PHASE 1 STAKEHOLDER ENGAGEMENT

In Phase 1 of stakeholder engagement, GMRI engaged fishing industry stakeholders to discuss initial understandings of, curiosities about, and concerns regarding the potential for fishermen to operate in and around FOW arrays (detailed in Appendix B). GMRI engaged 23 fishing industry stakeholders, receiving input on various questions relating to fisheries' coexistence with FOW. Respondents represented different regions, fisheries, and gear types in the Gulf of Maine, and most respondents reported having fished in the Gulf of Maine WEAs or the Request for Competitive Interest area (area associated with the Maine Research Array) in the last 10 years. Questions in this phase were framed to enhance an understanding of concerns and anticipated challenges of fishing within FOW arrays, how the fishing community defines coexistence, as well as to outline gear and fishery-specific closure challenges.

From a thematic assessment of stakeholder input, findings suggest a range of perspectives among fishery stakeholders. Most respondents were skeptical about the feasibility of fishing to coexist with FOW. Respondents representing both mobile and fixed gear industries shared concerns related to gear entanglement, navigation challenges, safety risks, and the potential social, economic, and environmental impacts of FOW development, among other topics.

Respondents also shared mixed opinions on the definition of coexistence. Some view potential coexistence as a compromise where both FOW and the fishing industry adapt to share space with minimal disruptions, ensuring both entities can thrive and operate efficiently. Others view coexistence as unachievable, noting that the operations required for both industries to function efficiently are prone to conflict.

Overall, findings from Phase 1 engagement highlight an unease among many fishing industry stakeholders regarding the potential for fisheries to coexist with FOW technology. These findings

[9] Fisheries Mitigation Project - Special Initiative on Offshore Wind

underscore the need for FOW developers to incorporate coexistence approaches early in Project design, layout, technology, communication practices, and other factors. Respondents throughout Phase 1 emphasized the importance of a FOW development process that ensures a genuine and transparent consideration of the fishing industry's needs, to avoid undermining the safety and livelihoods of those reliant on fishing in the Gulf of Maine.

3. TECHNOLOGY ASSESSMENT

To better understand the potential interaction between fishing activity and FOW in the Gulf of Maine, ERM identified the top commercial fishing species, fishing gear, and vessel types used within the Gulf of Maine's eight Proposed Lease Areas (Figure 1). The desktop study focused on commercial fishing due to the availability of commercial fishing data for the Proposed Lease Areas; data on recreational or charter fishing is limited. ERM also assessed FOW technologies to identify the potential technical compatibility of fishing and FOW technologies.

3.1 FISHERIES TECHNOLOGIES ASSESSMENT

The desktop fisheries assessment was conducted in summer 2024 and focused on the most recent stage of BOEM siting at the time – the eight Proposed Lease Areas proposed by BOEM in April 2024 (OCS-A 0562 through OCS-A 0569; see Figure 1). The Proposed Lease Areas, like BOEM's Final Lease Areas in the Gulf of Maine, are ecologically and geologically diverse and support a range of marine species and commercial fishing operations. ERM evaluated publicly available data to determine the top fish species and their associated fishing gear types and vessel size in each of the Proposed Lease Areas.

To identify the **top fish species** within the Proposed Lease Areas, ERM assessed data from the Maine Department of Marine Resources[10] and the NOAA Fisheries Landings database[11]. The analysis identified the top 10 species by weight and value and looked at temporal trends; methods and results are presented in Appendix C and the species are listed in Table 2.

To assess the potential interaction between fishing activities and FOW technologies in the Proposed Lease Areas, ERM reviewed data on **fishing gear type** and vessel operation; data were obtained from NMFS[12, 13]. Gear types are categorized as **mobile gear**, such as trawls and dredges, which are towed behind vessels to cover larger areas; and **static gear**, including pots and gillnets, which are set in place to capture fish.

The primary **mobile gear** types are:

- **Bottom trawls**: target groundfish species such as haddock, pollock, monkfish, cod, hake, redfish, and flounders;
- **Midwater/Pelagic trawls:** target pelagic species such as mackerel and menhaden;
- **Hook and Line Vessels:** target haddock, pollock, cod, and bluefin tuna; and
- **Dredges**: target sea scallops.

Midwater trawls and purse seines are used for Atlantic herring, and harpoons are used for bluefin tuna; however, these species are not designated within the top 10 in the Proposed Lease Areas.

---

[10] Most Recent Maine Commercial Landings | Department of Marine Resources
[11] NOAA Fisheries Landings in the US. 2022. Fisheries One Stop Shop (FOSS) | NOAA Fisheries | Landings
[12] Socioeconomic Impacts of Atlantic Offshore Wind Development | NOAA Fisheries
[13] Due to confidentiality, the NMFS gear type data for the Proposed Lease Areas are representative and not directly linked to the top ten species identified; however, NOAA confirmed that few fish are landed using gear types not included in the NMFS gear type dataset.

The primary **static gear** types are:

- **Pots and Traps:** target lobster; and
- **Bottom gillnets:** target haddock, pollock, cod, monkfish, and hake.

ERM also reviewed **vessel data** from NMFS for 2014 through 2024. This dataset detailed federally permitted vessels, including permit types, vessel lengths, and home ports. Most top species in the Proposed Lease Areas identified in Table 2, such as haddock and cod, fall under the Northeast Multispecies Permit; lobster, monkfish, and scallops require species-specific permits.

TABLE 2 TOP AND STAKEHOLDER IDENTIFIED SPECIES, GEAR TYPES, AND VESSEL TYPES AND SIZES IN THE PROPOSED LEASE AREAS

Top Species	Gear Type	Vessel Type and Size
Haddock	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Pollock	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Cod	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Monkfish	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Redfish	Bottom Trawl	Bottom Trawlers (40-90 feet)
American Lobster	Pots and Traps	Offshore Lobster Vessels (40-70 feet)
Sea Scallop	Dredge	Scallop Dredge Vessels (40-100 feet)
White Hake	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
American Plaice Flounder	Bottom Trawl	Bottom Trawlers (40-90 feet)
Witch Flounder	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Atlantic Herring (bait)*	Pelagic Trawl, Purse Seine	Pelagic trawlers (60-90 feet), Purse seine vessels (60-90 feet)
Bluefin Tuna*	Hook and Line, Harpoon	Different Vessels (20-50 feet)

*Species identified by a local fisheries expert, in addition to the top 10 identified through analysis.

There were some limitations to the analysis, including the complexity of permit data, inactive vessels, mismatches between home ports and fishing grounds, and other constraints, which are detailed in Appendix C.

3.2 FLOATING OFFSHORE WIND TECHNOLOGIES ASSESSMENT

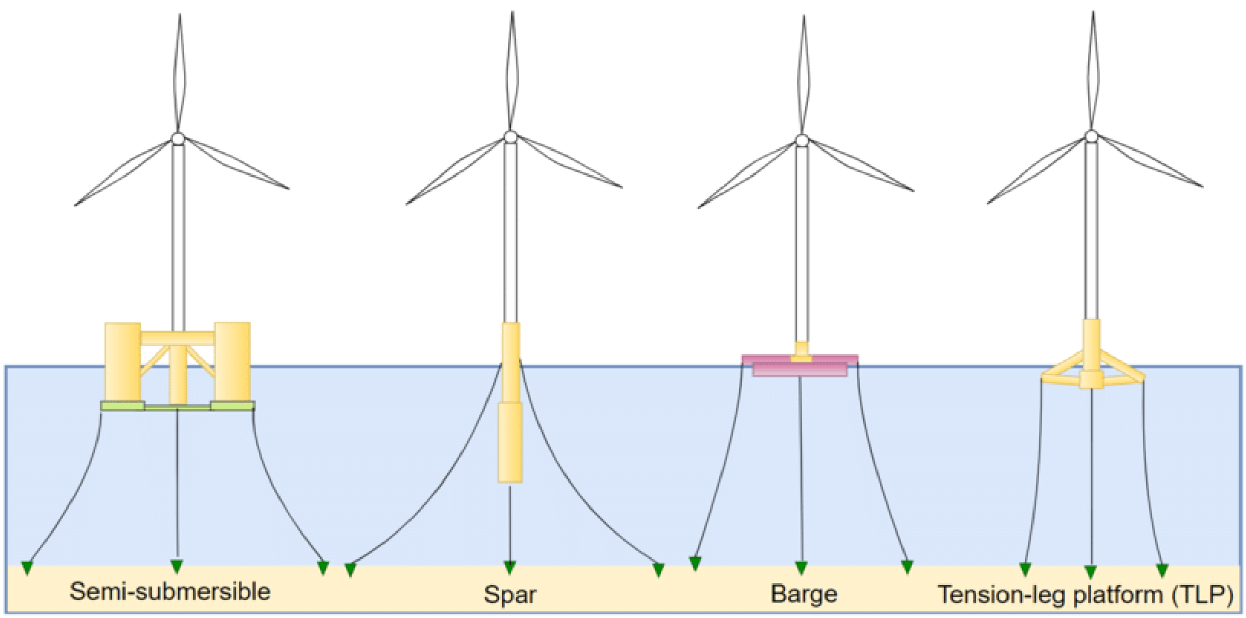
FOW technologies are built around three primary components: the **platform**, the **mooring systems**, and the **electrical cables** that connect the wind turbines. FOW designs are optimized for water depths where conventional fixed-bottom wind turbines are not feasible. The FOW platforms are anchored by different mooring systems, depending on the depth and environmental conditions. The electrical cables are typically buried or laid on the seabed covered by concrete mattresses and are engineered to withstand marine environments. FOW designs are determined based on the known environmental conditions in various regions, such as wave load, wind strength, and seabed characteristics. With advancements in materials and engineering techniques, FOW technology is expected to evolve in the future, particularly as FOW farms are deployed in deeper waters. Understanding the spatial footprint, material requirements, and the impact of installation and operation of the FOW technology on the marine environment is critical for mitigating potential conflicts with fishing activities.

ERM analyzed the components and design of FOW systems to assess their potential technical compatibility with fishing activities in the Gulf of Maine, particularly within the Proposed Lease Areas. This section provides an overview of the different types of FOW foundations, drawing on ERM's industry knowledge and expertise, including insight from professionals with extensive experience in offshore wind, engineering, and related fields. Additional information on the FOW technologies is provided in Appendix E.

3.2.1 PLATFORM TECHNOLOGIES

There are four main types of FOW platforms: **semi-submersible**, **spar**, **barge**, and **tension-leg platform** (TLP; Figure 2).

FIGURE 2 FLOATING WIND TURBINE PLATFORM TYPE[14]



Note: Schematic figures are not to scale.

The **semi-submersible** (semi-sub) platform has a relatively large footprint, though it is smaller than a barge, and has less of the platform exposed to the wave zone compared to other platform

[14] Source: *Evolution of Floating Offshore Wind Platforms: A Review of At-Sea Devices* - January 2023 Renewable and Sustainable Energy Reviews

designs. Relative to other platform types, a semi-sub needs a larger surface area in the water to provide buoyancy. When the platform tilts or sways, one side of the platform goes deeper into the water, and, in effect, generates more buoyancy, while the other side of the platform rises and loses buoyancy. This difference in buoyancy creates a righting force that keeps the platform stable. Globally, there are several operational projects with semi-sub platforms (turbines up to 10 megawatts [MW] and FOW farms of up to 50 MW). The semi-sub is the most mature technology out of all the foundation types.

The **spar** platform has the smallest footprint, with a relatively small portion of the platform in the wave zone, but this platform type has a deep draft and is generally not suitable for water depths less than 100 meters. This platform would require the smallest mooring spread, excluding TLPs. The spar was the first type of FOW platform used commercially and is used in the largest FOW farm at the time of writing (88 MW – Hywind Tampen). The platform technology is well developed but requires a suitable site near the Project to build the spar platforms.

The **barge** platform is a pontoon and has the largest footprint of the four platform types. Much of the platform is in the wave zone, so the platform experiences a lot of the wave force. Of the platforms, the barge has the lowest draft, but it is also the heaviest and requires the largest mooring spread to keep it on station. Barge platform technology is less developed compared to semi-sub and spar platform technology. Currently, only smaller scale turbines (i.e., 2 to 3 MW) have been deployed on barge flatforms; however, there are projects in development (targeting 2025 installation) that will deploy large scale turbines (i.e., greater than 10 MW) on a barge platform.

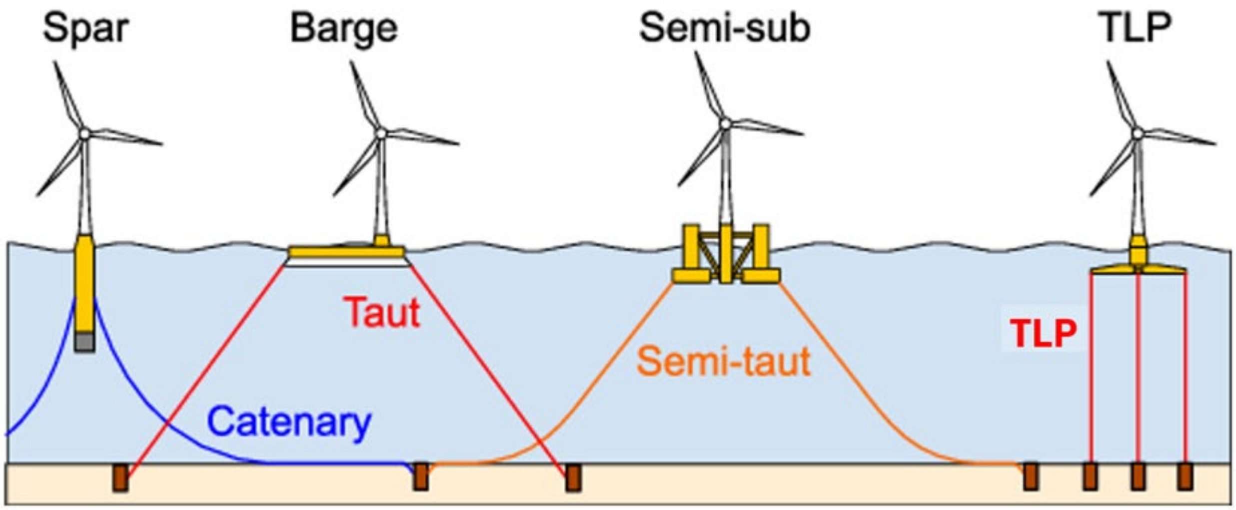
The **TLP** has a smaller footprint than the semi-sub, and there is relatively little of the platform in the wave zone. The moorings (or tendons) are critical for the platform's stability and thus the moorings and platform are designed together. Because the TLP relies on the mooring line for stability, if the mooring line fails, the platform could become unstable depending on the level of redundancy in the mooring system. The other platform types (i.e., semi-sub, barge, and spar) maintain their balance and position through their design and buoyancy; the moorings keep the platform in place and prevent drifting but are not required for platform stability. TLP technology is mature and there is an operational FOW farm (Provence Grand Large, France) that uses TLPs with 8 MW turbines (24 MW total).

The platform type is a key factor in determining the mooring design, which influences spacing. Therefore, the potential fisheries interference risks are driven by the mooring technology (Section 3.2.2).

3.2.2 MOORING TECHNOLOGIES

There are four main mooring configurations: **catenary**, **taut**, **semi-taut**, and **TLP** (Figure 3). The mooring configuration is determined by several factors, including the platform type, wind turbine generator (WTG), platform size and offset requirements, water depth, metocean conditions (strength and direction of wind, wave, and current), seabed (geology and geotechnical conditions), and permit restrictions. The Gulf of Maine lease areas have water depths between 140 to 240 meters; this water depth is not a limiting factor for the mooring types reviewed here.

FIGURE 3 MOORING SYSTEM CONCEPTS IN FLOATING PLATFORMS[15]



The **catenary mooring** is the most common mooring type and has been used for centuries for vessels. The weight of the mooring line is used to produce a restoring force if the platform is offset. Thus, chain (which is heavy but robust) is the preferred mooring material for the mooring lines. For large platforms and large waves, larger chains and longer mooring lines are required (up to six mooring lines can be used). Catenary moorings are best suited for water depths greater than 100 meters.

Taut moorings achieve their motion-keeping properties by stretching the mooring lines, which are synthetic materials (primarily 260 millimeter diameter polyester rope) that have some elasticity (catenary mooring chains do not stretch at all). The design and size of the mooring line allows some motion (but not too much), which reduces the load on the mooring. A taut mooring may require twice as many lines as a catenary mooring to get the right amount of stretch yet still have enough strength to keep the platform on station. The synthetic ropes are almost neutrally buoyant, and as they are preloaded (i.e., tensions are applied to the mooring line before it is put into operation), the taut mooring line is effectively a straight line from the anchor to the platform. Taut moorings are better suited for shallower water (i.e., less than 100 meters deep).

The design of the **semi-taut moorings** can be considered a compromise between the catenary and taut mooring types. In a semi-taut mooring, the portion of the mooring line connected to the anchor is chain and the portion of the mooring line connected to the platform is synthetic rope. Restoring force is created using both the weight of the chain and the stretch of the synthetic rope. Depending on design, around three-quarters of the mooring line length would be synthetic. When the platform is in its nominal position, all the mooring lines are slack, and the profile of the mooring lines looks half-way between the catenary and taut mooring. Advantages of the semi-taut mooring are easier hook up of the mooring line to the platform and potentially reduced mooring radius and size of mooring components (relative to a catenary mooring design). However, the

[15]Source: *Specificities of floating offshore wind turbines for risk and safety evaluation of anchoring systems - September 2024, Geotechnical Engineering Challenges to Meet Current and Emerging Needs of Society*

disadvantage is that it is more challenging to keep the platform offset (i.e., the amount the platform moves while moored) within allowable limits, so the mooring components – including anchors and mooring lines – may need to be larger, or more mooring lines may be required compared to a taut mooring.

TLP moorings (also known as TLP tendons) are pre-tensioned mooring systems that are integrated with the TLP platform. TLP moorings (or tendons) are designed not to stretch. TLP moorings work well in water depths between 100 and 250 meters (depths in Gulf of Maine Proposed Lease Areas largely fall within this range). In general, TLPs are challenging to design for medium to deeper water (i.e., greater than 300 meters); however, the technology is evolving and will likely be suitable for deeper water in the future.

3.2.3 CABLING

Electrical cables connect all the FOW WTG units to an offshore substation[16]. The design of the cabling depends on the mooring type and the amount of motion on the platform. For indication purposes, schematic cabling is presented for the TLP in Appendix E, where a cable (also called an 'inter-array cable') is laid in one large string[17].

The TLPs offer good station keeping and may allow for a simple catenary cable layout from the floating platform to the seabed. In the Gulf of Maine Proposed Lease Areas, where water depths are typically less than 300 meters, it is likely that most of the cable will be on the seabed. The cable on the seabed may be protected using concrete mattresses, rocks, or burial methods. As water depth increases, the amount of cable on the seabed decreases. In very deep waters (i.e., over 1,000 meters), all the cable may be suspended in the water column.

Cabling for catenary and taut moorings is more complex due to the greater movement of these moorings compared to TLPs. To accommodate this movement, more of the cable must remain in the water column, which is achieved by adding buoyancy modules at specific points along the cable. This results in a "lazy wave" shape that allows the platform to move. The cable in this configuration is significantly longer in the water column compared to a TLP catenary cable. The percentage of cable in the water column generally increases with water depth, and the seabed cable will still require protection. An additional presentation of layouts and cabling is provided in Appendix E.

3.2.4 PHASE 2 STAKEHOLDER ENGAGEMENT

In Phase 2 of stakeholder engagement, GMRI engaged 13 fishing industry stakeholders, gathering input on questions relating to fisheries' coexistence with FOW technologies (detailed in Appendix D). GMRI presented stakeholders with visuals and technical descriptions of potential FOW array designs, which include FOW platform, mooring, anchoring, and cabling concepts (Appendix D). GMRI then asked questions to understand stakeholders' concerns and anticipated challenges of navigating and fishing with various gear types around different conceptual FOW technologies.

---

[16] Typically, there is one offshore substation for one FOW project (possibly two for very large projects).

[17] Realistically the cabling would be more complicated, with up to eight turbines on a string and looped into one offshore substation.

Stakeholders have diverse perspectives on the feasibility of coexisting with FOW technology. Mariner safety, technical and operational uncertainties, gear entanglement, and environmental impacts, among others, were the key concerns raised by stakeholders. While many respondents were opposed to development of any FOW technology in the Gulf of Maine, most generally noted preference for FOW technologies with limited spatial footprints, both above and below the sea surface.

Respondents offered suggestions to facilitate potential fisheries' coexistence with FOW. Key suggestions, some of which have been implemented by BOEM or are outlined in the BOEM Fisheries Mitigation Guidance document[18], include maintaining adequate spacing between turbines for fishing and navigating, plotting FOW infrastructure on automatic identification systems, employing markers or visual aids for FOW mooring and anchor locations to support navigation, and providing clarity on regulations and insurance policies that would allow fishing within FOW arrays. Respondents also stressed the importance of promoting mariner safety through improved communication between the wind and fishing industries. Respondents also noted that comprehensive research into the social, economic, and environmental implications of FOW development is critical to understanding how FOW may impact stakeholders and the Gulf of Maine environment.

3.3 TECHNICAL COMPATIBILITY ASSESSMENT

ERM identified the FOW technologies likely to be used in the Gulf of Maine and did a desktop assessment of the technical compatibility of the FOW technologies and the fishing activities in the Proposed Lease Areas (Table 2) using a Red Amber Green ("traffic light") approach (Table 3). The technical compatibility assessment considered current FOW technology and fishing gear; other technology and gear types may be available in future, when a commercially viable FOW project would potentially be operational in the Gulf of Maine. Though there are several potential combinations of FOW technologies and layout scenarios, the mooring system influences the cabling and takes up the most space, so it was used for the technical compatibility assessment. More information on engineering assumptions can be found in Appendix E.

Table 3 summarizes the results of the desktop technical compatibility assessment as discussed below; these results are not an indication of what fishing activities will be allowed in the Proposed Lease Areas, nor do they consider fishermen's comfort fishing near FOW technology or their perceived risk, which must be considered in an overall assessment of compatibility. In addition, geotechnical conditions are a key factor in determining which mooring type is best suited for a particular site. This Project did not evaluate the relative suitability of different mooring technologies for individual Proposed Lease Areas within the Gulf of Maine based on site conditions, but rather reviewed each mooring technology as it relates to fishing activities. More information on the feedback from fishing industry respondents that informed this assessment, and the assumptions and limitations can be found in Appendix F.

[18] Guidelines for Providing Information for Mitigating Impacts to Commercial and For-Hire Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR Part 585, January 2025

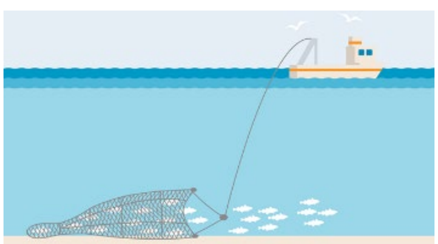
TABLE 3 TECHNICAL COMPATIBILITY SUMMARY OF FISHING GEAR TYPES AND FOW TECHNOLOGIES

	Bottom Trawls	Midwater / Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon **
Mooring Type								
Catenary	X	~	~*	~*	X	~	~*	~
Semi-Taut	X	~	~*	~*	X	~	~*	~
Taut	X	X	~*	~*	X	~	~*	~
TLP	~*	~	✓*	✓*	~*	~	~	~

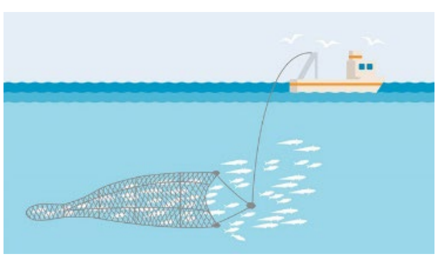
* Technical compatibility depends on the cable being buried to sufficient depth (at least 1.25 meters) and any exclusion zone around the WTGs, for which required standards would need to be developed for the site by regulators, in addition to existing standards such as DNV-ST-0119, and approved from an engineering perspective.
** Harpooning tuna or swordfish might involve chasing the catch after it is struck, increasing the risk of gear entanglement with moorings.
Note: Fishing methods were rated using the key below

✓ = Expected to be technically compatible throughout most of the farm	~ = May be technically compatible in certain areas of the farm in certain circumstances[1]	X = Not expected to be technically compatible

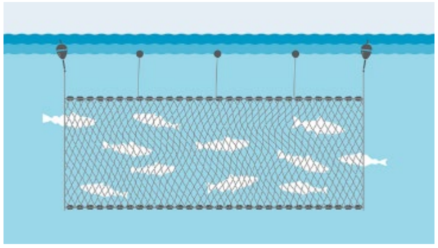
[1] For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the FOW array. More information can be found in Appendix F.



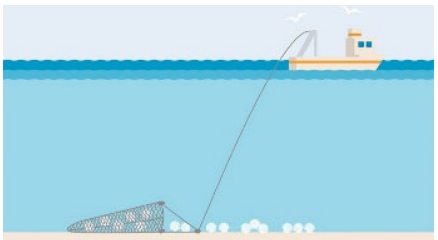
Bottom trawls cannot operate within FOW farms if the moorings are catenary, semi-taut, or taut due to the risk of fishing gear snagging the mooring lines. For a TLP, there is more space, and trawling may be feasible if the trawls are smaller; however, there is a risk of snagging a cable if the cable is not buried. Trawls cover many miles and take up a lot of space, so the compatibility with the TLP mooring type will depend on the size of the trawls, the swept area they cover, and how much control fishermen have over the placement of the trawl nets behind the fishing vessels, especially as they get swept by currents.



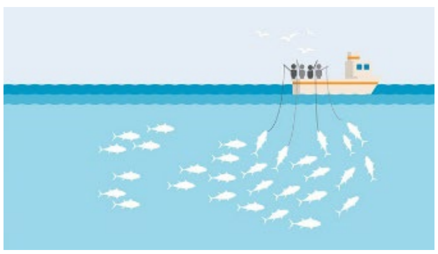
Midwater/pelagic trawls cannot operate in a FOW farm that uses taut mooring lines, as a large portion of the of the mooring line is in the water column and presents a snagging risk. It may be possible for midwater trawls (assuming the trawl does not reach the seabed) to operate in a FOW farm with catenary moorings, as most of the mooring lies on the seabed. However, catenary mooring lines are not always on the seabed and may rise into the water column in very strong wind and wave conditions. Therefore, careful consideration must be given to the metocean conditions when fishing activities occur in a FOW farm. Additionally, if the trawl net is well-controlled and a safe exclusion zone is maintained from the platform, moorings, and cabling, then midwater trawls could also be compatible with catenary and TLP moorings.



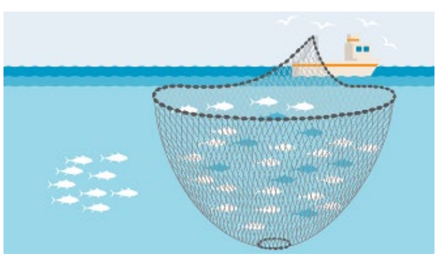
Bottom gillnets and **pots and traps** are mainly static gear types that could operate within a FOW farm of any mooring type with appropriate safety considerations. Because there is more space in a FOW farm within TLP moorings and platforms, there would be fewer restrictions on the bottom gillnets and pots and traps being used on a FOW farm with TLPs compared to one with catenary, taut, or semi-taut moorings.



Dredges are not expected to be able to operate in any FOW farm, except TLP, because dredges can dig up to several feet below the seabed and interfere with catenary, taut, or semi-taut mooring lines and would snag on the dynamic part of the cables. For a TLP, there is less space taken up by the mooring, so dredging sea scallops may be feasible. However, the static part of the cables needs to be buried to a sufficient depth to ensure that there is not a risk of snagging them.



Pole and line fishing could operate within a FOW farm (any mooring type), at specific locations. Safe fishing locations would have to be specified to avoid entangling the fishing line with mooring lines and other FOW components. Assuming the orientation of mooring and cable layouts is incorporated into the design envelope, in line with tidal flow and ambient current, coexistence is possible because fishing gear could be deployed to avoid submerged FOW infrastructure. However, fishing gear deployment precision may vary depending on water depth, length of the fishing line, water current, and weather conditions. Therefore, to reduce risk, shorter fishing lines and fishing in shallower water depths may be recommended.



Purse seines can reach the seabed, so fishing with this gear type in a FOW farm would require fitting between mooring lines and avoiding the cables (assuming they are buried). The largest purse seines may be too large to fit safely between the moorings, so compatibility of this gear type could depend on the final mooring configuration and size of net used. To be compatible, a safe distance would need to be maintained between the purse seine and the mooring lines and cables.

A surface **harpoon** may be able to operate within a FOW farm with any mooring technology, if an exclusion zone around the WTG unit is defined. Harpooning involves actively pursuing the fish (tuna or swordfish in this region) after it is struck, and this pursuit would need to be confined to areas without moorings/cables to avoid gear entanglement.

Following the technical compatibility assessment, ERM developed preliminary recommendations to promote coexistence. GMRI sought feedback in Table 3 and the preliminary recommendations during Phase 3 of stakeholder engagement (Section 3.4). The updated recommendations, which incorporate feedback from stakeholder engagement, are provided in Section 4.

3.4 PHASE 3 STAKEHOLDER ENGAGEMENT

In Phase 3 of stakeholder engagement, GMRI engaged 18 fishing industry stakeholders (Appendix F) and nine members of Maine's Offshore Wind Research Consortium Advisory Board (Appendix G). GMRI sought feedback on the preliminary technical compatibility assessment (draft version of Table 3 as presented in Attachments of Appendix F) and the preliminary recommendations to promote fisheries' coexistence with FOW (Appendix F).

Respondents provided mixed feedback on the preliminary technical compatibility assessment but broadly underscored the need for assessments to incorporate more comprehensive factors, including fishermen's perceived risk of operating in FOW areas, environmental factors (e.g., extreme weather), and site-specific expectations (i.e., what specific mooring technologies will be used by developers in the Gulf of Maine lease areas). In this phase, GMRI held a focus group with five fishermen, during which the group created a compatibility table that incorporated their perceived risk of fishing in these areas (see Appendix F). Respondents also shared insights on how to improve or alter the preliminary recommendations to ensure they align with the respondent's experiences and perceptions. Stakeholder recommendations include:

- Incorporating language into regulations to give the fishing industry greater influence in the decision-making process regarding FOW development.
- Conducting a comprehensive assessment of current fishing patterns in the lease areas with robust consultation with the fishing industry to optimize FOW array layouts by micro-siting turbine locations.
- Creating work and training opportunities for the fishing industry to support offshore wind surveys and operations as long-term positions to supplement existing, unaltered fishing operations.
- Ensuring that data are available to the public in accessible, understandable, interpretable formats (e.g., biological, oceanographic, geological, etc.).
- Accurately marking FOW anchoring lines, mooring structures, and cables to align with the existing charting practices used by the commercial fishing industry.

This feedback has been integrated into the recommendations in Section 4. The findings from Phase 3 engagement suggest that it is paramount to ensure continuous and meaningful collaboration between the FOW industry and Gulf of Maine fishing stakeholders. Moving forward, integrating fishermen's perspectives into the processes of planning and development (e.g., micro-siting lease areas) and prioritizing transparent communication will be key to addressing evolving challenges regarding FOW in the Gulf of Maine. Sustained engagement and innovative approaches will be essential to fostering mutual understanding and ensuring that FOW development aligns with the environmental, economic, and social priorities of the fishing industry and the Gulf of Maine region.

4. RECOMMENDATIONS

The coexistence of fishing and FOW in the Gulf of Maine is a challenge and an opportunity. There is an opportunity to proactively consider coexistence of FOW and fishing before FOW technology is deployed at scale. The recommendations outlined in this section are organized by category (i.e., Engineering Recommendations, Case Study Recommendations, and Other Recommendations) and highlight key opportunities to promote coexistence between fishing and FOW activities. The first draft of these recommendations was presented to fishermen and other stakeholders (see Section 3.4), and their feedback has been integrated into this section. The recommendations require coordination among various organizations and agencies; no single authority can oversee all aspects of communication, monitoring, data sharing, compensation procedures, and conflict resolution. Federal agencies like BOEM, NOAA, the Bureau of Safety and Environmental Enforcement, and the United States Coast Guard; state governments; the fishing industry; and private developers must work together to implement these recommendations to promote the fair and transparent management of ocean resources.

4.1 ENGINEERING RECOMMENDATIONS

Based on the review of fishing technology and vessel sizes used in the region (Section 3), there are no technical barriers preventing vessels from passing through a wind farm under normal conditions to access fishing zones, because it is assumed that there will be over 1 nautical mile [1.15 miles] spacing between platforms[19]. However, based on feedback from stakeholders (see Section 3.2.4), many fishermen in the Gulf of Maine are not comfortable navigating through a FOW farm. There is an opportunity to promote coexistence in FOW design by incorporating feedback from fishermen in decisions about platform spacing, mooring type, and windfarm layout (see Section 3.4).

Spacing Considerations: When designing a FOW array for fishing compatibility, there are tradeoffs to consider with WTG spacing. Some fishermen prefer clustering platforms (which would leave more open space free of FOW infrastructure) whereas others prefer widely spacing platforms, which would leave more space between platforms. If the spacing between the platforms is increased to allow sufficient clearance between platform subsea infrastructure (i.e., the mooring and anchor) for trawling, and if the cables are buried [20], then it may be possible to treat each individual platform as an individual obstacle, like an offshore O&G platform. Increasing spacing between platforms would reduce the platform density. Clearance distance would depend on fishing gear type, gear size (i.e., trawl net size), and safety factors.

Increasing the spacing between platforms may allow for better wake recovery (i.e., restoring wind speed and reducing turbulence downstream of a turbine for higher performance) and more fishing

[19] One nautical mile is the spacing between fixed turbines deployed off Massachusetts and is assumed to be the minimum spacing between FOW turbines. Comments from fishermen on this value are presented in Appendix F.
[20] Cable burial is a function of subsurface conditions (e.g., bedrock, unexploded ordnance), and its possibility should be identified based on geotechnical and geophysical surveys and studies.

to occur, but would also decrease the density of the array, requiring the FOW farm to take up more space to generate the same amount of power.

Greater spacing would also require more seabed, longer cabling (and associated costs), and higher operation and maintenance costs. Spacing will depend on site-specific conditions and the type of fishery active in the area. Using comprehensive data and conducting micro-siting are crucial in determining the most effective spacing approach.

Mooring and Platform Considerations: A TLP platform and mooring are most compatible with fishing because the mooring footprint is the smallest of the mooring types. However, trawling near upright obstacles, such as TLPs, can present a risk as there are still mooring lines (tendons) to support the TLP, which can snag fishing equipment. The taut mooring is the least compatible with fishing because the mooring has the largest footprint of the mooring types through the water column. Fishing near a taut mooring would require significant spacing between WTGs.

The final design of the FOW will be determined by site-specific conditions (e.g., geophysical, geotechnical, and metocean conditions at the site), which may necessitate adjustments from the proposed solutions. For example, TLP anchor systems may not be feasible in all areas, particularly in regions with hard-bottom substrates which can be identified after surveys. As such, the final selection of platform and mooring technologies will be contingent on detailed assessments, economic considerations, and feedback from stakeholders, including fishermen. Incorporating innovative solutions and, for example, customizing array layouts can help reduce spatial conflicts for both mobile and fixed gear users and ensure the needs of all ocean users are considered.

Layout Considerations: The wind farm layout is primarily driven by factors like energy generation efficiency, environmental impact, and site-specific technical considerations; and there are a variety of ways in which a layout could be optimized to promote coexistence. For example, aligning the rows of turbines with the predominant wind, wave, and current direction can make trawling and fishing operations easier by allowing vessels to head into the weather. Alternatively, designing the layout around bathymetry may be conducive to certain types of fishing. Determining a layout optimized for greater fishing potential would require a comprehensive understanding of active fishing in an area, an assessment of predominant fishing patterns, and significant consultation with fishermen. Incorporating micro-siting into the design process is crucial, as it allows for fine-tuning the placement of turbines to further minimize conflicts with fishing activities and maximize operational efficiency.

Technology Opportunities: For successful coexistence of fishing and FOW, any improvement in the knowledge and understanding of the location of underwater equipment, whether fishing equipment (e.g., trawler nets, pots), mooring, anchor lines, or cables, can only improve the certainty of the equipment's location and help reduce the risk of snagging. This could be achieved through leveraging technology, such as transponders and beacons, to get accurate real-time location information. Advancements in navigational technology, including charts, alarm systems, and mooring markers, should be standardized and applied consistently across all lease areas to promote predictability, uptake, and effectiveness. Fishermen stressed that technology uptake should not pose a financial burden (see Section 4.3).

4.2 CASE STUDY RECOMMENDATIONS

As discussed in Section 2.1, several global case studies have shown the viability of coexistence through approaches including multipurpose use (sharing the area and infrastructure/services), symbiotic use (sharing the area and peripheral infrastructure/services), colocation (occupying the same area), and repurposing (occupying the same area at different times).

Priority actions to enable fishery activities to coexist with FOW are outlined in Table 4, alongside relevant case studies and impacts on key fishing methods and activities.

TABLE 4 COEXISTENCE SOLUTIONS, CASE STUDIES, AND IMPACTS

Coexistence Solution/Action	Example Case Study	Impacts on Fishing Methods
Data-driven siting to reduce ocean user conflicts. Examples: • **BOEM** siting process in the U.S. is developed through collaboration with Tribal Nations, stakeholders, marine spatial scientists, ecologists, project coordinators, policy analysts, and other subject matter experts.[21] • The **Maritime Spatial Planning** siting process in Europe finds a balance between offshore wind energy development and other maritime activities (e.g., fishing, shipping, and marine protected areas).	For the Gulf of Maine, BOEM completed a multi-year planning process to determine the final lease areas. The siting process incorporated feedback from public comment and industry and was conducted in collaboration with NOAA and the National Centers for Coastal Ocean Science. Through BOEM's phased siting approach, the initial Call Area was ultimately reduced by 80% to develop the Final WEA. These reductions included fisheries specific siting measures, including avoidance of Lobster Management Area 1 and avoidance of Georges Bank.	Through a data-driven siting process, fisheries -related data and stakeholder feedback is incorporated to avoid specific user conflicts (e.g., specific fishing grounds or navigational routes).
Use preventive measures considering: • **Collision risk** between components, particularly platforms and moorings; and • **Snagging risk** with moorings.	The developers of Westermost Rough[22] and Neart na Gaoithe[23], both located in the UK, **buried the subsea** cables to reduce the likelihood of snags and will conduct "overtrawl ability" **surveys** to ensure that cables are buried, and the risk of fishing gear damage is reduced.	FOW-specific **guidance** for liaising with fisheries in the project design process **to avoid areas in which activities with high snag-risk are crucial for local fishery activities** (relevant to bottom trawls, midwater/pelagic trawls bottom gillnets, pots and traps, dredges, pole and line, and purse seine). **Technological innovations** to mitigate key risks (e.g., alarm or monitoring systems for snagging events, navigational innovations,

[21] Wind Energy Commercial Leasing Process - BOEM
[22] Westermost Rough Offshore Wind Farm, Yorkshire (power-technology.com)
[23] Neart na Gaoithe (NnG) Offshore Wind Farm, Scotland, UK (nsenergybusiness.com)

Coexistence Solution/Action	Example Case Study	Impacts on Fishing Methods
		and ropeless gear innovations) should be considered. Static fishing is the most compatible with floating wind farms[24], provided that the fishing activities occur at an appropriate distance from the turbines.
Consider **navigational impacts** on fisheries (and other shipping/tourism companies) in the wind farm design process.	Électricité de France designed Saint-Nazaire[25] with **turbines spaced 1 kilometer apart** for safe navigation, and construction was staggered to reduce disruption. **Fisheries were restricted to passive gear within the farm**, **with compensation** provided for lost income to those using active gear.	Coexistence-first project designs can mitigate navigational restrictions on other sea-users. Mitigation and compensation measures for fisheries should be considered where impacts are unavoidable.
Consider **regulations** to ensure coexistence opportunities and solutions are implemented, where feasible.	As discussed in Section 2.2, regulations may need to evolve to address FOW and coexistence with fisheries[26]. These include: • Existing environmental impact assessment regulations and permitting have been implemented for existing fixed-bottom projects. Requirements will need adjustment as FOW projects progress through review. • Requirement for construction, maintenance, or decommissioning activities to be scheduled around key fishing seasons and fish life cycle stages (e.g., spawning periods). • Policies around access to fishing areas surrounding FOW farms, including potential spillover effects to other areas and navigational risks/limitations.	Comprehensive regulations covering all interfaces between FOW and fisheries can apply to the coexistence of all fishing methods operating symbiotically with the wind farm.

4.3 OTHER RECOMMENDATIONS

In addition to the engineering recommendations (Section 4.1) and Case Study Recommendations (Section 4.2), this section summarizes 'Other Recommendations' to support coexistence, which integrate guidance from existing international regulations and programs, the Maine Offshore Wind

[24] Floating Offshore Wind and Fishing Interaction Roadmap (pnnl.gov)
[25] Saint Nazaire Wind Farm, Loire-Atlantique, France (power-technology.com)
[26] Regulatory and Policy Frameworks for Offshore Wind Projects: Spatial and Temporal Considerations in Light of Fisheries Sustainability amid Climate Change by Abdullah Al Arif, Ignacio Herrera Anchustegui :: SSRN

Roadmap Fisheries Working Group recommendations[27], and insights provided by fishing industry stakeholders. The recommendations reflect the breadth of previous engagement and established best practices that continue to shape this evolving dialogue. These recommendations provide practical guidance for fostering collaboration between FOW developers and the fishing industry, with a focus on survey operations, geophysical monitoring, gear loss compensation, and long-term ecological impact assessments.

Some recommendations have been, may be, or are being implemented through existing laws and regulations. For instance, the terms and conditions of construction and operations plan approval for offshore wind projects can require benthic habitat and fisheries monitoring as conditions.[28] Lease stipulations and BOEM's Fisheries Mitigation Guidance document[29] also offer mechanisms to support coexistence.

4.3.1 ENGAGE AND COMMUNICATE WITH FISHERMEN

Fishermen want to be engaged in the planning and development of FOW, beyond ongoing federal siting and state planning, outlined previously. This includes engagement in survey operations and engagement with developers on technology and siting decisions. Fishermen want this engagement to be site- and gear-specific, in-person, and planned around their fishing schedules to ensure its effectiveness. Creation of developer-fishermen engagement committees could help to ensure fishermen's voices are consistently heard in Project planning, aligning with Roadmap Fisheries Working Group strategies. Examples of engagement include:

- Engage local fishing communities before and during survey operations to minimize conflicts during survey activities;
- Assign local fishermen to survey vessels to provide real-time guidance and support;
- Use properly credentialed fishermen and fishing vessels to conduct surveys, offering long-term opportunities to create revenue for fishermen while also ensuring survey compatibility with fishing industry operations;
- Align survey requirements and standards among developers and regulators to ensure fishermen know what is expected from their vessels and crews, avoiding unnecessary costs and complexity that could hinder their participation;
- Establish communication protocols with the fishing industry to inform them about upcoming and ongoing survey activities (e.g., timeline and locations) through apps and text alerts;
- Engage fishermen with offshore wind engineers on technology decisions and with developers on micro-siting decisions (e.g., working with fishermen on corridor placement and turbine spacing); and,
- Engage fishermen in fishing industry and gear-specific workshops that address both economic and ecological concerns, echoing the Fisheries Working Group's call for site-specific engagement.

---

[27] Maine Offshore Wind Fisheries Working Group Recommendations
[28] BOEM. (2024). Conditions of Construction and Operations Plan Approval Lease Number OCS-A 0534.
[29] BOEM. (2025). Guidelines for Providing Information for Mitigating Impacts to Commercial and For-Hire Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR Part 585.

When fishermen support developers (e.g., to support surveying), they should be fairly compensated for their time and the opportunities should be offered to supplement rather than replace fishing.

4.3.2 ESTABLISH CLEAR PROTOCOLS FOR COMPENSATION

Compensation programs are essential to address residual impacts, after all efforts to minimize impacts to fisheries have been fully exhausted by conducting comprehensive research, making informed siting decisions, and prioritizing measures to reduce conflicts. A standard and regionally administered compensation fund (like the Fishermen's Contingency Fund under the OCSLA) should be established to address losses related to offshore wind development. Recommendations to be considered during the creation of such a program include:

- Address the cost of upgrading fishing and navigational technologies to avoid financial burdens on the fishing industry;
- Establish (prior to surveys) methods to mitigate the financial impact on fishermen whose equipment may be damaged during operations;
- Capture specific details, including the type of lost gear (e.g., rope, traps, buoys), estimated gear value, missed harvest days, travel costs for replacing gear, and location of loss (including aquaculture losses); and
- Provide transparency to ensure fairness and efficiency.

4.3.3 COLLECT AND SHARE DATA

Significant data is being or will be collected associated with FOW development, which should be shared in a format that is accessible by all ocean users. Specific recommendations related to data include:

- Conduct comprehensive baseline biological and oceanographic monitoring in coordination with the fishing industry before, during, and after FOW construction;
- Use an automatic identification system to track location and provide a record of activities for conflict resolution;
- Map fishing activities, habitats, and predict future trends through continuous monitoring;
- Define reporting requirements for fishing;
- Expand mapping initiatives that visually communicate areas of high fishing activity within FOW lease areas, echoing recommendations from the Fisheries Working Group;
- Enhance accessibility of offshore wind data through interactive platforms, allowing fishermen to visualize potential areas of conflict and provide direct feedback; and
- Share the raw monitoring data in an open-source format with common standards and metadata and establish clear data access policies.

4.3.4 ESTABLISH ADAPTIVE MANAGEMENT FRAMEWORKS

Given that it will be several years before FOW is operational in the Gulf of Maine, there is an opportunity to establish adaptive management frameworks so that coexistence is considered and prioritized as data, understanding, and technologies evolve. This could include:

- Establish frameworks that consider new fishing and monitoring data and adjust operations, where needed, to reduce impact;
- Innovate technologies to enhance the coexistence of FOW and fishing (e.g., developing fishing-friendly cable protection systems and ropeless gear technologies);
- Conduct site-specific compatibility assessments that incorporate feedback from fishermen on gear interaction risks;
- Conduct real-time monitoring of offshore wind impacts on fishing grounds to allow developers to adjust operations as needed; and
- Create adaptive mechanisms to assess the actual economic impacts on fishermen so that if those impacts exceed initial projections, compensation can be adjusted.

4.3.5 MITIGATE IMPACTS ON FISHING

Additional actions can be taken to mitigate FOW impacts on fishing, including:

- Micro-site within the lease areas to avoid specific habitats and fishing areas;
- Develop clear guidelines and buffer zones to avoid interference;
- Promote dialogue between developers and fishermen to update best practices and adjust mitigation measures as FOW projects evolve; and,
- Implement transit lanes and fishing corridors to reduce disruption of fishing patterns and ensure safe navigation through wind farms.

5. NEXT STEPS

This Project has summarized existing regulations and case studies, assessed technical compatibility, and provided recommendations that incorporate feedback from fishermen. This Project could not address all aspects of coexistence, and throughout the Project, knowledge gaps and additional research topics were identified. As technologies in both FOW and fishing gear continue to evolve, additional research, innovation, and collaboration are needed to promote coexistence. Suggested next steps for future study include:

- Collect empirical data.
  - Establish pilot coexistence zones and demonstration scale projects where developers can test different layouts and assess interactions in the water to identify best practices for coexistence, in alignment with Roadmap recommendations for phased deployments.
  - Fill species distribution data gaps.
  - Conduct mooring and cable interaction studies to evaluate potential conflicts between fishing gear and floating turbines.
  - Expand pre-construction surveys and monitor ecosystem changes over time, as recommended by the Fisheries Working Group.
  - Develop a comprehensive baseline dataset (including physical parameters and nutrients) to inform hydrodynamic and larvae modeling.
- Conduct climate and economic modeling to evaluate the impact of climate change on fisheries.
- Conduct hydrodynamic and ecosystem modeling to evaluate the impact of FOW arrays on species distribution and to optimize layout design for coexistence.
- Conduct socioeconomic impact modeling to evaluate how restricted fishing zones may alter community livelihoods, to promote equitable compensation where displacement occurs.
- Evolve fishing gear and FOW technologies to facilitate coexistence.
- Explore nature-inclusive design solutions that promote fishery coexistence.
- Engage with the insurance industry to understand the potential insurance implications for fishermen who fish within a FOW array.
- Design adaptive compensation models that account for both direct and indirect economic impacts, ensuring that all gear types are fairly represented.
- Evaluate the regulatory framework to ensure all stakeholders are represented.
- Develop clear engagement frameworks to promote communication and collaboration between the fishing industry and FOW developers, while minimizing stakeholder fatigue.

By pursuing these targeted areas of study and innovation, challenges and concerns associated with integrating FOW developments into existing ocean uses can be addressed, and sustainable coexistence can be promoted.

APPENDIX A DEFINING COEXISTENCE, CASE STUDIES AND REGULATIONS

Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind

Appendix A: Defining Coexistence and Case Studies

PREPARED FOR
State of Maine, Governor's Energy Office

DATE
10 May 2024

REFERENCE
0724797

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronyms	**Description**
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
EFH	Essential Fish Habitat
EIA	Environmental Impact Assessment
EMF	electromagnetic field
ERM	ERM Consulting & Engineering, Inc.
ESA	Endangered Species Act
EU	European Union

Acronyms	Description
FAD	fish aggregating device
FMMS	Fisheries Management and Mitigation Strategy
FOW	floating offshore wind
GEO	The Governor's Energy Office, State of Maine
km	kilometer
km^2	square kilometer
kW	kilowatt
m	meter
MPA	Marine Protected Area
MRP	Marine Renewable Power Ltd.
MW	megawatt
NA	not available
NEPA	National Environmental Policy Act
NGO	non-governmental organization
NiD	Nature-inclusive Design
NnG	Neart na Gaoithe
NOAA	National Oceanic and Atmospheric Administration
O&G	oil and gas
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OFCC	Oregon Fishermen's Cable Committee
OSW	offshore wind
OWF	offshore wind farm
SAMP	Special Area Management Plan
SFF	Scottish Fishermen's Federation
T&C	Terms and Conditions
TFA	Thanet Fishermen's Association
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
US	United States
USC	United States Code
WEA	wind energy area

A1. INTRODUCTION

Over the course of 2023, the Maine Offshore Wind Research Consortium Advisory Board underwent a rigorous prioritization process to identify three research topics to fund in its inaugural round of projects. This project, Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind, was one of the projects included in the competitive Request for Proposals that was issued in November 2023 by the Governor's Energy Office (GEO) on behalf of the Research Consortium.

ERM Consulting & Engineering, Inc. (ERM) and the Gulf of Maine Research Institute were awarded the project to pursue research and stakeholder engagement to advance understanding of floating offshore wind (FOW) and fishery coexistence. The project kicked off in February 2024.

As part of this project ERM has prepared this *Review of Case-Studies and Regulations Applicable to Fisheries' Coexistence with Floating Offshore Wind* for GEO. ERM and Gulf of Maine Research Institute (the Project team) are working to explore approaches to fisheries' coexistence with FOW (the Project) and to effectively engage the fishing industry in their coexistence with FOW in the Gulf of Maine.

Commercial fishermen and fisheries represent one of the existing ocean users and stakeholders in the potential development of future FOW projects in the Gulf of Maine. Fishermen have concerns about the potential impacts of the offshore wind (OSW) industry on their operations and resources, including that OSW will restrict fishing access, will create entanglement and navigation risks, will impact fish habitats, and will create increased industry competition within a smaller sea area[1]. Specific characteristics of FOW projects (e.g., potentially greater footprint of FOW versus fixed-foundation projects, and sub-surface mooring lines and inter-array cables) may result in new challenges to areas of sea for fishing activity during the operational phase. There are recognized benefits of offshore wind farms (OWF) on fisheries, including the increase in biological productivity (BOEM 2014) and the creation of refuges for organisms (Wilson et al. 2010*). Habitats for benthic and commercial fish are understood and have been co-located in Europe; however, due to the novelty of FOW, more comprehensive studies and monitoring are needed to address the ability to conserve and improve the fishing industry while simultaneously advancing the development of FOW. The Project objective is to explore ways to promote compatibility between fishing activities and FOW, specifically in the Gulf of Maine.

The objective of this assessment is to collate and synthesize existing knowledge available through desktop research that may be useful in informing coexistence in the Gulf of Maine. It includes relevant definitions, types, and enabling conditions of coexistence through a review of case studies by geographical location; and reviews the regulatory, legal, and other project requirements associated with the coexistence of fisheries and FOW to overcome barriers associated with coexistence as defined in the GEO's request for proposal #202310220.

[1] Offshore Wind and the Fishing Industry: The Path to Co-Existence - June 2021, Kleinman Center for Energy Policy
* Throughout this report an asterisk (*) indicates a peer-reviewed article. References without an asterisk are non-peer-reviewed sources.

A2. DEFINING COEXISTENCE

ERM conducted a case study review and synthesis to support defining coexistence in the context of the Gulf of Maine.

Based on ERM's review of the academic literature, coexistence is an umbrella term covering four key types shown in Table 1.

TABLE 1: TYPOLOGIES OF COEXISTENCE

Type of Coexistence[2]	**Definition**
Multipurpose	Users occupy the same area, at the same time, and share core infrastructure and services
Symbiotic Use	Users occupy the same area, at the same time, and share peripheral infrastructure or services (onshore or offshore)
Colocation	Users occupy the same area at the same time
Repurposing	Users occupy the same area, but subsequently (one after the other) rather than at the same time

In addition to these typologies, Nature-Inclusive Design (NiD) can be considered an approach to coexistence. NiD can fall under any of the typologies described in Table 1. The primary goal of NiD-type projects is to increase biodiversity and mitigate environmental impacts of energy projects (Pardo et al. 2023*). NiD projects present opportunities to rebuild fisheries for commercial and recreational use in the long-term, but further study and ongoing monitoring of existing projects is required.

[2] "Coexistence and nature-inclusive design in Nordic offshore wind farms" (norden.org)

A3. SUMMARY OF CASE STUDIES

Based on existing academic literature, reports from multi-lateral organizations, media, and project technical documents, case studies were selected that encompass a variety of coexistence approaches, incorporating as much geographic diversity as feasible. Most selected cases are for OSW projects, but other technologies have been included to highlight relevant lessons from more established sectors.

Table 2 presents high-level information about the 10 case studies reviewed for this report, organized by typology of coexistence. Additional information about each case is provided in the following sections.

TABLE 2: PRESENTED CASE STUDIES BASED ON COEXISTENCE TYPE

Coexistence Approach (# of cases)	Country	Project	Estimated Investment	Commissioning	Installed Capacity
Multipurpose (1)	United States[3]	Block Island Wind Farm	$290 million[4]	February 2017	30 MW
Symbiotic Use (3)	England[5]	Thanet Offshore Wind Farm	$1.2 billion[6]	September 2010	300 MW
	England[7]	Westermost Rough Offshore Wind Farm	$1.37 billion[8]	May 2015	210 MW
	Scotland[9]	Neart na Gaoithe Offshore Wind Farm	$2.4 billion[10]	Expected 2024	432 MW
Colocation (4)	France[11]	Saint-Nazaire Wind Farm	$2.21 billion[12]	November 2022	480 MW
	Scotland	Hywind Scotland Floating Wind Farm	$270 million	2017	30 MW

[3] Block Island Wind Farm (USA) - Wind farms - Online access - The Wind Power
[4] First American Offshore Wind Farm Fully Funded (maritime-executive.com)
[5] Thanet (United-Kingdom) - Wind farms - Online access - The Wind Power
[6] Wind power – DW – 09/24/2010
[7] Westermost Rough (United-Kingdom) - Wind farms - Online access - The Wind Power
[8] Westermost Rough Offshore Wind Farm, Yorkshire (power-technology.com)
[9] Neart na Gaoithe (United-Kingdom) - Wind farms - Online access - The Wind Power
[10] Neart na Gaoithe (NnG) Offshore Wind Farm, Scotland, UK (nsenergybusiness.com)
[11] Saint-Nazaire (France) - Wind farms - Online access - The Wind Power
[12] Saint Nazaire Wind Farm, Loire-Atlantique, France (power-technology.com)

Coexistence Approach (# of cases)	Country	Project	Estimated Investment	Commissioning	Installed Capacity
	Scotland	Kincardine Floating Wind Farm	$445 million	2021	50 MW
	United States	NorthStar Cable	NA	1998	NA
Repurposing (1)	United States	Multiple Oil and Gas Platforms	NA	NA	NA
Nature inclusive design (NiD) (1)	Netherlands	Multiple Offshore Wind Farms	NA	NA	NA

MW = megawatt; NA = not available

A3.1 MULTIPURPOSE

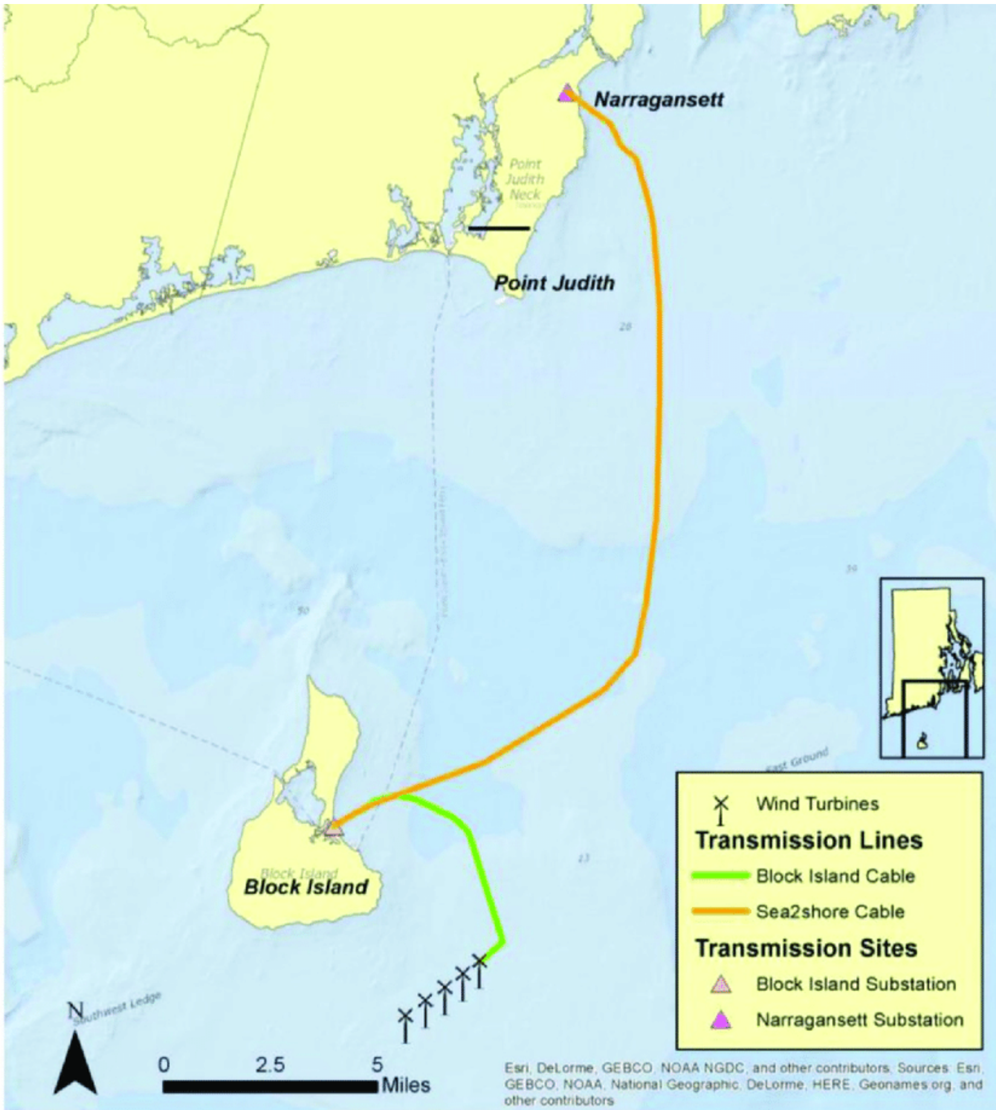
A3.1.1 UNITED STATES: FISHING, OFFSHORE WIND ENERGY, AND TOURISM IN THE BLOCK ISLAND WIND FARM

The Block Island Wind Farm was the first OWF in the United States (US). Construction of the pilot-scale wind farm began in 2015 and the project came online in 2016. The specifications and details of the project are presented in Table 3 (Moura et al. 2015*).

TABLE 3: BLOCK ISLAND PROJECT SPECIFICATIONS

Specifications[13,14]	Details
Project Name	Block Island Wind Farm
Project Type	Offshore Wind
Coexistence Type	Multipurpose
Fishing and Navigation Allowed in OWF	Yes
Estimated Investment	$290 million
Commissioning	December 2016
Location	New Shoreham, Rhode Island
Installed Capacity	30 MW
Total Spatial Use	2 km^2
Production Units	5 turbines

[13] Block Island Wind Farm (USA) - Wind farms - Online access - The Wind Power
[14] First American Offshore Wind Farm Fully Funded (maritime-executive.com)

Specifications[13,14]	**Details**
Details[15]	Haliade 150 turbines (6000 kW, diameter 150.8 m) 6.1 km from shore at 22-31 m depth
Layout	 Source: Block Island Offshore wind power project (turbines and transmission

ft = feet; km = kilometer; kW = kilowatt; m = meter; MW = megawatt

Stakeholders and Key Industries Involved: The industries involved in this project were commercial and recreational fishing, tourism, and cooperative research including academia and non-profit organizations. Noted stakeholders included:

- Coastal Resources Management Council
- Deepwater Wind (developer)
- Fishermen Advisory Boards

[15] Block Island Wind Farm | Tethys (pnnl.gov)

- Fishing, environmental, and research interest groups

Approach to Coexistence: Based on project specifications, existing conditions of the project site, and current uses of the location, the Rhode Island Ocean Special Area Management Plan (SAMP) designated the area as a Renewable Energy Zone. The Ocean SAMP is a federally adopted regulatory management plan that uses an ecosystem-based approach, balancing ecological concerns with potential for economic benefits. The site selection process was driven by an objective to choose a location that had the least impact on wildlife and the residents of Rhode Island.

The Ocean SAMP framework prioritizes a type of coexistence known as **multipurpose**, where users occupy the same area, at the same time, and share core infrastructure and services through coexistence-first project design. In this case, uses of marine resources occur at the same time and location, while different users support each other, and projects are designed to complement and accommodate multiple user types. For example, the Block Island project included impact studies on local finfish and lobster populations and the developer hired fishermen to collect the data, creating a mutually beneficial arrangement between the industries and stakeholders.

Enabling Conditions:

- *Communication:*
  - Fishing Industry Capacity Building – Several activities were undertaken to facilitate engagement between the fishing industry and the project developer. These included the appointment of a fisheries liaison from the local fishing industry, having a fisheries representative working on behalf of the Coastal Resources Management Council, establishing a government-to-industry Fisheries Advisory Board, and holding open industry-to-industry meetings with local fishermen.
  - Safety Communications – The developer prioritized the establishment of relevant safety communications protocols: i) cable route information and a cable communication and awareness system protocol for navigational warnings, and ii) an emergency response protocol including two wind farm-specific radio channels along with a marine communications plan for the construction phase.
- *Coexistence-first Project Design*: The government used the Ocean SAMP Marine Spatial Planning process to engage stakeholders and scientists to determine the project site. The design of facilities, construction, and operational procedures limited the interruption to the fishing industry to the 3-month construction period.
- *Local Benefits*: The developer employs local fishermen to support data collection for environmental impact studies and similar contracts. This approach not only meets the project's needs but also helps mitigate the economic impacts on fishermen due to suspension of fishing activities during construction.

A3.2 SYMBIOTIC USE

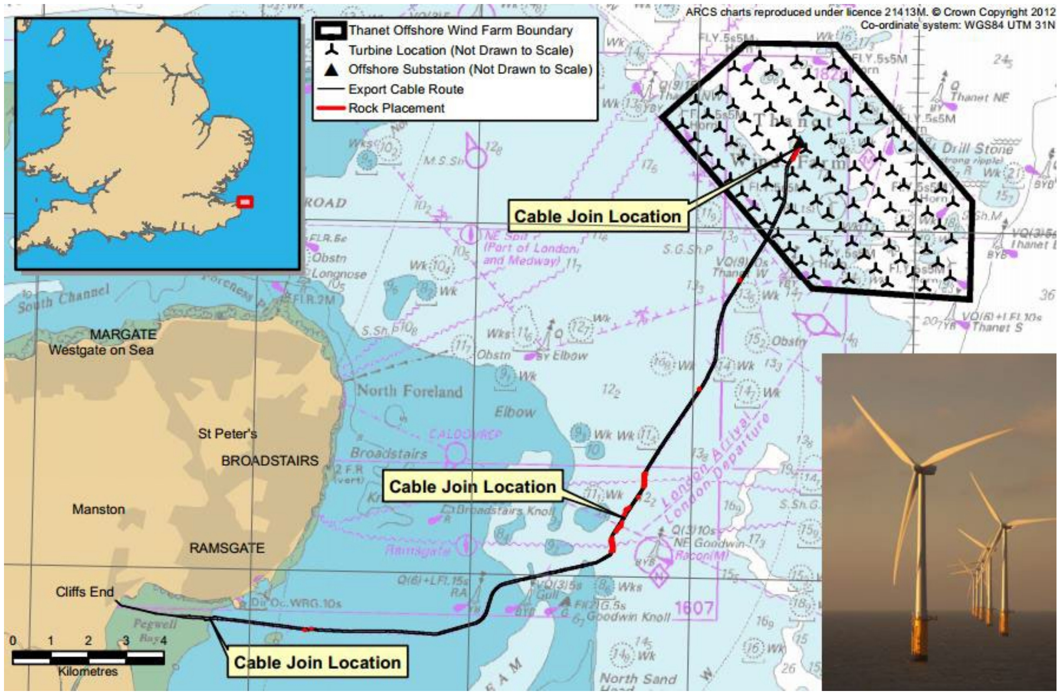
A3.2.1 ENGLAND: THANET OFFSHORE WIND FARM

The Thanet Offshore Wind Farm is approximately 7 miles off the coast of Kent, England. When it was commissioned in 2010, it was the world's largest wind farm, though it has since been overtaken by other projects. With a total capacity of 300 megawatts (MW), it supplies 240,000 homes yearly with electricity. The specifications and details of the project are presented in Table 4 (Moura et al. 2015*).

TABLE 4: THANET PROJECT SPECIFICATIONS

Specifications[16,17]	**Details**
Project Name	Thanet Offshore Wind Farm
Project Type	Offshore Wind
Coexistence Type	Symbiotic Use
Fishing and Navigation Allowed in OWF	Yes
Estimated Investment	$1.2 billion
Commissioning	September 2010
Location	Kent, England (7 miles off the coast of Thanet)
Installed Capacity	300 MW
Total Spatial Use	35 km^2
Production Units	100 turbines
Details	Vestas V90/3000 turbines (300 kW, 90 m diameter) 15 km from shore at 20-25 m depth

[16] Thanet (United-Kingdom) - Wind farms - Online access - The Wind Power
[17] Wind power – DW – 09/24/2010

<table>
<tr><th>Specifications[16,17]</th><th>Details</th></tr>
<tr><td>Layout</td><td>

Source: Balfour Beatty to Operate Thanet OWF's Offshore Transmission Link</td></tr>
</table>

km = kilometer; km² = square kilometer; kW = kilowatt; m = meter; MW = megawatt

Stakeholders and Key Industries Involved:

- Thanet Fishermen's Association (TFA)
- Fishing Industry
- Vattenfall (developer)

Approach to Coexistence: Vattenfall, the project developer, worked with fishing industry stakeholders, especially the TFA, to understand local fisher's interests and inform its decision-making. In addition to proactive communications, the TFA operates an onshore fuel facility at the Port of Ramsgate. The Thanet Wind Farm supports the TFA by purchasing fuel for wind farm vessels from the fuel facility. The fuel facility then shares its profits with TFA members and allows members to purchase fuel at a reduced price.

Thanet Wind Farm is an example of **symbiotic use**. The fuel infrastructure and sales business venture benefits both the wind and the fishing industries and the development of other port infrastructure by the developer (i.e., providing fueling infrastructure on site for future port services).

Enabling Conditions:

- *Communication*: Like the Westermost Offshore Wind Farm (see Section A3.2.2), the project developer employs a Fishing Liaison Officer and funds the employment of a Fishing Industry Representative to support ongoing communication efforts. Similarly, a Port Operational Interface Group was established to allow representatives from local fishing, offshore wind, shipping industry, and port interests to meet regularly and discuss port operations and industry concerns. Additionally, the developer established a cable communication and awareness system to alert fishermen to the location of submarine cables.

- *Coexistence-first Project Design*: To mitigate the impact on fishermen's livelihoods, the developer buried the submarine cables to reduce the likelihood of snags and allowed fishermen to transit through the wind farm site during construction, saving them time and fuel. Also, the developer has actively invested in upgrading port and shore-side infrastructure.
- *Local Benefits*: The TFA constructed and operates an onshore fuel facility that provides fuel to the wind farm vessels and reduced fuel prices for TFA members. The developer also hires fishing vessels for a variety of support services.
- *Compensation* – The developer has agreed to directly compensate fishermen for any hindered access or ability to generate livelihoods from fishing.

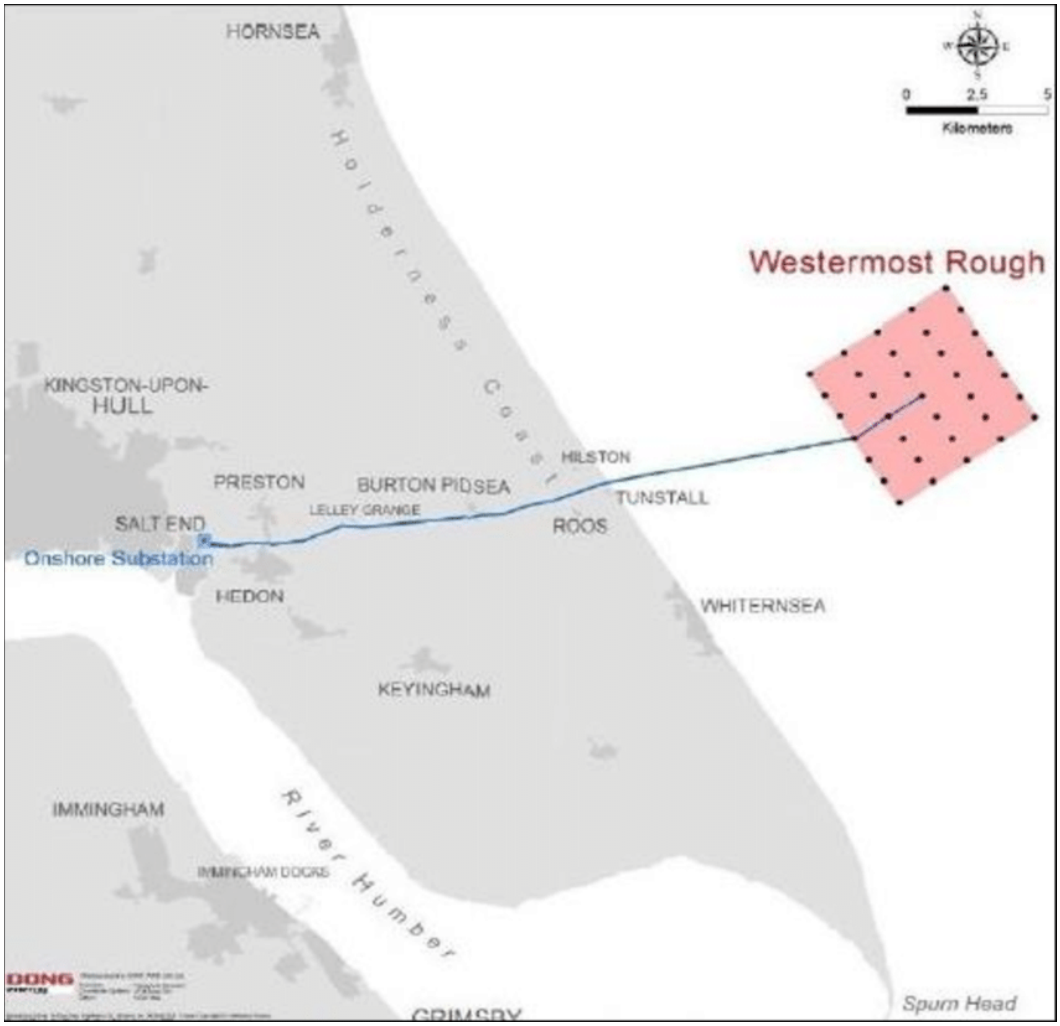
A3.2.2 ENGLAND: WESTERMOST ROUGH OFFSHORE WIND FARM

The Westermost Rough Offshore Wind Farm commenced construction in 2014 and reached full power generation in 2015. The specifications and details of the project are presented in Table 5 (Moura et al. 2015*).

TABLE 5: WESTERMOST ROUGH PROJECT SPECIFICATIONS

Specifications[18,19]	**Details**
Project Name	Westermost Rough Offshore Wind Farm
Project Type	Offshore Wind Farm
Coexistence Type	Symbiotic Use
Fishing and Navigation Allowed in OWF	Yes
Estimated Investment	$1.37 billion
Commissioning	July 2015
Location	Yorkshire, UK (5 miles off the Holderness Coast)
Installed Capacity	210 MW
Total Spatial Use	35 km^2
Production Units	35 turbines
Details	Siemens SWT-6.0-154 (6,000 kW, diameter 154 m) 10 km from shore at 15 m depth

[18] Westermost Rough (United-Kingdom) - Wind farms - Online access - The Wind Power
[19] Westermost Rough Offshore Wind Farm, Yorkshire (power-technology.com)

Specifications[18,19]	Details
Layout	 Source: Location of Westermost Rough offshore wind farm, image provided by DONG Energy (Ørsted).

km = kilometer; km² = square kilometer; kW = kilowatt; m = meter; MW = megawatt

Stakeholders and Key Industries Involved:

- Lobster industry
- West of Morecambe Fisheries Fund
- Local fishing industry group(s)
- DONG Energy (developer)
- UK Green Investment Bank

Approach to Coexistence: The Westermost Rough project was relatively controversial with local lobstermen when it first began. According to interviews conducted by the case study authors, proactive communication and collaboration eventually created a positive relationship built on mutual support between industries. The developer, DONG Energy, established industry-to-industry communications and provided support that led to increased trust between the wind industry and local lobstermen.

In this case, coexistence is based on a **symbiotic use** approach, as the users are at the same place at the same time, sharing peripheral infrastructure or services.

Enabling Conditions:

- *Communication:*
  - Fisheries Liaison – To establish effective communication and address fishing industry concerns, the developer employed an experienced commercial fisheries liaison to create a communication platform between the industries.
  - Fishing Industry Capacity Building – The developer provided resources to support a fisheries representative leader from a local industry group to bring forward collective concerns for discussion and resolution, while maintaining continuity in communications between the two industries.
- *Local Benefits*: The developer has contributed to two separate fisheries funds, the West of Morecambe Fisheries Fund, and the Lost/Damaged Gear Fund. The West of Morecambe Fisheries Fund sponsors projects within the fishing community including direct enhancements to the industry, such as the purchase of a research vessel to conduct impact monitoring surveys at the wind farm site. The Lost/Damaged Gear Fund reimburses lobstermen if they can demonstrate the wind farm support/transit vessels damaged their lobster pot gear.
- *Coexistence-first Project Design*: The project and facilities design considered access rights for local fishermen, mitigating the impact on the lobster and fishing industries' productivity.
- *Cooperation*: The developer funded studies of the wind industry's impact on lobster and crab populations in and around the wind farm. The fishermen used their own vessels to conduct the research, creating an opportunity for the wind industry to bring additional economic benefit to the fishing community (i.e., symbiotic use). These studies are ongoing during the operations phase, with post-construction surveys conducted in 2015, 2017, and 2019 (Roach et al. 2022*).

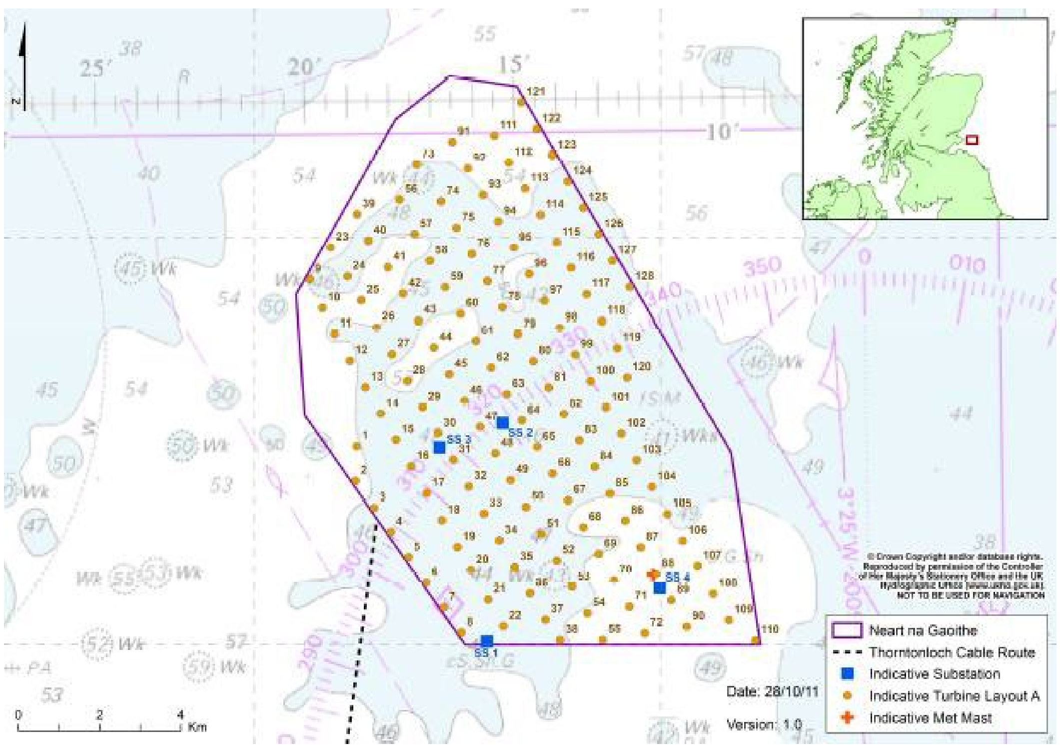
A3.2.3 SCOTLAND: NEART NA GAOITHE OFFSHORE WIND FARM

Construction on Neart na Gaoithe (NnG) Offshore Wind Farm began in 2019 (onshore) and 2020 (offshore). The project was delayed several times, most recently due to supply chain issues in 2020. Full commissioning is expected in mid-2025. NnG will provide power for around 375,000 homes and will offset more than 400,000 tons of carbon dioxide emissions. The specifications and details of the project are presented in Table 6 (Moura et al., 2015*).

TABLE 6: NEART NA GAOITHE PROJECT SPECIFICATIONS

Specifications[20,21]	Details
Project Name	Neart na Gaoithe Offshore Wind Farm

20 Neart na Gaoithe (United-Kingdom) - Wind farms - Online access - The Wind Power
21 Neart na Gaoithe (NnG) Offshore Wind Farm, Scotland, UK (nsenergybusiness.com)

Specifications[20,21]	**Details**
Project Type	Offshore Wind
Fishing and Navigation Allowed in OWF	Yes
Coexistence Type	Symbiotic Use
Estimated Investment	$2.4 billion
Commissioning	Expected 2025
Location	Fife, Scotland (10 miles off the coast)
Installed Capacity	450 MW
Total Spatial Use	105 km^2
Production Units	54 turbines
Details	Siemens-Gamesa SG 8.0-167 DD (power 8,000 kW, diameter 167 m) 15.5 km from shore at 45-55 m depth
Turbine Layout	
	Source: Location of Nearth Na Gaoithe OWF

km = kilometer; km^2 = square kilometer; kW = kilowatt; m = meter; MW = megawatt

Stakeholders and Key Industries Involved:

- Scottish Fishermen's Federation (SFF)

- Marine Renewable Power Ltd. (MRP) (developer)

Approach to Co-Existence: Similar to the Westermost Rough project (see Section A3.2.2), the developer, MRP, established industry-to-industry communications, business opportunities, and provided monetary support while the project was still in the construction phase.

As with the other UK cases, coexistence here is based on a **symbiotic use** approach: same place, same time, sharing peripheral infrastructure or services.

Enabling Conditions:

- *Communication*: MRP supports ongoing dialogue with local fishing interests through a Commercial Fisheries Working Group. The developer employs a fisheries liaison on vessels during construction to ensure that fishing industry concerns are represented in real-time during the construction phase.
- *Coexistence-first Project Design:* The developer has integrated cable burial into its design where possible and will use other protective measures for other cables. Related to this, the developer will conduct "overtrawl ability" surveys to ensure that cables are buried, and the risk of fishing gear damage is reduced. Facility infrastructure will be properly marked and lit for safety.
- *Local Benefits*: Like the Thanet Offshore Wind Farm and the Westermost Rough Offshore Wind Farm, the NnG developer employs fishermen from the SFF as personnel for surveys and environmental assessments, and as guard/patrol vessels. Also, the developer committed to forming a compensation agreement with fishermen for reduced access during construction.

A3.3 COLOCATION

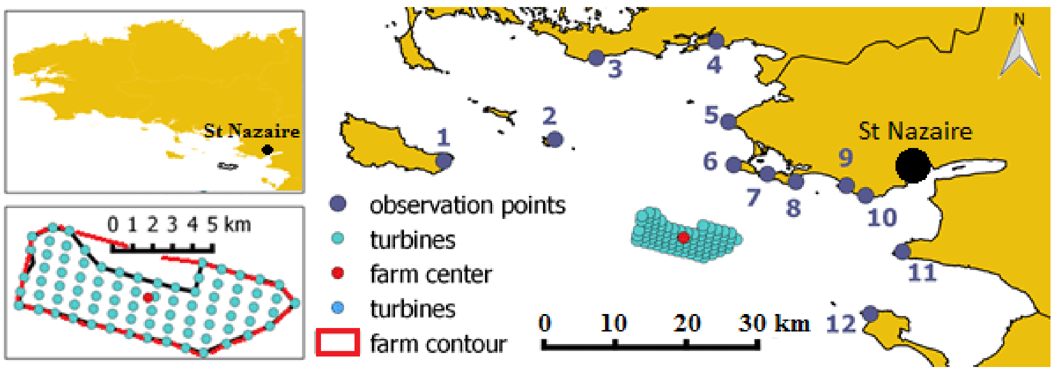
A3.3.1 FRANCE: OFFSHORE WIND AND FISHING IN LOIRE-ATLANTIQUE

The Saint-Nazaire Wind Farm was commissioned in November 2022 and was the first operational wind farm at sea in France. The expected production capacity of 480 MW represents about 20 percent of the total electric consumption of the Loire-Atlantique region, which includes three arrondissements (administrative districts): Chateaubriant-Ancenis, Nantes, and Saint-Nazaire. The specifications and details of the project are presented in Table 7 (Lukić et al. 2023).

TABLE 7: LOIRE-ATLANTIQUE PROJECT SPECIFICATIONS

Specifications[22,23]	Details
Project Name	Saint-Nazaire Wind Farm
Project Type	Offshore Wind Farm
Fishing and Navigation Allowed in OWF	Yes
Coexistence Type	Colocation

[22] Saint-Nazaire (France) - Wind farms - Online access - The Wind Power
[23] Saint Nazaire Wind Farm, Loire-Atlantique, France (power-technology.com)

Specifications[22,23]	Details
Estimated Investment	$2.21 billion
Commissioning	November 2022
Location	Loire-Atlantique, France (12 km from coastline)
Installed Capacity	480 MW
Total Spatial Use	78 km^2
Production Units	80 turbines
Details	GE Energy Haliade 150 (power 6,000 kW, diameter 150.8 m) 15 km from shore at 20 m depth
Turbine Layout	 Source: Offshore wind farm layout projected in the Saint-Nazaire region

km = kilometer; km^2 = square kilometer; kW = kilowatt; m = meter; MW = megawatt

Stakeholders and Key Industries Involved: The relevant industries in Loire-Atlantique are small scale fishermen, commercial shipping, shellfish farming, and tourism. Noted stakeholders include:

- Industry stakeholders: fishermen, shellfish farmers, shipping companies, tourism companies
- EDF-R (developer)

Approach to Coexistence: The primary challenge to coexistence for the Saint-Nazaire wind farm was limitations on navigation and fishing due to safety concerns. To address this challenge, the farm was designed with 1 km between each turbine to ensure safe navigation. The construction and connection timelines were staggered to minimize the amount of space that was unusable by other industries at the same time. Additionally, safety measures were implemented, including restricting fishermen to use of passive gear[24] only within the farm. Compensation was provided to the fishermen who used active gear, to compensate for their lost income due to this safety requirement.

In this case, coexistence can be defined as "the joint use of resources in close geographic proximity by multiple users," also called **colocation**.

[24] Active gear: Fishing gear is dragged by human or an engine (e.g., trawls, dredge); Passive gear: Gear that relies on the fishes movement (e.g., traps, nets)

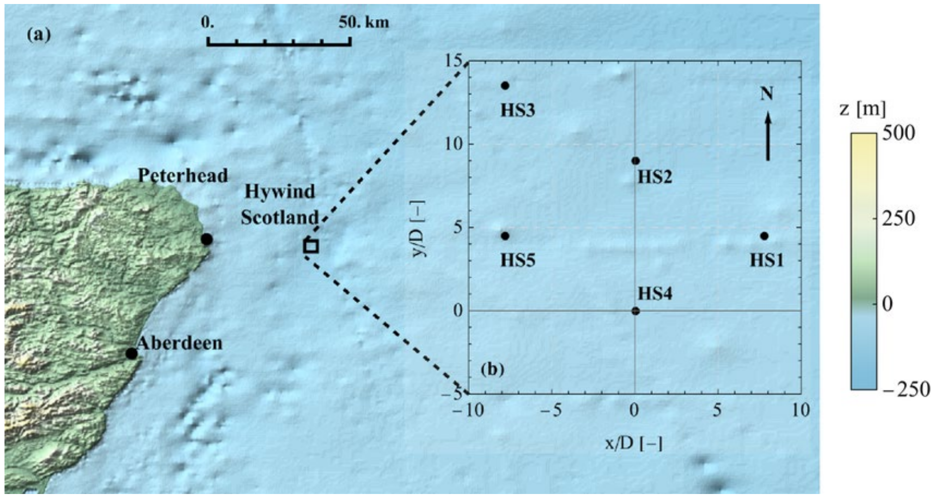
Enabling Conditions:

- *Known Entity*: The developer, EDF-R, was already a known entity as the French company had several previous offshore wind projects in its global portfolio, instilling a foundational level of trust with stakeholders.
- *Coexistence-first Project Design*: The site selected for this project is a minor fishing zone and fishermen using passive gear were unaffected, which limited the number of those impacted. Local fishermen were also less concerned because this is only the first project in the area, unlike in the English Channel where fishermen are highly impacted by multiple active marine renewables projects[25].
- *Local Benefits*: The project, which is expected to produce at least 20 percent of the region's total energy capacity, benefits the city of Saint-Nazaire and the Loire-Atlantique region. Also, compared to similar projects, it provided relatively generous mitigation and compensation measures for fishermen.
- *Communication*: The developer and stakeholders were in proactive and long-term discussions about the location, design, construction, and operation of the wind farm. Over the course of more than a decade, trust was built between the parties and an agreement was reached before major investments, setting an example for future investments in the region.

A3.3.2 SCOTLAND: HYWIND OFFSHORE WIND FARM

Specifications[26],[27],[28]	**Details**
Project Name	Hywind Scotland
Project Type	Floating Offshore Wind
Coexistence Type	Colocation
Fishing and Navigation Allowed in OWF	Yes – outside of safety zones
Estimated Investment	$270 million
Commissioning	2017
Location	Peterhead, Scotland
Installed Capacity	30 MW
Total Spatial Use	4 km^2
Production Units	5 turbines
Details	Siemens Gamesa SWT-6.0-154 (power 6,000 kW, diameter 154 m) 25 km from shore at 105 m depth

[25] Multi-frame case studies - SUBMARINER Network
[26] Hywind Scotland - the world's first floating wind farm - Equinor
[27] Masdar | Hywind Scotland
[28] Tethys - Hywind Scotland Pilot Park

Specifications[26,27,28]	**Details**
Layout	 Source: Map of the eastern coast of Scotland where the offshore Hywind Scotland wind farm is located (black rectangle)

km = kilometer; km² = square kilometer; kW = kilowatt; m = meter; MW = megawatt

Stakeholders and Key Industries Involved: The key industries identified in the project Environmental Impact Assessments (EIA) were pelagic fish, demersal fish, and shellfish. Impact on the industry was estimated to be minimal due to the limited amount of fishing that takes place in the turbine deployment area and the availability of fishing in areas outside the safety zone (Equinor, 2015). Stakeholders engaged in the EIA included (but were not limited to):

- Buchan Inshore Fishermen's Association
- Marine Scotland
- Peterhead Port Authority
- SFF
- Scottish Natural Heritage
- Local and national government offices (e.g., National Oceanographic Centre, Ministry for Energy, Enterprise and Tourism)

Approach to Coexistence: The expected primary impacts on fisheries were loss of access to fishing grounds during construction and the presence of mooring lines and inter-array cables, which could snag on fishing gear during operations (Equinor, 2015). To mitigate these risks, the project proposed safety zones for navigation and fishing of 500 meters (m) during construction and installation, and 50 m during operation. The Project also provides information of the location of seabed infrastructure via FishSafe allowing fishermen to manage risks independently. Finally, the project set up a Fisheries Liaison Officer to ensure effective communication between the fishers and the Project.

The approach to coexistence for the Hywind Scotland project is **colocation.**

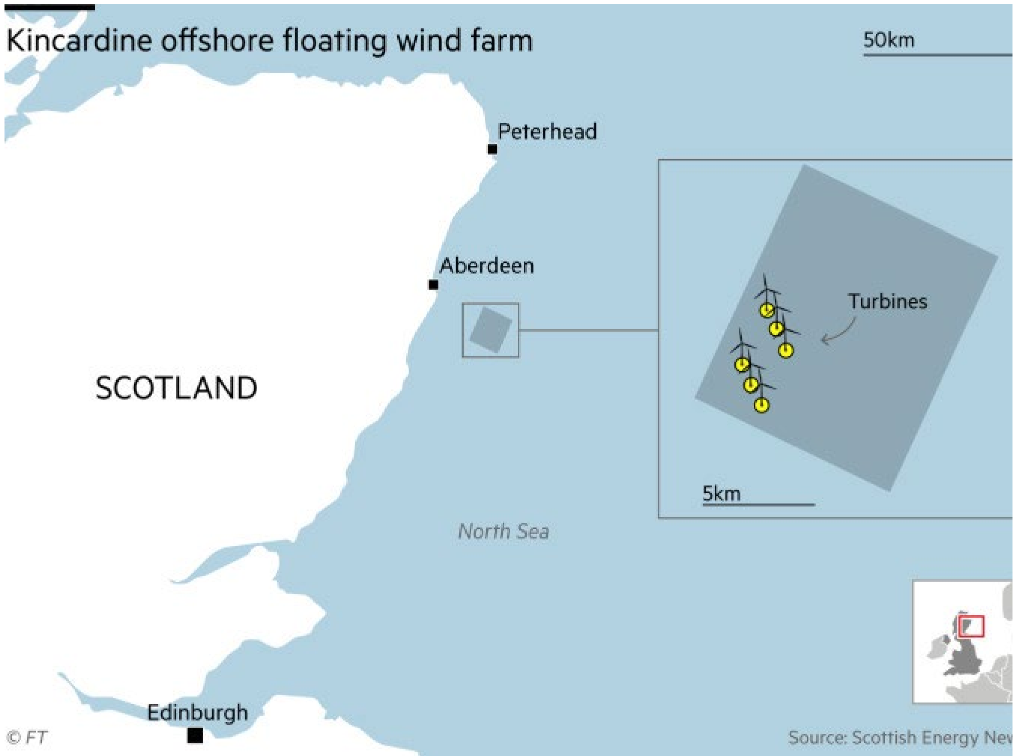
Enabling Conditions:

- *Communication:* According to the Environmental Statement for the project, the SFF were engaged very early in the impact assessment process and ultimately supported the project. The Project also appointed a fisheries liaison officer early on to ensure proactive engagement and communications throughout project development.
- *Coexistence-first Project Design:* The Project Environmental Statement indicated that the site was chosen due to the abundance of fisheries outside of the project zone so that the overall impact on yields would be minimal.
- *Commitment to future fisheries activities:* The Project conducted a pilot study of passive fishing gear use within the project area to determine the safety and suitability of fishing methods and their impact on catch composition and rate. The findings were positive and will help determine safety zones for fishing and navigation within the project area, expanding where fishers can conduct activities (Wright, et al, 2023). That the Project funded this study helps illustrate to fishers that their needs are a priority and that the Project is oriented to true coexistence.

A3.3.3 SCOTLAND: KINCARDINE OFFSHORE WIND FARM

Specifications[29],[30],[31]	**Details**
Project Name	Kincardine Offshore Wind Farm
Project Type	Floating Offshore Wind
Coexistence Type	Colocation
Fishing and Navigation Allowed in OWF	Yes – outside of safety zones
Estimated Investment[32]	$445 million
Commissioning	2021
Location	Aberdeen Bay, Scotland
Installed Capacity	50 MW
Total Spatial Use	110 km^2
Production Units	6 turbines
Details	Vestas V164-0.525 (power 9500 kW, diameter 164 m) and Vestas V80-2.0 (power 2000 kW, diameter 80 m) 15 km from shore at 60-80 m depth

[29] Projects: Kincardine Offshore Wind Farm - Principle Power, Inc.
[30] World's largest floating wind power plant project completed (balkangreenenergynews.com)
[31] Kincardine Offshore Wind Farm | Tethys (pnnl.gov)
[32] Kincardine Floating Offshore Wind Farm, Scotland, UK (nsenergybusiness.com)

Specifications[29],[30],[31]	Details
Layout	 Source: The Financial Times

km = kilometer; km² = square kilometer; kW = kilowatt; m = meter; MW = megawatt

Stakeholders and Key Industries Involved: In the EIA, KWOL identified scallop, squid, creel (crabs and lobsters), and demersal trawl fisheries as the most relevant industries.

- Fishing representative organizations;
- Fishing and marine government departments;
- Statutory bodies;
- Local planning authorities;
- Non-governmental organizations (NGOs);
- Others as the project develops (KOWL Fisheries Management and Mitigation Strategy, 2019)

Approach to Coexistence: The coexistence approach in this case is **colocation**. To facilitate this, the Project focused on proactive communications through stakeholder engagement and a Fisheries Liaison Officer, compensation and investment in the fisheries industry, and a project design that focused on safety for fishing activities. Further details can be found in the project's Fisheries Management and Mitigation Strategy (FMMS).[33]

[33] FMMS - Kincardine Offshore Wind Project

Enabling Conditions:

- *Communication*: Like other projects, Kincardine established a Fisheries Liaison Officer to support proactive engagement with stakeholders and developed FMMS. The FMMS lays out a full communications plan for engaging stakeholders throughout the life of the project. As of the time of its drafting, it indicates significant efforts to bring stakeholders along throughout the project development process. It also establishes a regional working group for collaborative discussions.
- *Compensation:* The FMMS includes a commitment to compensate fishers when removing or relocating static fishing gear during operations[34]. The Project also committed to investing in a fishing community fund to support local fishing communities to improve facilities and health and safety of the industry[35].
- *Coexistence-first Project Design:* The Project took steps to ensure that cables were suitably buried and other safety measures were in place (e.g., marking and lighting of structures) to ensure fishing could be done safely.

A3.3.4 UNITED STATES: OREGON FISHERMEN'S CABLE COMMITTEE

A 1995 submarine telecommunications project created concerns among the fishing industry about the loss of productive fishing areas and liability for submarine cables laid for the project. In response to these concerns, the fishing industry created the Oregon Fishermen's Cable Committee (OFCC) to negotiate an agreement to limit fishermen's liability for fiber optic cable damages and to provide compensation for damaged fishing gear. The specifications and details of the project are presented in Table 8 (Moura et al., 2015*).

TABLE 8: OREGON PROJECT SPECIFICATIONS

Specifications	Details
Project Name	NorthStar Cable
Project Type	Submarine Telecommunications
Fishing and Navigation Allowed in OWF	Yes
Coexistence Type	Colocation
Estimated Investment	NA
Commissioning	July 1998
Location	Nedonna Beach, Oregon
Installed Capacity	NA
Total Spatial Use	NA
Production Units	NA

[34] KIN-PL-MEM-KO-0002 Fishing Engagement Plan V1 ISSUE
[35] Kincardine Offshore Windfarm - Environmental Statement and Appendices | marine.gov.scot

Specifications	Details
Details[36]	2,500 km cable Cables were buried in water depths ranging from 0.5 m to 1500
Layout	NA

km = kilometer; m = meter; NA = not available

Stakeholders and Key Industries Involved:

- Trawl fishermen
- AT&T and other telecommunications stakeholders

Approach to Coexistence: The OFCC extends from Washington to California and conducts ongoing collaboration and information sharing with cable-laying entities. It provides a 24-hour hotline for fishermen who experience cable snags, upholds a cable damage liability waiver for OFCC-registered vessels, and supports cable companies with charter vessels for security and patrols. The OFCC also supports cable-laying companies with site selection and has established a fund for fishing gear replacement.

The coexistence approach, in this case, is based on **colocation** with some elements of symbiotic use-sharing services like the chartered vessels and support for site selection. Given the initial objectives of the OFCC, co-location can be identified as the primary approach, with symbiotic use as a shared benefit for both industries.

Enabling Conditions:

- *Communication:* OFCC facilitates consultation between the telecommunications industry and fishermen about cable siting and developments. Importantly, the OFCC also establishes Memoranda of Understanding with cable companies. These agreements outline goals for engagement with fishermen, communication protocols, and dispute resolution.
- *Coexistence-first Project Design:* By collaborating early in the site selection process, the OFCC helps advise cable companies on siting. Fishermen support the telecommunications industry by conducting cable route surveys and generating buy-in and trust before project construction begins.
- *Local Benefits:* The OFCC oversees a fund provided by cable companies to compensate fishermen for lost gear. Also, the OFCC provides cable companies with personnel and vessels as guards and patrols from its registered members.

A3.4 REPURPOSING

A3.4.1 UNITED STATES: RECREATIONAL FISHING, BIODIVERSITY, AND OIL AND GAS PLATFORMS IN THE GULF OF MEXICO

This case is relevant to multiple projects throughout the Gulf of Mexico in Federal Outer Continental Shelf. The activities are focused on the decommissioning of offshore projects,

[36] northstar_installation_report (ofcc.com)

specifically offshore oil and gas (O&G), though the lessons can be applied to offshore wind. The specifications and details of the project are presented in Table 9 (Lukić et al. 2023).

TABLE 9: GULF OF MEXICO PROJECT SPECIFICATIONS

Specifications	Details
Project Name	Multiple projects throughout the Gulf of Mexico Region
Project Type	Offshore Oil and Gas
Fishing and Navigation Allowed in OWF	Yes (primarily recreational fishermen and divers in this case)
Co-existence Type	Repurposing
Estimated Investment	NA
Commissioning	NA
Location	Alabama, Florida, Louisiana, Mississippi, Texas
Installed Capacity	NA
Total Spatial Use	NA
Production Units	NA
Details	NA
Layout	NA

NA = not available

Stakeholders and Key Industries Involved: Given the wide geographic coverage of these projects, the recreational/tourism fishing industries of the states covered are all likely to be impacted to varying degrees. Noted stakeholders include:

- Environmental NGOs
- Bureau of Safety and Environmental Enforcement (BSEE)
- Artificial reef programs by the states of Alabama, Florida, Mississippi, Louisiana, Texas

Approach to Coexistence: Typically, when offshore oil production leases expire or production ceases, companies must decommission and remove their facilities and equipment, ensuring the seabed is cleared of any obstructions. However, BSEE has a coexistence approach that allows energy companies to minimize decommissioning costs while improving relations with the recreational/tourism fishing industry and conservation groups. The Rigs-to-Reef program allows operators to work with BSEE and the relevant state to transfer ownership of the decommissioned infrastructure to the state's artificial reef programs. Artificial reefs attract diving and recreational fishing by increasing the population of different species of fish.

The Rigs-to-Reef programs fall under a **repurposing** definition of coexistence where ocean users use the same space subsequently, rather than simultaneously.

Enabling Conditions:

- *Cooperation*
  - Federal and State Partnerships: This approach benefits from a clearly defined national policy that recognizes the potential benefits of artificial reefs that O&G platforms can provide. The BSEE also established a standard procedure for the conversion of the platforms to ensure timely and safe conversion.
  - Support from Diverse Sectors: The project has resulted in enhanced marine life activity, which has generated further engagement from recreational fishing and environmental NGOs to advance the program. The O&G industry equally supports the initiative due to the significant reduction in decommissioning costs.
- *Capacity*: Each Rigs-to-Reef program has its own plan and coordinator to allow states to engage more effectively than if there were a singular program managed at the regional level. This allows each state to determine which sites are appropriate for reef conversion and to work with the operator to design a site-specific decommissioning plan.

A3.5 NATURE-INCLUSIVE DESIGN

A3.5.1 NETHERLANDS: NATURE ENHANCEMENT IN OFFSHORE WIND FARMS

This case is relevant to multiple projects throughout the Dutch North Sea. The activities are focused on six different OWF areas with at least 10 different Nature Enhancement projects. The first pilot location in 2018 was in the Eneco Luchterduinen Offshore Wind Farm, 23 km off the coast at Noordwijk aan Zee. The specifications and details of the project are presented in Table 10 (Lukić et al. 2023).

TABLE 10: NETHERLANDS PROJECT SPECIFICATIONS

Specifications	Details
Project Name	Multiple projects throughout the Dutch North Sea
Project Type	Offshore Wind
Fishing and Navigation Allowed in OWF	Not at this time – purpose is replenishing populations, passive fisheries (e.g., pots or creels) may be an option in the future
Coexistence Type	NiD
Estimated Investment	NA
Commissioning	NA
Location	Netherlands
Installed Capacity	NA
Total Spatial Use	NA
Production Units	NA
Details	NA
Turbine Layout	NA – multiple sites

NA = not available

Stakeholders and Key Industries Involved:

- Shellfish farmers
- Fishermen
- Rich North Sea project initiated by two NGOs: Stichting de Noordzee (North Sea Foundation) and Naturr & Milieu (Dutch Nature and Environment Foundation)
- Wind farm owners
- Offshore installation companies

Approach to Coexistence: Due to the installation of wind farms and other activity, the Dutch North Sea ecosystem is considered "degraded" and natural flat oyster reefs have disappeared. The installation of wind farms has changed the ecosystem, including acting as artificial reefs, which has changed the species' populations in the wind farms and surrounding waters. While artificial reefs are beneficial to these species, this does not necessarily mitigate negative impacts of wind farms posed by increased turbidity, vibrations, and noise pollution. Through nature enhancement programs, active restoration efforts have added hard substrate for oyster restoration, pipe reef building, fish hotels, NiD, and scour protection for reefs. While the primary goal is nature enhancement rather than boosting commercial fishing, it may be an option in the future to support fishing industries. Thus, nature enhancement could be considered as a potential means to achieve improved conditions for the fisheries industry.

In this case, coexistence falls under the **NiD** approach, with a focus on enriching the North Sea ecosystem and improving biodiversity.

Enabling Conditions:

- *Coexistence-First Project Design:*
  - Regulations – Developing nature enhancement regulations for OWF design and installation creates alignment with safety requirements and decommissioning requirements, creating opportunities for nature enhancement programs.
  - Tendering – Including nature enhancement as part of the tendering process promotes coexistence and ensures a fit-for-purpose design that meets the needs of the local conditions, habitat, history, and future prospects.
  - Technology – Ensuring the selection of suitable technology takes into consideration local environment and geomorphological conditions (e.g., some oyster cage types are not suitable for sandy environments). Technology selection considerations may include habitat types, species, and other conditions to mitigate negative effects.
- Cooperation:
  - Industry leadership – NGO leadership and the wind industry cooperate and are both interested in nature enhancement due to regulatory obligations and an inherent need for responsible use by all ocean users. Project costs are typically shared by all partners, highlighting that cooperation can further these objectives more quickly than working in silos.

- Access and Monitoring – Access to the wind farm for monitoring required careful planning to ensure safety while reducing costs and emissions. Similarly, cooperative monitoring plans of environmental restoration is fit-for-purpose to each project site.

A3.6 KEY TAKEAWAYS FOR MAINE

Based on the reviewed case studies, common themes related to coexistence and enabling conditions emerged relevant to the Gulf of Maine.

- **Coexistence-first Project Design** – Most chosen project sites minimized disruption to local fishing by either selecting areas where commercial fishing was already limited or limiting the construction phase to a short time period.
- **Language** – Coexistence is a general, umbrella term, with multiple meanings possible within it. In contrast to popular literature and less formal discussion, formal case studies are careful to call out specific types and meanings where possible. It is likely that different meanings will be attributed to the general term "coexistence" by stakeholders and, thus, specific typographies can and should be used when a specific type of coexistence is intended.
- **Communication** – Proactive communication, particularly early stakeholder engagement, has arguably been the most effective enabler of coexistence, playing a crucial role in building trust between stakeholders and industry. The reviewed cases all included engagement and communications around site location, project design and construction, operations, and safety. Many also included industry-to-industry communications between fishing leadership and project developers.
- **Local Benefits** – Once a developer understood the concerns and needs of the local fishing industries, ensuring local benefits often helped to address those concerns and needs. Methods used by many projects included compensation for lost income and damaged gear, as well as support of new business opportunities to help offset losses during periods of interruption. Opportunities included profit sharing for onshore facilities (e.g., fuel sales), employment of fishermen, and chartering of vessels for impact studies and security/guard patrols.
- **Cooperation** – Coexistence efforts, especially those for multipurpose and NiD type projects, benefitted from the support of federal, state, and local governments, as well as from NGOs, academia, and industry (wind, fishing, and others). Developers contributed by funding liaisons and representatives and by supporting government efforts to establish agreements among various stakeholders.

A3.7 GAPS IN AVAILABLE CASE STUDIES

Three key gaps in understanding coexistence specific to FOW have been identified through this case study review:

- <u>Nascent FOW</u> – Because the FOW industry is relatively new, no academic case studies related to coexistence are available for existing FOW projects. Projects are coming online in different countries (e.g., Norway and Portugal), and solid information regarding how these projects are managing interaction with fisheries is yet to emerge.

- Limited existing case studies and academic literature – There are limited English-language case studies and academic literature on FOW projects. Where possible, they have been supplemented with publicly available project information and media.
- Lack of geographic diversity of existing case studies – Current case studies in English that cover coexistence tend to focus on North America and the North Sea, particularly in the Netherlands and the UK. This limits the types of coexistence seen in the case studies and therefore limits the lessons that can be taken from them.

These research gaps indicate that expert interviews are needed to gather information about projects for which there may not be formal case studies or academic literature.

A4. REGULATORY REQUIREMENTS

This section discusses regulations and other requirements focused on the complex interplay between fishing activities and FOW projects. As offshore energy development expands, particularly in designated areas like those proposed for FOW, it becomes imperative to address the potential conflicts between FOW development and the fishing industry. This study reviewed regulations, policies, laws, and literature relevant to OWFs including both FOW, and monopiles, as well as offshore O&G structures. This review included studies conducted in the US and internationally (OSW developments are currently more common in other regions such as the North Sea). The review identified three categories of concern: impacts on the marine environment (Section A4.1), access to wind energy areas (WEA; Section A4.2), and financial considerations (Section A4.3). Each of the following sections focuses on one of the categories, detailing the relevant concerns from the fisheries, examining regulations both within and outside of the US, and presenting gaps and recommendations that were identified through the review of the literature. This is a preliminary review of existing regulations relevant to the Project and is subject to change.

A4.1 IMPACTS TO THE MARINE ENVIRONMENT

Existing research on the impacts on the marine environment from FOW are limited. Research and regulations on fixed bottom OWFs, other marine renewable energy developments, and decommissioned O&G structures were leveraged. This section focuses on any available information pertaining to FOW, but also explores the research, regulations and policies, and provides a summary of recommendations identified in the literature that were developed for other marine infrastructure.

Impacts on the marine environment from marine structures can vary widely, ranging from sound emissions during construction that affects marine mammals, to decreases in total fish populations during decommissioning after serving as de facto artificial reef structures (DeGraer et al. 2019*, Methratta et al. 2020*, Sih et al. 2022*). The impacts can influence marine life in a variety of ways, both positively and negatively, within the vicinity of the structures. Regulations often help mitigate these impacts by setting limits on the acceptable level of environmental impact.

A4.1.1 ACTING AS ARTIFICIAL REEFS

There is evidence of FOW turbine structures serving as fish aggregating devices (FAD) which can increase catchability for some species. Limited entry and access to the WEA (concerns regarding access to the WEA are discussed in Section A4.2) can further amplify fishery catch near FADs by protecting juvenile fish that are drawn to the underwater structure, aiding in population growth. Acting as artificial reefs, OWFs could have the same benefits as natural coral reefs including nature enhancement. The catch rates of some tuna species may be 10 to 100 times greater near FADs than in open water areas. FADs also increase the propensity of some species to remain in a particular area, like the "reef effect" that has been noticed in monopile OWFs (Fayram and de Risi2007*, Degraer et al. 2020*). Within the Adriatic Sea, there are concerns that the OWFs act as FADs, potentially leading to overfishing in those areas (Fayram and de Risi 2007*).

Though artificial reef creation can be viewed as a benefit, there are also some concerns about the OWFs acting as artificial reefs, as they can become a nuisance to nature with the unpredictable effects of altering a previously balanced ecosystem. Structures are sometimes added-on to promote fish habitat (e.g., fish hotels). These structures contribute to ocean sprawl, which is the removal or transformation of marine habitats (DeGraer et al. 2020*). The cascading effects of transforming an ecosystem are nuanced and location-specific, and often difficult to predict.

A4.1.2 CREATION OF MARINE PROTECTED AREAS

The literature suggests that one way to protect fish populations near the WEA is to establish a Marine Protected Area (MPA); an area where there are limits on human activity. Commercial fishing is an important factor in siting WEAs to minimize overlap with the heaviest areas of activity and yield, and would thus help to minimize impacts if an additional MPA is deemed appropriate. The establishment of an MPA would benefit recreational anglers, commercial fishermen, and fisheries managers with increased yield since it can provide protection, especially for juvenile fish. While the establishment of an MPA could lead to more competition in other areas with less space to fish in, it could be beneficial in managing fish populations.

There are caveats to the MPA approach, including that MPAs mainly benefit fisheries that target non-migratory species. There is also a concern that OWFs provide opportunities for non-indigenous species to strengthen their populations, potentially posing a threat to indigenous marine species and subtidal communities. At the Block Island Wind Farm, non-indigenous ascidian *Didemnum vexillum* rapidly multiplied and were observed on both the foundation structure and as an epibiont (i.e., an organism living on the surface of another organism) to the mussels. The threat to indigenous marine species and subtidal communities has yet to be demonstrated from an OSW development (Degraer et al. 2020*). Understanding both the negative and positive impacts of these structures, as well as the regulations that govern their effects on the marine environment, is vital in assessing the coexistence between fisheries and FOW.

A4.1.3 IMPACTS ON BENTHIC SPECIES AND SPAWNING ACTIVITIES

Some of the concerns raised by fishermen about the impacts of FOW within the Gulf of Maine include the effects of the electromagnetic fields (EMF) and heat from cables on the benthic environment and organisms. Inter-array cables that are laid in or on the seabed with protection emit EMFs which can be sensed by benthic species. EMFs have been linked to changes in behavioral activity such as migration and foraging. The impact of EMF is dependent on the species present, as well as the life cycle stage of the organism. FOW has inter-array cables in the water column, which introduce EMFs into the pelagic zone, unique from monopile OWFs (Hutchison et al. 2020*). There is a gap in the research on the relationship between migratory species and EMFs, including the potential influence of homing and associated reproduction. Species-specific natural experiments are necessary to understand the impacts of FOW on an environment (Hutchison et al. 2020*).

While OWF construction does not seem to affect the morphological features of the seabed permanently during construction, there are concerns that fish are temporally displaced and reduced and the natural processes and structures are disturbed. There could also be adverse effects on fish roe and fish spawning activities (for example Atlantic Cod) due to the turbidity and sedimentation caused by construction (Al Arif and Anchustegui 2022*, Corell et al. 2023*). Unlike fixed-bottom OWF, FOW does not require pile driving, which is one of the most environmentally impactful practices associated with fixed-bottom OWFs due to the high noise levels emitted. The noise can cause the displacement and injury of marine mammals, as well as fish displacement (Farr et al. 2021*). However, increased turbidity and sedimentation are still expected from the construction of FOW.

A4.1.4 IMPACTS FROM SURVEYS, CONSTRUCTION AND OPERATION ACTIVITIES

There are concerns about the impacts of survey activities, OSW development, and OSW operation on wildlife including whales, and the effects on spawning migrations. The concerns about the baseline environment also include the impact of FOW on key circulation patterns, like the Gulf of Maine gyre (BOEM 2023). Looking specifically at North Atlantic right whales, there are concerns related to OSW activities including exposure to noise; strikes from vessels and shifted traffic due to OSW activities; entanglement from marine debris or appurtenances of FOW; and changes to habitat regarding abundance, quality, or availability of prey (BOEM and NOAA Fisheries 2024). The impacts on North Atlantic right whales are a particular concern to fishermen in the Gulf of Maine because protections for these whales have already led to several restrictions on the fishing industry including additional temporal and spatial closures or gear restrictions.

Concerns about impacts from surveys, construction, and operation activities have also been raised by fishermen from various other countries. For example, in an interview study, some Scottish fishermen were concerned that OWFs could negatively impact recruitment of target finfish species (Schupp et al. 2021*). Dutch fishermen expressed concern that the sound produced by OWFs, during both construction and operation, would deter fish, and that porpoises could be deafened, leading to mortality (Boffey 2018). It should be noted that the construction of FOWs does not produce the sound associated with pile driving during construction, unlike the construction of fixed-bottom OSW.

All these concerns highlight the need for guidance, regulations, and policies that protect the marine environment and allow for the development of FOWs.

A4.1.5 RELEVANT LAWS, REGULATIONS, AND POLICIES

Throughout the world, many policies, regulations, and laws have been established that address the marine structures and the marine environment. These regulations aim to assist in the coexistence of a bountiful marine environment and structure development. In many cases, different countries' regulations coincide with each other, though there are some variations. For example, EIAs are often required; however unlike in many other countries where general assessments are sufficient, in Germany the requirements include monitoring fish before, during, and after installation (Bonsu et al. 2024*). The US has existing regulations that encompass impacts on the marine environment; however, as the US OSW industry is relatively new and emerging, the requirements for future projects are subject to change.

This section examines some examples of regulations from the US and other countries throughout the different phases of an OSW lifecycle from conception to decommissioning.

A4.1.5.1 PRE-CONSTRUCTION REGULATIONS

International Practices

EIA and Environmental Impact Statements are mandatory assessments that are required in various countries before OWF development can be approved. This includes the US regulations through the **National Environmental Policy Act** (NEPA)[37], and European Union countries regulations through the Maritime Spatial Planning Directive. While exact requirements for the EIAs vary between countries, the basic requirements generally include both socioeconomic and ecological impact assessments (Al Arif and Anchustegui 2022*, Bonsu et al. 2024*, Haggett et al. 2020*). Most of the impact assessments are carried out prior to the construction and installation of the OWFs. In some countries, an assessment during operation and at the decommissioning phase is needed. For example, impact assessments for countries adjacent to the North Sea also require a decommissioning plan to examine the effects on the marine environment and fishery activities (Al Arif and Anchustegui 2022*). Strategic Environmental/Impact Assessments are also sometimes required. These evaluate the impact of plans, including alternatives, to determine overlap, conflicts, and impacts on ecosystems, uses, and activities. This includes changes to fish communities, damage to benthic species, and social and economic impacts on fishing sectors (Bonsu et al. 2024*).

US-Specific Practices

In the US, Bureau of Ocean Energy Management (BOEM) has established a Wind Energy Commercial Leasing process to develop WEAs in the Outer Continental Shelf (OCS) of the US (BOEM 2021). For a WEA to be approved, BOEM first works with its federal, state, local, and tribal partners to identify areas that are most suitable for OSW activities, taking fishery activities into account. BOEM is legally mandated by the **Outer Continental Shelf Lands Act** (OCSLA)[38] to safeguard the environment and preserve the natural resources of the outer continental shelf. BOEM is obligated by statutes such as NEPA, National Historic Preservation Act, Endangered Species Act (ESA), and the Magnuson-Stevens Fishery Conservation and Management Act. According to BOEM's regulations, any OSW plan on the OCS must detail the potential impacts on biological, social, and economic resources stemming from proposed activities (BOEM 2019). Once the permitting stage is complete for an OSW project in the US, a Record of Decision is published by BOEM and other cooperating agencies, which lists several Terms and Conditions (T&C) that the project must adhere to. The T&C covers a range of different topics, including mitigation measures for potential interactions and impacts on the regional commercial fisheries industry. The specific T&C associated with four recent OSW projects related to commercial fisheries are listed in Attachment A-A, and a high-level summary of some relevant survey requirements stipulated in the T&Cs is provided below.

- **Advance Notice:** the T&C for the Empire Wind OSW Project, offshore of New York, includes conditions of approval stating that the Lessee must provide advanced notice of survey plans to the commercial fishing industry in the area.

[37] 42 United States Code (USC) § 4332 and 42 USC § 4321 et seq. 40 Code of Federal Regulations (CFR) Parts 1500-1508
[38] 43 USC. § 1337(p)

- **Results Sharing:** BOEM requires that the Lessee share the results from a trawl survey for finfish and squid and requires that they report all sightings of North Atlantic right whales.
- **Survey Type and Timing:** per BOEM requirements, the trawl survey must occur a minimum of 1 year before, 1 year during, and 3 years after the construction of the OWF both within the Project footprint as well as at control sites (BOEM 2023, 2021). For the Vineyard Wind Project, BOEM required ventless trap surveys at the same frequency as the trawl surveys, following the protocols of the coast-wide ventless trap survey.[39] This includes six traps alternating between vented and ventless. To alleviate the concerns of entanglement for North Atlantic right whales, the traps must use weak-link technology, and not be conducted between November and early May when they are likely to be in the area.
- **Population Monitoring:** the Vineyard Wind OSW Project is required to tag lobsters, which it was already doing voluntarily, and record any instances of re-capture (BOEM 2021).
- **Survey Mitigation Agreement:** in the T&C for New England Wind, offshore of Massachusetts, BOEM stated that since there are 14 National Marine Fisheries Service surveys that are impacted by the WEA, the Lessee is required to submit a Survey Mitigation Agreement (BOEM 2024). These surveys are often used to determine the stocks and available catch limits of different species for commercial fisheries, indicating that a disruption in these surveys could lead to a negative impact on commercial fisheries.

Though these T&C are not technically federal or state law, they are examples of some of the common conditions of approval that BOEM requires for OSW development. More specific details on T&C related to commercial fisheries for the projects mentioned above are provided in Attachment A-A.

In addition, National Oceanic and Atmospheric Administration (NOAA) Fisheries, in conjunction with NEPA, requires an **Essential Fish Habitat** (EFH)[40] assessment through the **Magnuson-Stevens Fishery Conservation and Management Act** and the **Fish and Wildlife Coordination Act**[41]. This assessment is in response to any action that could adversely affect EFH, crucial for spawning, breeding, feeding, or growth to maturity of federally managed fisheries.

Under the **ESA** [42], a biological assessment is also required for any action that could potentially affect endangered species. This is followed by a formal consultation that culminates in the issuance of a Biological Opinion, which is provided after the final Environmental Impact Statement is completed. This regulation was developed to assess any action that may lead to the take or harassment of endangered or threatened species. Specifically, in the Gulf of Maine this includes, for example, sea turtles and North Atlantic right whales. The ESA is similar to the **Marine Mammal Protection Act**[43], which requires an **Incidental Take Authorization** or a Letter of Authorization to be submitted to the relevant agency concerning any action that may lead to the take or harassment of marine mammals. In the Gulf of Maine, this amounts to the federal protection of whales, dolphins, porpoises, and seals. There are also implications of modified

[39] Vineyard Wind - Conditions of Construction and Operations Plan Approval
[40] 50 CFR § 600
[41] 16 USC § 1855
[42] 16 USC § 1536
[43] 16 USC 1361 et seq.

assessments for species like black sea bass, summer flounder, Atlantic Sea scallops, and longfin squid (Methratta et al. 2020*).

A4.1.5.2 CONSTRUCTION REGULATIONS

There are regulations associated with the construction and installation of OWFs to reduce the negative construction impacts of OWFs. For OWFs with pile-driven foundation types, the Belgian Marine Strategy Framework Directive Article 8 advises testing sound mitigation measures before the construction work starts to reduce the number of marine animals disrupted (DeGraer et al. 2019*).

A similar regulation exists within the US, tied to the ESA and Marine Mammal Protection Act; noise mitigation measures and vessel speed restrictions are required during construction to help protect large mammals, like the North Atlantic right whale and endangered finfish like the Atlantic sturgeon, regardless of the type of OSW structure (Methratta et al. 2020*). With FOW, the floating structures can be constructed onshore and transported out to sea, reducing the impacts of construction-related noise and vessels.

A4.1.5.3 OPERATION REGULATIONS

There are regulations that mandate monitoring and research throughout the OWF lifespan.

US Regulations

The US federal government recommends guidelines for conducting fishery monitoring activities, with spatial boundary delineation for fishery management highlighted in the **Magnuson-Stevens Fishery Conservation and Management Act**[44] (Gill et al. 2020*). Recently, BOEM and NOAA have been working together to create the North Atlantic Right Whale and Offshore Wind Strategy. This strategy "…provides guidance for a coordinated effort across the federal government and with agency partners to protect and promote the recovery of North Atlantic right whales and other marine life, while responsibly developing offshore wind energy to address the climate crisis"[45]. It highlights three main goals: a) mitigation and decision-support tools; b) research and monitoring; and c) collaboration, communication, and outreach. Immediate impact mitigation efforts include guiding developers on conducting sound field verification to ensure that expected noise levels from OWFs do not exceed acceptable thresholds.

Other agencies have also contributed to this strategy, including the Department of Energy by supporting the development of technologies that can detect, monitor, and avoid negative interactions between marine mammals and OWFs. In addition, the Center for Enterprise Modernization is supporting the development of technologies and engineering approaches related to whale detection, vessel strike avoidance, and on-demand or "ropeless" fishing gear[46] . While working on this strategy, BOEM and NOAA proposed to create the Offshore Wind Strategy Implementation Group, to allow monitoring of North Atlantic right whales and to regularly engage with partners, tribes, and stakeholders (Brzozowski 2024). Some state governments in the US

---

[44] 50 CFR § 600
[45] NOAA, BOEM Announce Final North Atlantic Right Whale and Offshore Wind Strategy
[46] NOAA, BOEM Announce Final North Atlantic Right Whale and Offshore Wind Strategy

have enacted fishery research and monitoring policies that address state-level concerns and focus on individual projects, regardless of the transboundary nature of fisheries and marine resources.

Regulation of Other Countries

In the European Union, there are a variety of monitoring and research requirements among the various nations under the **European Directives** that require formal monitoring of the environmental impacts of each offshore energy development. These monitoring efforts center around the **Birds Directive** (2009/147/EC), the **Habitats Directive** (92/43/EEC), and the **Environmental Impact Assessment Directive** as a cumulative impact assessment. Australia has similar requirements for formal monitoring and research through the **Australian Environment Protection and Biodiversity Conservation Act** of 1999.

In all cases, environmental legislation for monitoring and research continues to shift from a species-centric to an ecosystem-based focus, allowing for more integrated assessments. These integrated assessments should be framed in societally meaningful terms; for example, whether seafood resources will be sustainable over time (Gill et al. 2020*; Wilding et al. 2017*).

A4.1.5.4 DECOMISSIONING REGULATIONS

As stated in Section A4.1.5.1, some countries bordering the North Sea require the decommissioning plan impact assessment to examine the effects on the marine environment and fishery activities (Al Arif and Anchustegui 2022*). In the US, BOEM's regulations[47] state that all plans, including construction and operation plans, must include a conceptual description of decommissioning methodologies. Before decommissioning can occur, a decommissioning plan and application must be submitted for environmental and technical review[48]. This plan will be reviewed under the consideration of the applicable laws and regulations and best management practices (BOEM and NOAA Fisheries 2024).

A4.1.6 EXISTING GAPS AND LITERATURE RECOMMENDATIONS

The largest gap identified was the lack of knowledge and experience in implementing regulations specific to FOW. Most of the available information pertained to monopile OWFs and other offshore activities. These gaps range from the need to better understand how individual FOW fits within the current regulations, to the need for additional research on a variety of topics, which are further outlined below. The identified gaps in knowledge and existing regulations provide guidance for future work required for coexistence between FOW and the marine environment.

A4.1.6.1 REGULATION GAPS

Specific gaps in existing regulations were identified, as summarized below:

- Lack of regulations for recreational fisheries within the OWF (Fayram and de Risi 2007*).
- As discussed above, some regulations exist on the impacts of OSW developments on the marine environment, and T&C have been established for current projects in the US waters,

[47] 30 CFR 585
[48] 30 CFR 285 subpart I

including monitoring requirements; however, modifications to regulations are recommended to address new technologies associated with FOW and how they interact with fisheries.

- As discussed in Section A4.1.5.4, existing regulations lack details concerning the decommissioning of the OWFs (Al Arif and Anchustegui 2022*).
- Existing regulations can be improved by considering the scheduling of specific construction, maintenance, or decommissioning activities around key fishery seasons and life cycle stages, such as spawning periods. This regulatory gap is often addressed through a project's T&C that are published in the Record of Decision by BOEM, or through the EFH consultation. The consultation results in conservation recommendations that include suggested schedules for OSW activities that avoid key seasons for local species.

As the OSW industry evolves, regulations are continuously updated and refined to address emerging challenges and fill previously identified gaps. This dynamic regulatory environment is essential for integrating technological advancement, new scientific data and best practices, environmental concerns, and stakeholder needs.

A4.1.6.2 KNOWLEDGE GAPS

In addition to the identified gaps in regulations, there are also gaps in the technical research. These gaps in knowledge include a lack of detailed analyses of OWF impacts during construction (Al Arif and Anchustegui 2022*), operation – like how EMFs from FOW may impact pelagic species (Farr et al. 2021*), and decommissioning (Sih et al. 2022*). There are also knowledge gaps about how the ecology is impacted by spillover effects from artificial reefs, as well as a general lack of understanding of the benthic-ecosystem-industry interactions (Bonsu et al. 2024*; Wilding et al. 2017*). There is an incomplete understanding of how different OSW foundation types impact the ecosystem, concerning how OWF foundations can act as artificial reefs for marine life. The introduction of artificial reefs with OSW foundations could lead to the expansion of nonindigenous marine species, which could be harmful to the indigenous marine species (DeGraer et al. 2020*). The impact of OWFs on indigenous marine species, like the bluefin tuna in Maine, is also not well understood (DeGraer et al. 2020*; Brzozowski 2024). Another key knowledge gap is the long-term effect of OWFs on fishery resources (Granit and Andrén 2023*).

Thus, while there is a need for additional monitoring and diverse types of monitoring, it is important to acknowledge the significant investment in government-supported and voluntary industry projects aimed at addressing these information gaps and delivering broader public benefits. Regulations require monitoring of various aspects of the marine environment; however, Wilding et al. (2017)* describe these monitoring programs as deficient in the identification of spatially and temporally delimited metrics, development-specific, and thus not encompassing the greater area of potential impact, or population-scale changes. Granit and Andrén (2023)* and Wilding et al. (2017)* identify there are many disruptions in monitoring events, including fishery surveys being deemed unusable due to interruption from OWF development. However, project-specific T&C like those that were implemented for Vineyard Wind and Empire Wind in the US often fill the gaps that exist on a local level, by requiring site monitoring events and surveys.

All these gaps, while not directly pertaining to FOW, provide insight into what is needed to better understand and establish coexistence between FOW, the marine environment, and fisheries.

A4.1.6.3 LITERATURE RECOMMENDATIONS

Outside of the gaps in regulations, the literature consistently recommends potential changes or additions to policies to protect the marine environment. For example, the literature recommends considering implementing limits on recreational and commercial fishing within the vicinities of OWFs because there is a risk that overfishing may occur due to the increased catchability near the OWFs. To protect the marine environment, the literature recommends establishing regulations to prevent overfishing, for example:

- **Permit Systems** to regulate recreational fishing, with the cost and difficulty of obtaining the permit being offset by the increased catch rates.
- **Commercial fishing limits** to mitigate the risk of overfishing, benefiting recreational and commercial fishermen by improving catch rates and yield, and aiding fishery managers in controlling recreational harvesting. However, if prime fishing grounds become more regulated after a project is developed nearby, this could force commercial fisheries to travel further or rely more heavily on already congested fishing areas. These regulations could also benefit the OWF owners by reducing the potential risk of damage to structures (Fayram and de Risi 2007*).
- **Establishing MPAs** that limit access to the waters surrounding the FOW facility to recreational fishermen (see Section A4.1). Commercial fisheries may be hesitant to deploy equipment, including long lines, gillnets, and bottom trawls near FOW equipment, regardless of the existence of an MPA due to the fear of damages and/or safety concerns. Limiting access to recreational fishers, who typically are not as regulated as commercial fisheries, would allow for the total harvest to be more closely controlled, thusthe fishery is more likely to be sustainably managed (Fayram and de Risi 2007*).

A4.2 ACCESS TO WIND ENERGY AREAS

The fishing industry is concerned that FOW development will restrict access to fishing within the Gulf of Maine. FOW development creates challenges for the fishing industry, including 1) potentially restricting access to traditional fishing grounds, 2) altering navigational routes, and 3) creating safety concerns. Countries with OSW structures near fishing operations have taken different approaches to establishing coexistence from an access perspective through regulations, laws, policies, or programs tailored to the fisheries. To facilitate coexistence, it is imperative to establish clear regulations that protect both the fishing industry and the OSW developer. Existing laws, regulations, and policies in the US (Sections A4.2.4.1 and A4.2.4.2), as well as guidelines from non-US entities (Section A4.2.4.3), can be studied to support developing sustainable coexistence of fisheries and FOW.

A4.2.1 ACCESS TO FISHING AREA

The proposed FOW development in the Gulf of Maine has received opposition from the commercial fishing community because of perceived restrictions to areas where they would typically fish.

Publication of the WEA by BOEM in March 2024[49] narrowed the potential FOW development areas, to address this concern.

Fishing activities are prohibited or strictly limited within European OWFs as described in Section A4.2.4.3 below. The development of OWFs and exclusion zones causes the available surface area for fishing to decrease. This reduction leads to concerns among fishermen about losing fishing areas, potentially leading to a decrease in catch and profitability, as well as sociocultural conflicts due to the loss of traditionally significant fishing grounds (DeGraer et al. 2019*, Al Arif and Anchustegui 2022*). Another access-related concern is the potential loss of fishing grounds due to the development of OSW projects causing spillover effects, such as overfishing in other areas (e.g., if fishing is restricted in the FOW farm, more fishing might occur in adjacent areas) (Fayram and de Risi 2007*). This can pose significant socioeconomic, environmental and conservation threats, which were discussed in Section A4.1.

A4.2.2 NAVIGATIONAL RISK

A second concern from the fishing industry is navigational risks and limitations imposed by FOW because OWFs may obstruct sea lanes and navigation pathways leading to conflicts over maritime space (Al Arif and Anchustegui 2022*). Development of FOW may also limit the available space for fishing, thus creating congestion and competition for resources, not only within fisheries but also with other sea users such as maritime transport vessels and recreational boaters, consequently increasing navigational risk.

In addition, FOW structures have a larger footprint than what is visible above the water surface due to the anchors that extend away from the individual turbines (Figure 1). Unlike monopiles that are anchored into the sea floor directly beneath the turbine tower, FOW turbines are secured with mooring lines that extend away from the tower, in the water column, to the seafloor with anchoring systems. These structures can also cause challenges for different fishing types. For instance, pelagic fishing, which involves unpredictable movement patterns and large trawl gear, faces difficulties navigating and increased risks within the OWFs (Granit and Andrén 2023*).

[49] This report was developed in March–June 2024.

FIGURE 1: WIND TURBINE SCHEMATIC

Note: Floating turbines have a larger footprint than what is visible above the water. The three turbines on the right are fixed-bottom structures and the three turbines on the left are floating. From left to right, the structure types are: Monopile, Jacket, Twisted Tripod, Floating Semi-Submersible, Floating Tension Leg Platform, and Floating Spar.

Source: Illustration by Josh Bauer/NREL – Department of Energy

A4.2.3 SAFETY OF FISHING

A third area of concern is the safety of fishing within the vicinity of offshore structures, with the main safety concern being risk of entanglement. Entanglement of various gear types (e.g., long lines, gillnets, and trawls) with components of the OSW structures (e.g., anchoring structures and underwater cables), can result in damage to the equipment, ship, and infrastructure, and potential injuries or fatalities (Fayram and de Risi 2007*, Hagget et al. 2020*, Rouse et al. 2020*, Granit and Andrén 2023*). Some marine entanglement events have resulted in serious damage to vessels. For example, in the UK, vessels "Westhaven" and "Harvest Hope" sank, resulting in fatalities, when their trawl doors and tickler chains became snared on sub-surface O&G equipment. Other entanglements causing financial losses and damage have likely occurred, but the Marine Accident Investigation Board in the UK only requires reporting of serious incidents with injuries, fatalities, and near-misses (Rouse et al., 2020*). Other snagging incidents likely occurred, which "could have" resulted in the fatal outcome of the "Westhaven" and the "Harvest Hope", but without the reporting requirement, these are not noted. Though this example is in the UK, it demonstrates the valid concern of fishermen on the lack of regulations surrounding safety and reporting incidents. Other noted safety concerns related to navigation for both commercial and recreational fishermen and potential licensing demands from developers, which restrict fishing activities within the wind farm areas to mitigate risks (Hagget et al. 2020*). Additional regulations related to navigation are discussed in Section A4.2.4.3.

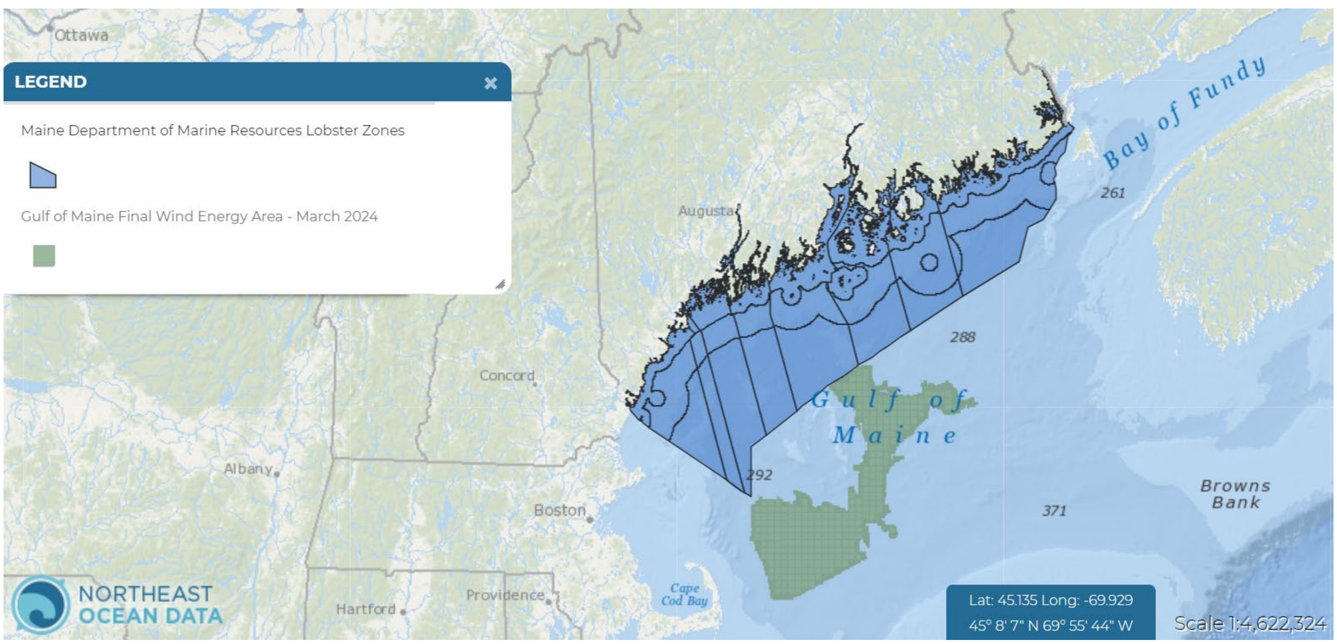
A4.2.4 RELEVANT LAWS, REGULATIONS, AND POLICIES

To evaluate the potential for coexistence and to address the fishermen's concerns regarding access to traditional fishing grounds, the relevant laws and regulations have been summarized for Maine (Section A4.2.4.1), the US (Section A4.2.4.2) and non-US entities (Section A4.2.4.3).

A4.2.4.1 STATE REGULATIONS ON ACCESS

Maine has a few regulations related to OSW developments and fishing access. As mentioned in Table 11, LD 1619 'An Act to Prohibit Offshore Wind Power Development in Territorial Waters and Submerged Lands of the State' passed in 2021, prohibits OSW development in state waters; the WEA is sited in federal waters of the Gulf of Maine more than 3 miles offshore. Pertaining specifically to the WEA, in March 2024, Governor Janet Mills and state congressional leaders praised the decision by BOEM to exclude the entirety of Lobster Management Area 1 from the WEA for the Project (Figure 2). This area is a crucial fishing ground for Maine's lobster industry. The exclusion from the WEA is a result of prior ongoing requests from Governor Mills, Senators Angus King and Susan Collins, and Representatives Chellie Pingree (ME-01) and Jared Golden (ME-02) (Popp 2024) in response to advocacy by the lobster industry. Other state-specific legislation that pertains to access are included in Table 11.

FIGURE 2: MAP OF THE LOBSTER MANAGEMENT AREAS AND THE WEA



Source: Northeast Ocean Data Portal – Data Explorer[50]

Note: The final WEA shown in dark green does not overlap with Lobster Management Area 1.

[50] Data Explorer | Northeast Ocean Data Portal

TABLE 11: MAINE REGULATIONS ON ACCESS

Law or Regulation	Regulating Agency	Action	Relevance to the Project
An Act to Prohibit Offshore Wind Power Development in Territorial Waters and Submerged Lands of the State[51]	Maine State Legislature	"A state agency or municipality or other political subdivision of the State may not license, permit or otherwise approve or authorize the siting, construction or operation of or issue a lease or grant an easement or other real property interest for a windmill or wind turbine or tower for an offshore wind power project in state-owned submerged lands or territorial waters"	OSW projects must be in federal waters in the Gulf of Maine (more than 3 miles off the coast of Maine), which is true for the approved WEA. This law that Governor Mills signed in July 2021 prioritizes the use of state waters for recreation and fishing. Up to an estimated 75% of Maine's commercial lobster harvesting occurs within the State's territorial waters. This law is not absolute in that it allows for the authorizations for utility cables or transmission lines to support the generation of electricity from OWFs.
The Maine Wind Energy Act[52]	Maine State Legislature	"If, in reviewing a proposed commercial lease for a wind energy development for any purpose other than scientific research or technological development to be located in federal waters within Lobster Management Area 1, the United States Department of the Interior, Bureau of Ocean Energy Management determines that the wind energy development would have a significant adverse impact on fisheries, the State shall request that the Bureau of Ocean Energy Management work to minimize that impact."	As stated in Section A4.2.4.1 above, the WEA does not include Lobster Management Area 1, making this Act irrelevant to FOW development.
Submerged and Intertidal Lands Owned by State[53]	Maine State Legislature	"…the proposed lease will not unreasonably interfere with navigation; will not unreasonably interfere with fishing or other existing marine uses of the area; will not unreasonably diminish the availability of services and facilities necessary for commercial marine activities; and will not unreasonably interfere with ingress and egress of riparian owners."	The FOW development cannot have significant impacts on entering or exiting navigable waters.

[51] P.L. 2021 c. 407, Section 2 [L.D. 1619]
[52] PL 2023, c. 481, §3 (RPR).
[53] PL 2009, c. 615, Pt. B, §1 (AMD); PL 2011, c. 657, Pt. W, §7 (REV); PL 2013, c. 405, Pt. A, §24 (REV)

A4.2.4.2 US FEDERAL REGULATIONS ON ACCESS

In addition to regulations specific to Maine, there are also federal laws that pertain to OSW development and fishing. The OCSLA[54] requires that OSW power projects assess their compatibility with other uses, such as commercial fishing. Additionally, it requires consulting and coordinating with other agencies, such as NOAA and the US Environmental Protection Agency to make a "public interest" determination regarding the obstructions in navigable water. This act is pertinent to the concern of access to the WEAs, as well as the safety of navigating these areas.

A4.2.4.3 REGULATIONS ON ACCESS FROM NON-US ENTITIES

Other entities (i.e., other countries and the United Nations [UN]) have some additional guidance on the access to OWFs. Governance practices and regulations differ across countries with various definitions of buffer zones around OWFs and turbine structures. Regulations and guidance range from strict fisheries prohibitions to mutual agreements to facilitate co-use.

United Nations Convention on the Law of the Sea

Article 60 in the United Nations Convention on the Law of the Sea (UNCLOS) addresses "artificial islands, installations, and structures in the exclusive economic zone". It also applies, with necessary modifications, "*mutatis mutandis",* to these structures on the continental shelf. This provision specifies that within the exclusive economic zone (a sea zone extending up to 200 nautical miles from a coastal state's baseline, within which the state has special rights regarding the exploration and use of marine resources), the coastal State may establish safety zones around said artificial structures to ensure the safety of navigation and of these structures. UNCLOS outlines that the breadth of the safety zones should be determined by the coastal State, considering applicable international standards. These zones should not extend beyond 500 m around the structure, "except as authorized by generally accepted international standards or as recommended by the competent international organization" (UNCLOS, 1982). All ships, including commercial fishing vessels, are required to respect these safety zones. While the Project WEA is sited outside of Maine's state submerged lands, the recommendation by the UN for the safety zones can be considered for the FOW development on the continental shelf with appropriate modifications.

OWF Buffer and Safety Zones in Other Countries

During the construction and maintenance phases, countries adopt similar safety distances as defined by the UNCLOS (500 m radius around turbines), while during the operation phase, safety distances vary greatly (Bonsu et al. 2024*). Examples of different regional safety zones are summarized below.

- In Scotland, The Marine Act 2010 and the UK Electricity Act 2004 support commercial fishing activities within Scottish OSW development areas and along the offshore export cable corridor (Schupp et al. 2021*). Safety zones of 500 m are established during construction, and safety zones of 50 m are implemented around installed infrastructure during operation to ensure that fishing activities can resume during operation, to some degree. The decision to fish within an

[54] 43 USC § 1333

operational OWF is up to the individual vessel skipper, responsible for the safety of the ship and crew (Schupp et al. 2021*).

- In Germany, the German Marine Spatial Plan designates "priority areas" to assign one maritime user precedence over other groups. These areas must abide by strict safety regulations, and fisheries are de facto not permitted inside the security zones of established OWFs (Schupp et al. 2021*). These two scenarios established in Scotland and Germany represent two extremes possible in regulating the access of OWFs ranging from co-use to partial exclusion.
- The UK, Sweden, Denmark, and Norway have no defined statutory safety zones around OSW turbines during operation; however, safety zones may be applied on a case-by-case basis.
  - In the UK and Sweden, operational safety zones are not mandatory, but developers have the option to apply for a 50-meter permanent safety zone around each structure.
  - In Denmark, 'cable protection zones' exist, which cover the entire WEA and a 200-meter buffer along each side of the export cables where access is restricted. To benefit the fisheries, conditional bottom trawling along the cable lines exists based on defined agreements (see Section A4.3.1).
  - In Norway, operational safety distances may be up to 500 m depending on the decision of the Norwegian Coastal Association and fishing is permitted in cable areas, facilitated by close collaboration between the cable owners and fishermen, promoting a co-use of this space.
  - In the Netherlands and Germany, the safety zones apply to a mix of individual structures and to the entire WEA (Bonsu et al. 2024*). The Netherlands has 'area passports' with guidelines to designate specific zones for co-location of fisheries and OWFs: 500-meter safety zones around wind farm areas with 250-meter maintenance zones around each monopile structure and both sides of infield cables are being implemented to allow for passive fisheries in offshore areas. Germany similarly allows passive fisheries during operation with safety distances of 150 m from the outer buffers of individual structures, allowing co-location outside of these buffer areas (Bonsu et al. 2024*).

There are some other regulations defining the safety zone in the WEA, which allow certain fishing activities to occur within the WEA. These regulations aim to provide alternative compensation for fishermen who may lose access to traditional fishing grounds due to the installation of offshore wind infrastructure and are discussed in Section A4.3.

A4.2.5 EXISTING GAPS AND LITERATURE RECOMMENDATIONS

Literature sources and some entities like the UN have recommended buffer zones and limited entry to OWFs, but there is no one-size-fits-all regulatory approach that can be applied to all OSW projects. The variations in the spatial, temporal, social, and ecological attributes across global oceans make it impractical to directly apply coexistence policies from one site to another (Bonsu et al. 2024*). With newer OSW technologies, specifically FOW, there are knowledge gaps across the sector.

- The safety and technical feasibility of fishing with passive gear types like pots and traps in the vicinity of OWFs has not been sufficiently tested (Bonsu et al. 2024*).
- Safety buffers around OWFs have not been fully tested and vetted and the impacts of weather conditions on passive fishing gear stability is not known (Bonsu et al. 2024*).
- Defined exclusion zones around the development area can restrict access and prevent scientists from collecting the necessary data to study the impacts of the offshore structures. Revised regulations are needed to facilitate scientific research within these zones; otherwise, exclusion zones around the OWF may lead to other knowledge gaps if access restrictions prevent scientists from collecting the necessary data to study the impacts of the offshore structures (Sih et al. 2022*).
- The impact of fishing restrictions in OWFs (including establishment of MPAs, as discussed in Section A4.1) has not been sufficiently studied. Fishing restrictions may lead to reduced fishing or may cause overfishing of other areas if no new sustainable or feasible fishing locations are available. This often leads to financial losses for fisheries and can lead to claims for compensation against the OWF developer, or the state (Al Arif and Anchustegui 2022*).

Given existing regulations and knowledge gaps, the following recommendations can be taken from the literature:

- Established access policies from other regions should be consulted and considered as models. However, local regulations must be established that consider the location-specific ocean users, as a one-size-fits-all regulatory approach cannot be applied to OSW.
- It is imperative to collect data from existing global OSW projects to fill established knowledge gaps. As studies are completed, data should be made widely available and should be leveraged, so that regulations and guidelines can take data-driven approaches to promote coexistence.

A4.3 FINANCIAL CONSIDERATION

There are financial considerations associated with the coexistence of fisheries and FOW, which include the cost to safely navigate within or near OWFs, insurance, and compensation programs.

As discussed in Section A4.2, there are navigation and safety concerns associated with OWFs which have cost implications.

- Fishermen may incur higher fuel and operational costs if they have to travel farther to reach fishing areas due to disrupted navigation lanes.
- Fishermen may incur costs if their fishing vessels require upgrades to minimize the safety risk of entanglement.
- Fishermen may incur costs if their fishing gear and equipment require repair or replacement due to damage from entanglement.
- Fishermen may incur costs to change their gear to facilitate coexistence with FOW.

Another fishing industry concern is insurance, specifically whether the fishermen's insurance will cover incidents (e.g., damage or injury) that occur within or in the vicinity of OWFs. Defining the insurance coverage itself is challenging as there is some difficulty estimating the risks accurately for fishing within OWFs (Granit and Andrén 2023*). In the Netherlands, it was determined that the regular protection and indemnity provided by insurance companies are sufficient for the specific circumstances of working in an OWF (Bonsu et al. 2024*). Even if insurance coverage is defined, there are concerns about excessive insurance premiums being applied for fishing in OWFs due to the elevated risks involved (Granit and Andrén 2023*).

Based on the literature review discussed in the following sections, coexistence between OWFs and traditional fishing activities is complex, partially due to the financial implications. Fishermen are wary about whether existing compensation mechanisms adequately cover potential financial losses, damages, or injuries resulting from activities within OWFs. Financial compensations are often a component of coexistence strategies because they help address the economic impacts and risks associated with sharing marine spaces; however, fishermen would prefer to find ways to coexist with OSW, rather than be compensated to not fish.

These financial considerations highlight the need for guidance, regulations, and policies that focus on safety; the necessary changes to insurance; and the potential for compensation.

A4.3.1 RELEVANT LAWS, REGULATIONS, AND POLICIES

A4.3.1.1 REGULATIONS IN THE US

In the US, the Fishermen's Contingency Fund as established under the OCSLA, compensates US commercial fishermen for property and economic loss due to obstructions related to O&G development activities on the OCS. However, an analogous fund was not established by Congress for OSW projects with the Energy Policy Act of 2005 (BOEM 2018). A Regional Fisheries Fund, and associated Fisheries Fund Regional Administrator, has been established to provide fisheries an accessible and equitable means to filing and receiving claims for individual costs and losses imposed on them from offshore wind developments and associated activities.

While there are no regulations in the US requiring compensation to commercial fisheries, the T&Cs in project Records of Decisions often include compensation requirements. The recent New England Wind Farm includes compensation programs for impacted recreational and commercial fisheries for potential gear loss and lost income (BOEM 2024). Vineyard Wind also established fishery compensation funds to support navigational and safety equipment and to deflect any increases in insurance costs from OWF development (Hagget et al. 2020). Other US OSW projects have similar requirements outlined in their T&C (see Attachment A-A), even though there is no state or federal regulation mandating this.

A4.3.1.2 REGULATIONS IN OTHER COUNTRIES

Regulations regarding compensation for fishermen affected by OSW development vary by country and sometimes by region, and from monetary to non-monetary compensations. Regulations on compensations for fishermen related to OWF development exist in the North Sea for the Netherlands, Denmark, the UK, Sweden, and Norway, but not for Germany and Belgium.

In jurisdictions where compensation regulations are in place, compensations are paid for economic losses resulting from the temporary or permanent seizure of grounds during different stages of OWF development. In Denmark, fishermen are compensated for lost time, and for additional travel costs of longer sailing distances to new fishing grounds, when traditional fishing grounds are occupied by OWFs.

Monetary Compensation

Cable protection regulations exclude practically all seabed-contacting fishing gear, thus monetary compensation is commonly used to manage the conflict that occurs when fishermen are excluded from OWFs. Evidence of recorded fishing losses is often required for fishermen to be eligible for compensation payments related to the associated economic loss (Bonsu et al. 2024*, Granit and Andrén 2023*):

- In Denmark, compensation is based on logbook evidence from 2 to 10 years, accompanied by interviews with fishermen.
- In the UK, the use of a FMMS, which includes financial compensation to fishermen affected by the construction and maintenance of an OWF, is a standard part of the permitting process (Granit and Andrén 2023*) and compensation is based on evidence of catches for the past 3 years.
- In Norway, there is a limit of 7 years from after losses were incurred to claim compensation, and any compensation processes regarding damaged equipment require the damaged objects to be retrieved, recorded, and brought ashore.
- In Sweden, regulations require compensations to be negotiated between the fishermen and the OWF developer regarding assumed income losses.
- In the Netherlands, compensation claims are handled by the Ministry of Infrastructure and the Environment using a financial formula to determine the compensation amount (Bonsu et al. 2024*).

Non-monetary Compensation

Non-monetary compensations may also be negotiated between fisheries and OWF developers:

- In Norway and Denmark, unique arrangements have been established to permit mobile bottom-contact fishing within designated safety zones over export cables, providing alternative compensation for the loss of fishing grounds. This non-monetary compensation allows fishermen to continue their activities in areas, that would otherwise be restricted, thereby mitigating the impact on their livelihoods. One example of this is the allowance of bottom trawling over export cables between Horns Rev 2 offshore and Danish West Coast (Bonsu et al. 2024*).
- In the UK, the Fishing Liaison with Offshore Wind and Wet Renewables developed guidelines for fishing in OWFs, including guidance on alternate compensation for disturbances and loss of income for fishing during construction and operation of an OWF (Granit and Andrén 2023*). One notable example of alternative compensation is the requirement for formal consultations with fishermen. Legislation mandates that data from fishermen be included in sustainability appraisals and used to identify mitigation measures. This approach ensures that fishermen's knowledge and concerns are considered, promoting more sustainable and equitable outcomes.

- In Germany, there are no regulations on compensations or evidence of compensations between OWF developers and fisheries, but the Wind Energy Act allocates 5 percent of funds from offshore bids to environmentally friendly fishing initiatives to support fisheries (Bonsu et al. 2024*).

A4.3.2 EXISTING GAPS AND LITERATURE RECOMMENDATIONS

The knowledge gaps associated with financial considerations were primarily related to furthering the knowledge base to enhance safety decisions and facilitate insurance determinations.

The following are recommended by the literature:

- Perform a comprehensive risk assessment to identify potential collision risks, gear entanglement, and other potential hazards to fishermen within OWFs (Granit and Andrén 2023*).
- Implement best fishing operations by considering navigational safety and investigating gear compatibility (Granit and Andrén 2023*).
- Study and develop insurance models that are adapted to account for multi-use marine areas and support determination of insurance that would cover fishermen who will be fishing within the OWFs (Granit and Andrén 2023*).
- Consider monetary and non-monetary compensation measures for areas of lost income (Bonsu et al. 2024*).

A4.4 KEY TAKEAWAYS FOR MAINE

The review of literature and regulatory requirements identified three recurring categories of concern from the fisheries relevant to the Gulf of Maine.

- **Fishermen are concerned about impacts of FOW on the marine environment** and additional studies are needed to understand the baseline marine environment, and the effects of construction of OSW, FOW structures and operation (e.g., EMF), and decommissioning on the marine environment (Section A4.1). Regulations exist to protect the marine environment, but there is a lack of detailed requirements for decommissioning of structures (Section A4.1.5.4).
- The main barrier to coexistence between fisheries and FOW is the **potential exclusion of fishing or navigation within the WEA** – and conversely, the potential exclusion of FOW in certain fishing areas (Section A4.2). State and federal law regulate coexistence to some extent, but additional guidelines are needed (Section A4.2.4.1 and A4.2.4.2).
- Fishermen are concerned about the **financial implications of OWF development** including the financial implications of loss of fishing grounds, entanglement, and insurance concerns (Section A4.3). The US does not currently have federal or state fisheries compensation requirements, but compensation is typically an OSW project requirement through T&C.

Another emerging theme that should be considered is the importance of communication around the coexistence of FOW and fisheries. The Energy Policy Act of 2005 requires the consideration of fisheries when developing an OWF, but the level of consideration is defined by the Department of the Interior, which has led to confusion among fishery participants (Methratta et al. 2020*). There have been some examples where programs have been developed to aid in the communication gap and create dialogue between the main parties. An example of this in the Netherlands is the *Communities of Practice* that encourage and facilitate cooperation and multi-use functions of the OWF areas (Granit and Andrén 2023*). This example demonstrates how collaborative efforts can address concerns and promote multi-use of marine spaces. One recommendation is to have communication with a "fisheries liaison" or an established fishing association present during the planning process, communicating with many different groups such as regional fishery management councils, or even utilizing environmental monitoring efforts to assist with investigating concerns and distributing data (Hagget et al. 2020*; Wilding et al. 2017*). There are many social arrangements, including the Responsible Offshore Development Alliance, which includes around 170 fishing industry associations and fishing companies along the Atlantic coast, that interface with developers and could also facilitate communications. It is also recommended to communicate with regional fishery management councils, NOAA, and BOEM to ensure that OSW development is compatible with fisheries businesses (Haggett et al. 2020*). Implementing similar initiatives and ensuring transparent communication channels can enhance cooperation and support sustainable practices that benefit both the renewable energy sector and the fishing community.

A5. CONCLUSION

Fishermen have three main areas of concern about FOW: impacts on the marine environment, access to WEAs, and financial considerations (Section A4). Regulations from the US and other countries can be leveraged to address some of these concerns, but additional studies are needed to fill knowledge gaps. While established regulations and guidelines from other countries and jurisdictions can be leveraged for guidance, a location-specific approach is needed so that guidance is fit for purpose for the relevant ocean users. Case studies (Section A3) can be leveraged to understand best practices for promoting coexistence. To achieve coexistence, it is important for developers to take a coexistence-first approach to the project design and siting, and articulate benefits to fishermen and the local community, and consider language, communication and engagement.

Effective communication between stakeholders is vital for coexistence, and the literature recommends that enforceable policies for this coordination be developed. By addressing these concerns and fostering open dialogue, Maine can pave the way for sustainable coexistence of fisheries and OSW development.

A6. REFERENCES

*Al Arif, A.A., and I.H. Anchustegui. 2022. *Regulatory and Policy Frameworks for Offshore Wind Projects: Spatial and Temporal Considerations in Light of Fisheries Sustainability Amid Climate Change*. Social Science Research Network. January. https://doi.org/10.2139/ssrn.4258322.

Bento, N., and M. Fontes. 2019. *Emergence of Floating Offshore Wind Energy: Technology and Industry*. Renewable & Sustainable Energy Reviews, vol. 99, pp. 66–82. January. https://doi.org/10.1016/j.rser.2018.09.035.

BOEM. 2014. Atlantic OCS Proposed Geological and Geophysical Activities in the Mid-Atlantic and South Atlantic Planning Areas: Final Programmatic Environmental Impact Statement Volume I. OCS EIS/EA BOEM 2014-001.

BOEM. 2018. *Commercial Fishing Frequently Asked Questions Wind Energy on the Outer Continental Shelf. Commercial Fishing Frequently Asked Questions Wind Energy on the Outer Continental Shelf*. September. www.boem.gov/sites/default/files/uploadedFiles/BOEM-Fishing%20FAQs.pdf.

BOEM. 2019. *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585*. Bureau of Ocean Energy Management Office of Renewable Energy Programs. June. https://www.boem.gov/sites/default/files/renewable-energy-program/Regulatory-Information/BOEM-Fishery-Guidelines.pdf.

BOEM. 2021. *Record of Decision Vineyard Wind 1 Offshore Wind Energy Project*. May. https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Final-Record-of-Decision-Vineyard-Wind-1.pdf.

BOEM. 2021. *Wind Energy Commercial Leasing Process.* Microsoft Word - BOEM Renewable Energy fact sheet 12192011 _3_.doc

BOEM. 2023. *Record of Decision Empire Offshore Wind: Empire Wind Project (EW 1 and EW2)*. November. https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Empire%20Wind%20OCA-A%200512%20ROD%20signed.pdf.

BOEM. 2024. *Record of Decision New England Wind Farm and New England Wind Project*. April. https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Record%20of%20Decision_New%20England%20Wind_OCS-A%200534.pdf.

BOEM and NOAA Fisheries. 2024. *BOEM and NOAA Fisheries North Atlantic Right Whale and Offshore Wind Strategy*. January. www.boem.gov/sites/default/files/documents/environment/BOEM_NMFS_NARW_OSW_0.pdf.

Boffey, D. 2018. *Dutch Fishermen to Sail Fleet Into Amsterdam in Wind Turbine Protest*. The Guardian. 1 June. www.theguardian.com/environment/2018/jun/01/dutch-fishermen-to-sail-fleet-into-amsterdam-in-wind-turbine-protest.

*Bonsu, P.O., J. Letschert, K.L. Yates, J.C. Svendsen, J. Berkenhagen, M.J.C. Rozemeijer, T.R.H. Kerkhove, J. Rehren, and V. Stelzenmüller. 2024. *Co-location of Fisheries and Offshore Wind Farms: Current Practices and Enabling Conditions in the North Sea*. Marine Policy, vol. 159, p. 105941. January. https://doi.org/10.1016/j.marpol.2023.105941.

Brzozowski, A. 2024. *Floating Offshore Wind in the Gulf of Maine: On-demand video series Part 2: Environmental, stakeholder, and developmental constraints*. Video. Presenter Anna Brzozowski, Offshore Wind Analyst. https://www.dnv.com/gulfofmaine

Convention on the Law of the Sea, 10 December 1982, 1833 U.N.T.S. 397.

*Corell, H., C. Bradshaw, and M. Sköld. 2023. *Sediment suspended by bottom trawling can reduce reproductive success in a broadcast spawning fish, Estuarine, Coastal and Shelf Science*, Volume 282, 108232, ISSN 0272-7714, https://doi.org/10.1016/j.ecss.2023.108232

*Degraer, S., R. Brabant, B. Rumes, and L. Vigin. 2019. *Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea: Marking a Decade of Monitoring, Research and Innovation*. Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management, 134 p.

*Degraer, S., D.A. Carey, J.W.P. Coolen, Z.L. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. *Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning: A Synthesis*. Oceanography, vol. 33, no. 4, pp. 48–57. December. https://doi.org/10.5670/oceanog.2020.405.

*Farr, Hayley, B. Ruttenberg, R.K. Walter, Y. Wang, and C. White. 2021. *Potential Environmental Effects of Deepwater Floating Offshore Wind Energy Facilities*. Ocean & Coastal Management, vol. 207, p. 105611. June. https://doi.org/10.1016/j.ocecoaman.2021.105611.

*Fayram, A.H., and A. De Risi. 2007. *The Potential Compatibility of Offshore Wind Power and Fisheries: An Example Using Bluefin Tuna in the Adriatic Sea*. Ocean & Coastal Management, vol. 50, no. 8, pp. 597–605. January. https://doi.org/10.1016/j.ocecoaman.2007.05.004.

*Gill, A.B., S. Degraer, A. Lipsky, N. Mavraki, E. Methratta, and R. Brabant. 2020. *Setting the Context for Offshore Wind Development Effects on Fish and Fisheries*. Oceanography, vol. 33, no. 4, pp. 118–27. December. https://doi.org/10.5670/oceanog.2020.411.

*Granit, J., and R. Andrén. 2023. *Coexistence of Offshore Wind Power with Commercial Fishing, Aquaculture and Nature Conservation: A Synthesis of Knowledge about Preconditions and Measures.* Swedish Agency for Marine and Water Management and the Swedish Energy Agency. Report. 66 Pages. ISBN: 978-91-89329-60-7. 14 August.

*Haggett, C., T. ten Brink, A. Russell, M. Roach, J. Firestone, T. Dalton, and B.J. McCay. 2020. *OFFSHORE WIND PROJECTS AND FISHERIES: Conflict and Engagement in the United Kingdom and the United States*. Oceanography. Volume 33, Issue 4, Pages 38–47. December. https://www.jstor.org/stable/26965748

*Hutchison, Z., D.H. Secor, and A.B. Gill. 2020. *The interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms*. Oceanography, vol. 33, no. 4, pp. 96–107. 1 December. https://doi.org/10.5670/oceanog.2020.409.

Lukić, I., K. Kurzweil, J.G. Tephany, J. McCann, C. Hodson, C. Rebours, and J.B. Thomas. 2023. *Ocean Multi-Use Blueprints Collection*. Zenodo (CERN European Organization for Nuclear Research). March. https://doi.org/10.5281/zenodo.7784785.

*Methratta, E.T., A. Hawkins, B.R. Hooker, A. Lipsky, and J.A. Hare. 2020. *Offshore wind development in the Northeast US Shelf Large Marine Ecosystem: Ecological, human, and fishery management dimensions*. Oceanography. Volume 33, Issue 4, Pages 16–27. December. https://doi.org/10.5670/oceanog.2020.402.

*Moura, S., A. Lipsky, and M. Morse. 2015. *Options for cooperation between commercial fishing and offshore wind energy industries: A review of relevant tools and best practices*.

National Oceanic and Atmospheric Administration (NOAA). 2024. *NOAA, BOEM Announce Final North Atlantic Right Whale and Offshore Wind Strategy*. 25 January. www.noaa.gov/news-release/noaa-boem-announce-final-north-atlantic-right-whale-and-offshore-wind-strategy#:~:text=The%20North%20Atlantic%20Right%20Whale%20and%20Offshore%20Wind%20Strategy%20provides,energy%20to%20address%20the%20climate.

*Pardo, J.C.F, M. Aune, C. Harman, M. Walday, and S.F. Skjellum. 2023. *A synthesis review of nature positive approaches and coexistence in the offshore wind industry*. ICES Journal of Marine Science. Volume 0, Issue 0, 1-17. https://doi.org/10.1093/icesjms/fsad191

Popp, E. 2024. *Maine Leaders Praise Decision Protecting Vital Lobstering Territory From Wind Development • Rhode Island Current*. Rhode Island Current. 15 March. https://rhodeislandcurrent.com/briefs/maine-governor-congressional-delegates-praise-decision-to-protect-vital-lobstering-territory-from-wind-development/#:~:text=AUGUSTA%2C%20Maine%20%E2%80%94%20Gov.,leased%20for%20offshore%20wind%20development.

Roach, M., Revill, A., and M. Johnson, 2022, Co-existence in practice: a collaborative study of the effects of the Westermost Rough offshore wind development on the size distribution and catch rates of a commercially important lobster (Homarus gammarus) population*, ICES Journal of Marine Science, Volume 79, Issue 4, May 2022, Pages 1175–1186, https://doi.org/10.1093/icesjms/fsac040

*Rouse, S., P. Hayes, and T.A. Wilding. 2020. *Commercial fisheries losses arising from interactions with offshore pipelines and other oil and gas infrastructure and activities*. ICES Journal of Marine Science. Volume 77, Issue 3, Pages 1148–1156. May-June. https://doi.org/10.1093/icesjms/fsy116

*Schupp, M.F., A. Kafas, B.H. Buck, G. Krause, V. Onyango, V. Stelzenmüller, I. Davies, and B.E. Scott. 2021. *Fishing Within Offshore Wind Farms in the North Sea: Stakeholder Perspectives for Multi-use From Scotland and Germany*. Journal of Environmental

Management, vol. 279, p. 111762. February. https://doi.org/10.1016/j.jenvman.2020.111762.

*Sih, T.L., K. Cure, I.N. Yilmaz, D. McClean, and P.I. Macreadie. 2022. *Marine Life and Fisheries Around Offshore Oil and Gas Structures in Southeastern Australia and Possible Consequences for Decommissioning*. Frontiers in Marine Science, vol. 9. November. https://doi.org/10.3389/fmars.2022.979212.

*Wilding, T.A., A.B. Gill, A. Boon, E. Sheehan, J. Dauvin, J. Pezy, F. O'Beirn, U. Janas, L. Rostin, and I. De Mesel. 2017. *Turning off the DRIP ('Data-rich, Information-poor') – Rationalising Monitoring With a Focus on Marine Renewable Energy Developments and the Benthos*. Renewable & Sustainable Energy Reviews, vol. 74, pp. 848–59. July. https://doi.org/10.1016/j.rser.2017.03.013.

*Wilson, J.C., M. Elliott, N.D. Cutts, L. Mander, V. Mendao, R. Perez-Dominguez, and A. Phelps. 2010. *Coastal and Offshore Wind Energy Generation: Is It Environmentally Benign?* Energies. 3(7):1383-1422.

Wright, K., Mair, J., Watret, R. and Drewery, J. 2023. *Static fishing gear trials at the Hywind floating offshore wind farm*. Marine Directorate, Scottish Government. 66p.. f4acf4706c8b0ab0a270a1950e12cefb38361b6c.pdf Accessed June 2024.

ERM

ATTACHMENT A-A TERMS AND CONDITIONS FOR RECENT OFFSHORE WIND DEVELOPMENTS IN THE UNITED STATES

Project	Terms and Conditions
New England Wind[55]	Fisheries Compensation and Mitigation Funds. No later than 1 year after the approval of the Copenhagen Offshore Partners (COP), unless a different schedule is agreed to as a component of a separate agreement between the Lessee and Rhode Island or Massachusetts or with Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE) for funds not subject to a state agreement, the Lessee must establish and implement a direct compensation program to provide monetary compensation to commercial and for-hire fishermen impacted by the Project. Additional details on funding program are found in the New England Wind Record of Decision.
	Shoreside Services. At least 90 days prior to establishment of the Direct Compensation Program described in Section 6.1.1, the Lessee must submit to BOEM a Shoreside Support Services report for a 60-day review and approval. If a state agreement for compensatory mitigation includes support for shoreside services, such as through a community fund, the amount allocated to shoreside services in the state agreement(s) may be removed from the calculation in Section 6.1.3 if such amount is greater than BOEM's required amounts, as stated in Section 6.1.1.3. The report must include a description of the structure of the Direct Compensation Fund and an analysis of the impacts of the Project to shoreside support services (such as seafood processing and vessel repair services) within communities near the ports listed below: • Point Judith, RI • New Bedford, MA • Montauk, NY • Fairhaven, MA • Chatham, MA • Little Compton, RI • Westport, MA • Beaufort, NC • New London, CT • Newport, RI
	Fisheries Gear Loss Compensation. The Lessee must maintain throughout the life of the Project, a fisheries gear loss claims procedure to implement the financial compensation policy proposed by the Lessee in Appendix III-E of the COP, Fisheries Communication Plan. The fisheries gear loss claims procedure must be available to all fishermen impacted by Project activities or infrastructure, regardless of homeport.
	Federal Survey Mitigation Program. There are 14 National Marine Fisheries Service (NMFS) scientific surveys that are impacted by overlap with wind energy development in the northeast region. Ten of these surveys overlap with the Project. Consistent with NMFS and BOEM survey mitigation strategy actions 1.3.1, 1.3.2, 2.1.1, and 2.1.2 in the National Oceanic and Atmospheric Administration (NOAA) Fisheries and BOEM Federal Survey Mitigation Implementation Strategy - Northeast US Region, 24 within 120 days of COP approval, the Lessee must submit to BOEM a survey mitigation agreement between NMFS and the Lessee. The survey mitigation agreement must describe how the Lessee will mitigate the Project impacts on the 10 NMFS surveys. The Lessee must conduct activities in accordance with such agreement. If the Lessee and NMFS fail to reach a survey mitigation agreement, then the Lessee must submit a Survey Mitigation Plan to BOEM and NMFS that is consistent with the mitigation activities, actions, and procedures described in the content for the survey mitigation agreement (see Sections 6.3.1 and 6.3.2), within 180 days of COP approval. BOEM will review the Survey Mitigation Plan in consultation with NMFS Northeast Fisheries Science Center. The Lessee must resolve comments to BOEM's satisfaction and must conduct activities in accordance with the plan.
	Fisheries Compensation and Mitigation Funds (Planning) (Construction) (Operations) (Decommissioning). No later than 1 year after the approval of the COP, the Lessee must implement their direct compensation program as determined in Section 6.1.1 below and

[55] New England Wind Project Record of Decision - BOEM, 2024

Project	Terms and Conditions
Revolution Wind[56]	augment the program to include reserve funding for shoreside support service revenue loss directly related to the Project, as determined in Section 6.1.2 below. Calculation steps are shown in Section 6.1.3 below.
	Shoreside Support Services. At least 90 days prior to establishment of the Direct Compensation Program described in Section 6.1.1, the Lessee must submit to BOEM a Shoreside Support Services report for a 60-day review and approval. If a state agreement for compensatory mitigation includes shoreside services, those ports may be removed from this analysis if greater than BOEM's requirements, as described in 6.1.1(c). The report must include a description of the structure of the Fund and an analysis of the impacts of the Project to shoreside support services (such as seafood processing and vessel repair services) within communities near the ports: • Beaufort, NC • Chilmark/Menemsha, MA • Fairhaven, MA • Fall River, MA • Hampton, VA • Little Compton, RI • Montauk, NJ • New Bedford, MA • New London, CT • Newport News, VA • Newport, RI • Point Judith, RI • Point Pleasant Beach, NJ • Stonington, CT • Tiverton, RI • Westport, MA
	Fisheries Gear Loss Compensation (Planning) (Construction) (Operations). The Lessee must maintain throughout the life of the Project, a fisheries gear loss claims procedure to implement the financial compensation policy proposed by the Lessee in Appendix E of the COP, Fisheries Communication and Outreach Plan. The fisheries gear loss claims procedure must be available to all fishermen.
	Federal Survey Mitigation Program (Planning) (Construction) (Operations) (Decommissioning). There are 14 NMFS scientific surveys that overlap with wind energy development in the northeast region. Nine of these surveys overlap with the Project. Consistent with NMFS and BOEM survey mitigation strategy actions 1.3.1, 1.3.2, 2.1.1, and 2.1.2 in the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy - Northeast US Region, 24 within 120 days of COP approval, the Lessee must submit to BOEM a survey mitigation agreement between NMFS and the Lessee. The survey mitigation agreement must describe how the Lessee will mitigate the Project impacts on the nine NMFS surveys. The Lessee must conduct activities in accordance with such agreement.

[56] Revolution Wind Farm Record of Decision - BOEM, 2023

Project	Terms and Conditions
	Environmental Data Sharing with Federally Recognized Tribal Nations (Planning) (Construction) (Operations) (Decommissioning). No later than 90 days after COP approval, the Lessee must make a request to the BSEE Tribal Liaison Officer and the Eastern Seaboard Tribal Liaison at tribalengagement@bsee.gov to coordinate with federally recognized Tribal Nations on the following: (1) to solicit their interest in participating as active monitors on board vessels during construction and/or maintenance activities, and in postmortem examinations of mortality events as a result of these activities; and (2) provide open access to reports generated as a result of the Fisheries Research and Monitoring Plan; reports of North Atlantic right whales (NARW) sightings; injured or dead protected species reporting (sea turtles, NARW, sturgeon); NARW passive acoustic monitoring (PAM) monitoring; protected species observer (PSO) reports (e.g., pile driving reports); and pile driving schedules and schedule changes. At a minimum, the Lessee must offer access to the following federally recognized Tribal Nations: Delaware Nation, Delaware Tribe of Indians, Mashantucket A-91 (Western) Pequot Tribal Nation, Mashpee Wampanoag Tribe, Mohegan Tribe of Connecticut, Narragansett Indian Tribe, Shinnecock Indian Nation, and Wampanoag Tribe of Gay Head (Aquinnah). The Lessee must provide to any federally recognized Tribal Nation, in a manner suitable to the Tribal Nation, access to nonproprietary, nonconfidential business information listed in this paragraph no later than 30 days after the information becomes available.
Empire Wind[57]	Fisheries Compensation and Mitigation Funds (Planning) (Construction) (Operations)(Decommissioning). No later than 1 year after the approval of the COP, unless a different schedule is agreed to as a component of a separate agreement, the Lessee must implement their direct compensation program as determined in Section 6.1.1 below and augment the program to include reserve funding for shoreside support service revenue loss directly related to the Project, as determined in Section 6.1.2 below. Calculation steps are shown in Section 6.1.5 below.
	Shoreside Support Services. At least 90 days prior to establishment of the Direct Compensation Program described in Section 6.1.3, the Lessee must submit to BOEM a Shoreside Support Services report for a 60-day review and approval. The report must include a description of the structure of the Fund and an analysis of the impacts of the Project to shoreside support services (such as seafood processing and vessel repair services) within communities near the ports: • Atlantic City, NJ • Barnegat, NJ • Beaufort, NC • Belford, NJ • Belmar, NJ • Brooklyn, NY • Cape May, NJ • Chincoteague, VA • Davisville, RI • Fairhaven, MA • Fall River, MA • Freeport, NY • Hampton Bays, NY • Hampton, VA • Islip, NY • Long Beach, NJ • Montauk, NY • Morehead City, NC • Neptune, NJ • New Bedford, MA • New London, CT • Newport News, VA • Newport, RI • North Kingston, RI • Ocean City, MD • Oriental, NC • Other Nassau, NY • Other Suffolk, NY • Point Judith, RI • Point Lookout, NY • Point Pleasant, NJ • Shark River, NJ • Shinnecock, NY • Stonington, CT • Wanchese, NC • Wildwood, NJ

[57] Empire Wind Project (EW 1 and EW2) Record of Decision - BOEM, 2023

Project	Terms and Conditions
	Fisheries Gear Loss Compensation (Planning) (Construction) (Operations). The Lessee must maintain throughout the life of the Project, a fisheries gear loss claims procedure. The fisheries gear loss claims procedure must be available to all fishermen impacted by Project activities or infrastructure, regardless of homeport.
	Navigational Enhancement Training Program (NETP). The Lessee will establish a NETP for New York State commercial and for-hire fishermen in an amount equivalent of up to $13,000 per commercial vessel or inspected charter/party vessel and up to $8,000 per uninspected charter/party vessel. These amounts consist of: (1) up to $10,000 for navigation equipment per commercial vessel or inspected charter/party vessel and up to $5,000 for navigation equipment per uninspected charter/party vessel; and (2) up to $1,000 per person for training or experiential learning opportunities, with a maximum of three people per vessel. Vessels that receive funding under another state or project NETP will become ineligible for this program.
	HRG Survey Conditions for Fisheries (Planning) (Construction). The Lessee will be required to follow its Fisheries Communication Plan to provide advanced notice of HRG survey plans to the commercial fishing industry in the region and must schedule surveys that, to the extent practicable, avoid peak longfin squid fishing activity in the survey area. The Lessee must avoid the use of boomers and sparkers in HRG surveys A-103 in the 29 aliquots in the most northwestern portion of the Lease Area 29 from 1 April through 31 July of any year, as practicable.
	Federal Survey Mitigation Program (Planning) (Construction) (Operations) (Decommissioning). There are 14 NMFS scientific surveys that overlap with wind energy development in the northeast region. Eight of these surveys overlap with the Project. Consistent with NMFS and BOEM survey mitigation strategy actions 1.3.1, 1.3.2, 2.1.1, and 2.1.2 in the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy - Northeast US Region 30, within 120 days of COP approval, the Lessee must submit to BOEM a survey mitigation agreement between NMFS and the Lessee. The survey mitigation agreement must describe how the Lessee will mitigate the Project impacts on the nine NMFS surveys. The Lessee must conduct activities in accordance with such agreement.
	Environmental Data Sharing with Federally Recognized Tribal Nations (Planning) (Construction) (Operations) (Decommissioning). No later than 90 days after COP approval, the Lessee must make a request to both the BSEE Tribal Liaison Officer and the Eastern Seaboard Tribal Liaison at tribalengagement@bsee.gov to coordinate with federally recognized Tribal Nations with geographic, cultural, or ancestral ties to the project area (hereinafter "interested Tribal Nation"), including, but not limited to: the Absentee-Shawnee Tribe of Indians of Oklahoma, the Cayuga Nation, the Delaware Nation, the Oklahoma, the Delaware Tribe of Indians, the Eastern Shawnee Tribe of Oklahoma, the Mashantucket Pequot Indian Tribe, the Mashpee Wampanoag Tribe, the Mohegan Tribe of Indians of Connecticut, the Narragansett Indian Tribe, the Oneida Indian Nation, the Oneida Nation, the Onondaga Nation, the Saint Regis Mohawk Tribe, the Seneca-Cayuga Nation, the Seneca Nation of Indians, the Shawnee Tribe, the Shinnecock Indian Nation, the Stockbridge Munsee Community, the Tonawanda Band of Seneca, the Tuscarora Nation, and the Wampanoag Tribe of Gay Head (Aquinnah). The purpose of this coordination is to (1) solicit Tribal Nation interest in participating as an environmental liaison during construction and/or maintenance activities, so the environmental liaison can safely monitor, and participate in postmortem examinations of mortality events, as a result of these activities; and (2) provide open access to the following: reports generated as a result of the Fisheries Research and Monitoring Plan; reports of NARW sightings; injured or dead protected species reporting (sea turtles, NARW, sturgeon); NARW PAM monitoring; PSO reports (e.g., pile driving reports); pile driving schedules and schedule changes; and any interim and final sound field verification reports, and its associated data. If an interested Tribal Nation expresses interest in participating as an environmental liaison, the Lessee must provide the interested Tribal Nation information regarding training(s), certification(s), and safety measures, required for participation. Environmental liaisons must be invited to

Project	Terms and Conditions
	monitor/participate from a safe platform, such as a vessel. The Lessee must provide to the interested Tribal Nation, in a manner suitable to the Tribal Nation, access to all Endangered Species Act reports, Post Review Discovery Plans, and other documents listed in this paragraph no later than 30 days after the information becomes available. The Lessee may redact or withhold documents listed in this paragraph when it is information that the Lessee would not generally make publicly available and considers that the disclosure may result contrary to the Lessee's commercial interests. The Lessee must submit a justification for the request to redact/withhold in writing to the BSEE Tribal Liaison Officer and the Eastern Seaboard Tribal Liaison at tribalengagement@bsee.gov. Only upon approval of such request may the document be redacted/withheld.
Vineyard Wind	Trawl survey for finfish and squid. To support a before-after-control-impact analysis, sampling must occur a minimum of 1 year before, 1 year during, and 3 years after construction. Before, during, and 1 year after construction, survey stations must be both within the Project footprint as well as at control sites. A total of 40 tows, 20 in the Project area, and 20 in control areas, must be conducted four times per year. Specific post-construction protocols for the trawl survey can be found in the Vineyard Wind Record of Decision.
	Ventless Trap Surveys. Ventless trap surveys must be conducted a minimum of 1 year before, 1 year during, and 3 years after construction to allow for comparison with 2019 baseline sampling. The ventless trap survey must follow the protocols of the coast-wide ventless trap survey, with six traps alternating between vented and ventless; this method has been adopted by New York and all New England states with the exception of Maine and has been accepted by the Atlantic States Marine Fisheries Commission. There must be 15 sampling sites in the 501N Study Area and 15 in the Control Area, for a total of 30 stations. Each location must be sampled two times per month from 15 May to 31 October with a target soak time of 3 to 5 days. To alleviate concerns relative to NARWs, the traps must use weak-link technology to minimize whale entanglement and no sampling may occur between November and early May, when NARWs may be in the area. Additionally, Vineyard Wind must tag lobsters, which it is currently doing voluntarily, and must record all reported recaptures of tagged lobsters
	Rhode Island Compensation Fund. A $4.2 million direct compensation fund to be held in escrow to compensate for any claims of direct impacts on Rhode Island vessels or Rhode Island fisheries interests 15 in the Project area.
	Massachusetts compensation fund. A $19,185,016 million direct compensation fund to be held in escrow to compensate for any claims of direct, downstream, and cumulative (upstream) impacts on Massachusetts vessels or Massachusetts fisheries interests in the Project area.
	Other states' compensation fund. A $3.3 million direct compensation fund to be held in escrow to compensate for any claims of direct, downstream, and cumulative (upstream) impacts from other affected states including Connecticut, New Jersey, and New York vessels or fisheries interests in the Project area for the 30-year life of the Project.
	Rhode Island Fisherman's Future Viability Trust. Vineyard Wind entered into an agreement with the Rhode Island Coastal Resources Management Council regarding the establishment and funding of the Rhode Island Fishermen's Future Viability Trust (the "Trust"). The purpose of the $12.5 million Trust is to further the policies of the Ocean Special Area Management Plan with respect to the continued viability and success of Rhode Island's fishing industry and to support and promote the compatibility of offshore wind and commercial fishing interests within Rhode Island's Geographic Location Description. The Trust will provide funds to address concerns about safety and effective fishing in and around the Project area and wind energy facilities generally. Examples of how the funds may be used include improvements in fishing vessels; fishing methods and gear; supporting widespread deployment of

Project	Terms and Conditions
	navigational equipment; financial support of individual fisher; purchase of updated safety equipment (e.g., radar, global positioning system, survival suits, life rafts, etc.); and payment for increased insurance costs related to fishing around wind farms.
	Massachusetts Fisheries Innovation Fund. On 21 May 2020, the Massachusetts Executive Office of Energy and Environmental Affairs and Vineyard Wind entered into Memorandum of Understanding for a $1.75 million Fisheries Innovation Fund (CZM 2020). The purpose of the fund is to support programs and projects that ensure safe and profitable fishing continue as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters. The fund will provide support to programs and projects through grants to conduct studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries as well as provide grants for technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area. These programs and projects may include, but are not limited to, studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries, improvements in fishing vessels and gear, development of new technology to improve navigation in and around the wind farm area, the development of alternative gear and fishing methods, optimization of vessel systems, technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area, and general fishing vessel safety improvements.

ERM HAS OVER 160 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina
Australia
Belgium
Brazil
Canada
China
Colombia
France
Germany
Ghana
Guyana
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
The Netherlands
New Zealand
Peru
Poland
Portugal
Romania
Senegal
Singapore
South Africa
South Korea
Spain
Switzerland
Taiwan
Tanzania
Thailand
UAE
UK
US
Vietnam

ERM's Boston Office

One Beacon Street
5th Floor
Boston, MA 02108

T +1 617 646 7800
F +1 617 830 8975

www.erm.com

APPENDIX B PHASE 1 STAKEHOLDER ENGAGEMENT: EXISTING UNDERSTANDINGS OF COEXISTENCE

Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind

Appendix B: Phase 1 Stakeholder Engagement - Existing Understandings of Coexistence

Prepared by the Gulf of Maine Research Institute

PREPARED FOR

Environmental Resources Management and the State of Maine Governor's Energy Office

DATE

31 July 2024

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronyms	Description
BOEM	Bureau of Ocean Energy Management
EMF	electromagnetic fields
ERM	ERM Consulting & Engineering, Inc.
FOW	floating offshore wind
GMRI	Gulf of Maine Research Institute
NOAA	National Oceanic and Atmospheric Administration
RFCI	Request for Competitive Interest
WEA	Wind Energy Area

EXECUTIVE SUMMARY

Over the course of 2023, the Maine Offshore Wind Research Consortium Advisory Board underwent a rigorous prioritization process to identify three research topics to fund in its inaugural round of projects. This project, Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind, was one of the projects included in the competitive Request for Proposals that was issued in November 2023 by the Governor's Energy Office on behalf of the Research Consortium.

ERM Consulting & Engineering, Inc. (ERM) and the Gulf of Maine Research Institute (GMRI) were awarded the project to pursue the research and stakeholder engagement to advance understandings of floating offshore wind and fishery coexistence. The project kicked off in February 2024.

As part of this project, GMRI conducted stakeholder engagement exploring the feasibility of fisheries' coexistence with floating offshore wind (FOW) technology,including this study, *Phase 1 Stakeholder Engagement - Existing Understandings of Coexistence*. During Phase 1, GMRI engaged 23 fishing industry stakeholders, receiving input on various questions relating to fisheries' coexistence with FOW. Questions were framed to enhance an understanding of stakeholders' concerns and anticipated challenges of operating within a FOW array, as well as outline gear and fishery-specific co-use challenges. The GMRI team conducted a thematic assessment of stakeholder input, the findings of which suggest a range of perspectives. Spatial conflict, gear entanglement, as well as economic, social, and environmental pressures, among others, represent key themes underlying respondents' concerns regarding the feasibility of fisheries' coexistence with FOW.

B1. INTRODUCTION

As a nascent industry, little is known about the potential interoperability between commercial-scale floating offshore wind (FOW) projects and fisheries within the Gulf of Maine. FOW in the Gulf of Maine presents a wide range of technical and logistical challenges for offshore wind and fishing industries. Fishermen are concerned about the potential impacts on their operations, including restricted fishing access, risks with navigating, and increased industry competition within limited areas of the ocean. Technology characteristics, including subsurface mooring lines and inter-array cables, may result in new challenges for fishing activity. It is crucial to engage constructively with the Gulf of Maine fishing industry around the feasibility and strategies for potential coexistence between traditional fishing practices and FOW.

As such, ERM Consulting & Engineering, Inc. (ERM) and Gulf of Maine Research Institute (GMRI) are working with fisheries stakeholders to explore approaches to fisheries' coexistence with FOW (the project). GMRI is leading the stakeholder engagement for this project, working with fishermen and fishing organizations to build an understanding of concerns, opportunities, and anticipated challenges of operating within a FOW array. This includes detailed discussions on gear and fishery-specific co-use challenges and providing feedback on the project's findings that will inform recommendations. Ongoing engagement with the fishing industry is key to ensuring the findings have relevance to the practicality of the Gulf of Maine fishing industry.

B2. ENGAGEMENT METHODS

To ensure effective and constructive engagement with stakeholders, GMRI employed a three-phase engagement approach for this project:

- Phase 1: engagement to test existing understandings and identify further research questions among fisheries stakeholders[1] ;
- Phase 2: engagement to understand interactions between the FOW technology scenarios specific to the various gear types used in the Gulf of Maine; and
- Phase 3: engagement to test draft guidelines with fishing stakeholders to consider their feedback, reactions, and opportunities for further research.

A subset of the Maine Offshore Wind Research Consortium Advisory Board approved this engagement approach, and the questions used in Phase 1 and 2. The subset of the Advisory Board also approved and elaborated on an initial set of associations and fishermen to participate in this project. To expand the participant base, GMRI employed a 'snowball' sampling method, a common approach in qualitative research where current participants suggest future participants from their networks.[2] The GMRI team used this method due to the highly specialized nature of the fishing community, where relationships and trust play a critical role in participation. Snowball sampling allowed the team to leverage existing connections to ensure broad, yet relevant stakeholder engagement. During Phase 1, stakeholders were asked the following questions:

B2.1 QUESTIONS FOR ORGANIZATIONS

- What types of gear does your organization primarily represent/utilize?
- What ports are used by your fishermen? If multiple, are you able to rank which ones are used most?
- If you are comfortable sharing, do affiliates of your organization fish or have fished in the Wind Energy Area (WEA) or the Request for Competitive Interest (RFCI) area in the last 10 years?
- Who else is important to speak with on this topic?

B2.2 QUESTIONS FOR INDIVIDUALS

- What type of gear do you use? In which seasons do you use certain gear for fishing?
- What is your homeport?
- If you are comfortable sharing, do you or have you fished in the WEA or the RFCI area in the last 10 years? (accompanied by visual assets of wind areas shared by GMRI)

B2.3 COEXISTENCE-SPECIFIC QUESTIONS (FOR BOTH ORGANIZATIONS AND INDIVIDUALS)

- How do you define "coexistence"?

---

[1] In addition, to help inform research questions, GMRI conducted an assessment of all public comments on the BOEM-designated Draft WEA in the Gulf of Maine (Attachment B-A).
[2] Lopez, V., & Whitehead, D. (2013). Sampling data and data collection in qualitative research. *Nursing & midwifery research: Methods and appraisal for evidence-based practice*, *123*, 140.

- What is your current understanding of FOW technology?
- When you hear the word "coexistence," what does that mean to you?
- What do you foresee being a challenge with your current fishing operation and with FOW technology?
- What is unique about the way that you fish that might make operating within wind arrays challenging?
- What should we be looking into to determine whether fishing in a FOW array is possible?
- What would make you feel safe navigating in or around FOW arrays? What do you want developers to consider when designing their layout?
- What other thoughts should be considered outside of physical conflicts between gear (e.g., safety, insurance)?
- How could you use the additional data that wind turbine sensors collect, such as current speed and direction, wind speed and direction, and wave height?
- Are there any important questions you believe we have not asked yet?

In total, the GMRI team contacted 49 stakeholders: 31 fishermen and 18 organizations. Of those contacted, the team successfully engaged 12 fishermen and 11 organizations (Table 1). To ensure a balance in avoiding stakeholder exhaustion while acknowledging the importance of offering multiple opportunities to engage, the team reached out for input no more than three times.

TABLE 1: SUMMARY OF STAKEHOLDER OUTREACH AND PARTICIPATION

Stakeholders	Contacted	Interviewed
Fishermen	31	12
Organizations[3]	18	11
Totals	49	23

As a Maine-based project, engagement prioritized fishermen and organizations with connections to the State of Maine. The team also prioritized engagement with fishermen who fish within the proposed Lease Areas to address specific gear and FOW technology concerns.

Fishing industry stakeholders are often engaged in other research and management decisions or are out on the water fishing, making scheduling engagement a challenge. To reduce the burdens of engagement, the GMRI team met individuals in locations selected by stakeholders. The GMRI team prioritized meeting with fishing associations and fishermen at existing meetings and forums and organizing times to engage in conversations at later dates if the proposed times did not work. Engagement during Phase 1 was also conducted via Zoom, phone, and e-mail.

The team employed a semi-structured style for engagement with stakeholders. Particularly in conversations with individuals who are taking time out of their workday to engage, the semi-

[3] Engagement included reaching out to individual fishermen and leaders of fishing associations/organizations. Organization leaders often represent groups of fishermen by geographic area, fishery, or gear type. Organization leaders were asked the same questions as individuals and were not asked to specify whether their answers were their own perspectives or represented input from their membership/organizational base. Therefore, use caution if interpreting input from organizations as a broader group of fishermen.

structured style ensures that participants have flexibility in expressing their opinions on a range of topics, while concomitantly helping the GMRI team receive answers to the predetermined questions. This style also allows participants to raise other important topics of concern that were beyond the initial scope of questions. Out of respect for participants' time, some interviews were expedited with a focus on questions of greater perceived importance to the goals of this project (coexistence-specific questions). Interviews ranged from 10 to 90 minutes. Throughout the Phase 1 engagement period (4 June through 12 July), engagement remained relevant to the Bureau of Ocean Energy Management (BOEM) development process by reflecting the most up-to-date area information, as the proposed Lease Areas were announced on 30 April 2024.

For this report of the engagement from Phase 1, the GMRI team used a thematic analysis approach. This process involves identifying, analyzing, and reporting patterns within qualitative data to organize and describe data sets in detail.[4,5] This common social science research strategy allowed the team to analyze and interpret stakeholder input in the most accurate and relevant manner.

[4] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.
[5] Clarke, V., & Braun, V. (2017). Thematic analysis. *The Journal of Positive Psychology*, *12*(3), 297-298.

B3. EMERGING THEMES FROM RESPONSES

B3.1 STAKEHOLDER DEMOGRAPHICS

Respondents from the Phase 1 engagement period represent organizations and individuals from Midcoast and Southern Maine; coastal New Hampshire; and North Shore, South Shore, Greater Boston, and Cape Cod, Massachusetts. It is important to note that, for some respondents, these regions represent their homeport and not necessarily where they land their catch. For instance, a fisherman may be based in South Shore, Massachusetts, but land most of their catch in Portland, Maine, or vice-versa. All respondents either fish, represent a fishing industry, or are directly connected to fishing activity in the Gulf of Maine.

The respondents represent diverse gear types. Of the respondents, 17 use mobile gear, 12 use fixed gear, and four use line gear (Figure 1). Mobile gear includes both bottom and midwater trawls and targets groundfish, scallops, squid, and herring. Mobile gear fisheries are generally characterized by their ability to cover large areas and capture significant quantities of target species. Fixed gear includes gillnets and lobster pots/traps. Fixed gear is typically more selective as it is set in determined locations. Line gear includes longlines and jigging gear, and can be set in place, drift, or move slowly. Note that many respondents use various gear types or represent an industry that employs multiple gear types. As such, these totals exceed the number of respondents. Further, the majority (19 out of 23 participants) noted having fished or represent fishermen who currently fish or have fished in the Gulf of Maine WEA or RFCI area in the last 10 years (Figure 2). Note, engagement during this period occurred prior to the Gulf of Maine offshore wind lease sale on 29 October 2024. The leased areas in the Gulf of Maine consist of 439,096 acres of the 2,001,902-acre WEA. The 10-year time frame was chosen to align closely with fisheries data used in the document, A Wind Energy Area Siting Analysis for the Gulf of Maine Call Area, which was conducted by the National Oceanic and Atmospheric Administration's National Centers for Coastal Ocean Science and BOEM.

These results suggest that the fishing activities of many of the stakeholders engaged may overlap with areas for future FOW development in the Gulf of Maine.

FIGURE 1: GEAR TYPES REPRESENTED BY RESPONDENTS

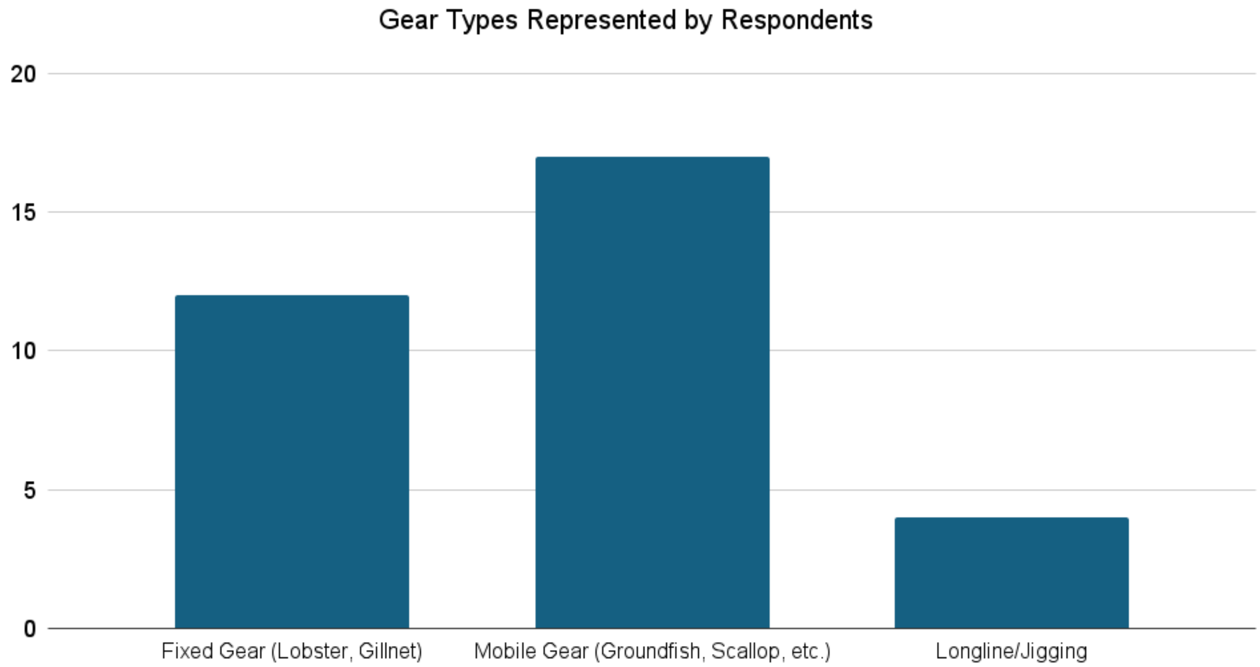
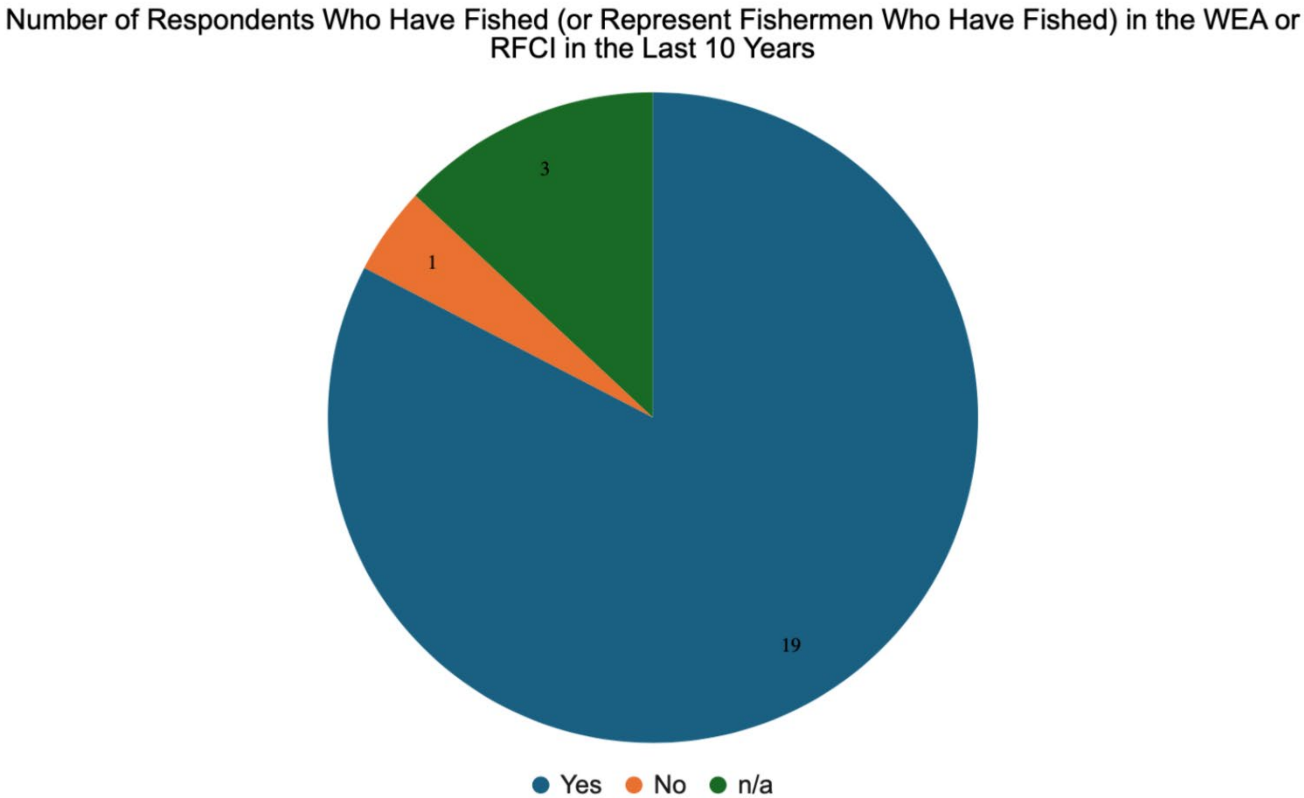


FIGURE 2: NUMBER OF RESPONDENTS WHO HAVE FISHED IN THE WEA OR RFCI IN THE LAST 10 YEARS



B3.2 DEFINING COEXISTENCE

Respondents provided various perspectives on the topic of coexistence, with the majority expressing strong skepticism regarding the feasibility of the fishing industry coexisting with FOW. Fifty-five percent of respondents noted strong opposition to the idea of fisheries' coexistence with FOW, and twenty-two percent of respondents noted that with certain adaptation strategies, some fisheries could achieve a semblance of coexistence with FOW. Some stakeholders declined to answer.

Spatial conflict, gear entanglement, economic, social and environmental pressures, perceptions of other energy sources, and selective coexistence arose as key themes surrounding their statements:

B3.2.1 SPATIAL CONFLICT

Fundamentally, many respondents view the issue of coexistence from a spatial lens. One in which both parties – FOW and fisheries – are not able to function efficiently in the same space, at the same time. Nine respondents referenced the idea that the inherent mobility that their industry demands will conflict with the static nature of a FOW array. The general perspective from these respondents is that FOW arrays will not be areas – due to a range of factors including safety and insurance – that are open to fishing. As one respondent noted, *"I see coexistence as crowding and displacement."* Another noted that coexistence requires both industries to be able to operate at maximum sustainable yield at the same time. These perspectives inform the prevailing sentiment among respondents that offshore wind development may displace the fishing industry.Building on the spatial notion, apprehension to the idea of successful fisheries' coexistence with FOW also stems from an ideological perspective. Respondents in multiple conversations alluded to the idea that FOW developers are seeking to lease a public resource through the established Federal process outlined in the Outer Continental Shelf Lands Act and accrue disproportionate benefits through its management. Respondents interpret these practices as unjust, fostering an imbalance of power between FOW and a fishing industry faced with the prospects of reduced access to traditional fishing grounds. Some respondents stated that coexistence requires both parties to have equal access to a resource as a part of the public domain.

B3.2.2 ECONOMIC, SOCIAL AND ENVIRONMENTAL PRESSURES

Respondents expressed concern regarding the economic, social, and environmental consequences of FOW development. Some noted that the spatial displacement of fisheries from FOW areas would have damaging effects on their livelihoods, as well as a cascading impact on prospective fishermen and other stakeholders beyond the fishing industry. For instance, one respondent underscored the idea that FOW presents a deterrent for young people who were originally considering entry into the commercial fishing industry but are now apprehensive. Another respondent raised concern that FOW development is an unsustainable investment that would spur a financial crisis by increasing utility rates for consumers. Many respondents also alluded to concerns with the potential environmental impacts of FOW development – electromagnetic fields (EMF) from FOW cables, secondary entanglement of whales, cooling station effluent, etc. – which some see as detrimental to the ecosystem fishermen depend on for their livelihoods. These impacts are perceived as contributing to environmental degradation, limiting the potential to coexist with FOW if the environment is no longer suitable for fishing activity.

B3.2.3 PERCEPTIONS OF OTHER ENERGY SOURCES

Pushback to the idea of coexistence by respondents also appears grounded in the idea that other renewable energy sources are better suited to the Gulf of Maine region. "*Wind energy was not made to be harnessed on the water,*" noted one respondent. Whether it be tidal, solar, hydroelectric, or onshore wind, respondents highlighted the presence of alternative energy sources – ones they view as better candidates for coexistence with the fishing industry and the Gulf of Maine region.

B3.2.4 SELECTIVE COEXISTENCE

As noted earlier, few respondents felt fisheries could coexist with FOW and that the possibility of coexistence is aspirational. Because the fishing industry is inherently mobile, respondents noted that very few gear types could fish efficiently within FOW arrays that remain in one place. Some respondents noted that of all gear types, fixed gear fisheries may have a greater potential for operating within FOW. However other respondents also described that if only certain fisheries can fish with FOW arrays, only a subset of the fishing industry can coexist, not the entirety. This suggests that successful coexistence must encapsulate the majority, if not all, of the fishing industry.

B3.2.5 EXAMPLES OF DEFINITIONS OF COEXISTENCE FROM RESPONDENTS:

Both industries – fishing and offshore wind – are able to thrive. Unfortunately, we are primarily talking about a spatial issue, and physics says no two things can occupy the same space at the same time.

Coexistence means no change in revenue, no large-scale spatial disruption.

Wind and fisheries are able to operate profitably and safely.

Striving for shared use of a common space where multiple parties minimize interference with one another's activities.

Coexistence means an absence of conflict.

Being able to operate in the place you are operating in with very minor adjustment without a change in profit or revenue that can be attributed to the wind farm and no spatial displacement outside of the array.

More than one interest being served simultaneously and ideally being mutually beneficial.

Sharing a resource, but with the equal ability to use it.

Multiple entities existing in the same space or at the same time.

Coexistence is an insult to the commercial fishermen that are fishing out there.

There is no coexistence between fisheries and offshore wind.

Coexistence is not possible...it is mutual.

There is no such thing as coexistence...once there is offshore wind developed, it's already done, and they have won.

> *"Coexistence is a way of getting to a compromise, where both sides are respecting the other side's perspective and needs, and give as much as they can."*
>
> *"Coexistence requires adaptation on both sides. Adaptation has to be a two-way street."*

B3.3 UNDERSTANDINGS OF FLOATING OFFSHORE WIND TECHNOLOGY

Individuals from different regions and fisheries consistently noted that they had a grasp of the scale of FOW, often alluding to the "enormous," "huge," or "giant" size of the proposed FOW turbines. Respondents also described that they knew there are multiple design options for floating platform technology proposed in the Gulf of Maine. The three designs noted with the greatest prominence were the semi-submersible, tension-leg, and spar platform designs, but many noted that the semi-submersible design is the technology most likely to be developed in the Gulf of Maine.

Most respondents (21 out of 23) noted a familiarity with the mooring/anchoring components used in FOW arrays. Several individuals noted awareness that each platform requires three or four mooring lines that are tethered to the seabed with sufficient scope on each line to ensure the stability of the FOW platform. One individual had an interesting analogy for the technology: "*FOW is like an iceberg*," describing how what you see above the water is not what you see below the water. Respondents expressed significant concern around anchoring systems as potential barriers to fishing operations. Many respondents noted that the scope of the mooring lines lends itself to the movement of the FOW platform which can be hard to predict, particularly in poor weather conditions. Some respondents also noted that they were aware of a potential 1 nautical mile separation between each floating platform but needed clarity on what to expect in the Gulf of Maine to know what coexistence may look like. Without sufficient knowledge of the scope of mooring lines – the size of a FOW watch circle – and the degree of separation between turbines within arrays, respondents find it hard to predict the potential constraints for their fishing operations.

Individuals also discussed familiarity with the cabling schemes of FOW platforms, describing how turbines are connected with inter-array cables, which are connected to a larger, centralized transmission system. However, respondents alluded to significant questions surrounding the location of these cables, their impacts on fishing activity, as well as any potential environmental impacts resulting from their presence in the Gulf of Maine. Specifically, individuals voiced concern around the location of inter-array cables floating in the water column, with some respondents noting that if the inter-array cables were not buried, then any potential fishing activity would not be possible. One respondent described the dynamic cable systems as the most important factor to consider as to whether folks can fish within FOW arrays. Another respondent discussed concern regarding potential impacts from EMFs generated by inter-array cables on local species sensitive to these frequencies. Respondents also voiced frustration over a lack of clarity as to whether these cables are suspended in the water column or buried. "*It is all a big looming question mark*," mentioned one respondent.

B3.4 FISHING, NAVIGATION, AND SAFETY

B3.4.1 OPERATIONAL CONSIDERATIONS (FISHING/NAVIGATION):

The potential development of FOW in the Gulf of Maine presents a range of operational concerns for fishermen including gear entanglement, navigation challenges, and reduced catch efficiencies.

Fishermen representing both mobile and fixed gear industries expressed unease at the prospect of deploying their gear near or within FOW arrays, fearing that their gear may potentially become entangled with the mooring and inter-array cabling systems connected to turbine structures. Fishermen employing mobile gear such as a trawl or dredge noted that their gear requires a large scope and can be about a quarter mile long and could move up to a quarter mile on either side of their vessel depending on ocean currents and wind conditions. These factors make it difficult to know precisely where their gear is deployed on the seabed while fishing. With FOW mooring lines and cabling systems that are not visible from above the water column, it is feared that mobile gear could very easily become entangled. According to respondents, the entanglement of gear can come at a tremendous cost because the gear is often cut or lost, rendering it unusable for future use. One fisherman noted that they tow roughly one hundred thousand dollars' worth of nets and how if they become entangled with a mooring line and do not receive their gear back, they may face significant economic challenges. Another respondent noted simply that "*no one can afford to get hung up on a cable*." Respondents suggested that there are serious financial consequences to gear entanglement to consider in discussions around FOW.

Respondents from fixed gear fisheries employing lobster traps or gillnets also discussed concerns around entanglement, but to a lesser degree as most of their gear often requires less scope and can operate in more discrete areas. One respondent employing lobster gear did, however, note that their end lines can extend up to 100 fathoms (600 feet), with lobster traps extending as long as two miles, buoy to buoy. This is a common fishing strategy for the offshore lobster fishery. Another respondent noted that fishermen using gillnets often set gear that spans at least 3,000 feet. Entanglement concerns were therefore voiced from both fixed and mobile gear fisheries and should be considered in conversations regarding potential coexistence between fisheries and FOW.

When prompted on whether wind turbine sensor data – current speed and direction, wind speed and direction, and wave height – would be helpful for fishing operations, six respondents expressed skepticism about the practicality of the data, noting that this information is already available from sources such as weather buoys. One respondent noted that first-hand experience is far more helpful than anything else, suggesting that more data would not be important for their fishing activities. Three respondents acknowledged some potential uses of the data for fishing operations if it is provided in real time. One respondent noted that having data on bottom water temperatures would be helpful for their fishing operations. Five respondents noted that more data is always better, but not necessarily for fishing operations and instead to enhance understanding of biology, ecology, or other oceanographic phenomena in the Gulf of Maine. Therefore, there is a mix of perspectives on the applicability of FOW sensor data for fishing operations, but the consensus is that more data is always helpful, whether that be for fishing operations or environmental monitoring.

Aside from fishing, another critical aspect of fishing operations is navigating through FOW arrays in pursuit of fishing areas. Navigation within and around FOW arrays is a critical source of concern among respondents. Navigating around obstacles in the ocean requires skillful maneuvering. Several respondents discussed apprehension navigating within a FOW because of potentially dangerous weather conditions offshore in the Gulf of Maine. Multiple individuals provided anecdotal accounts of having fished in the proposed Lease Areas, where the ocean can become turbulent and visibility can be poor, especially in the winter months. Respondents suggested that the integration of FOW into these offshore areas would leave vessels vulnerable to potentially hazardous collisions with FOW structures. Additionally, respondents expressed concern that transit lanes within FOW areas would be prone to increased vessel traffic because of limited access routes to traditional fishing grounds. One respondent also noted hearing from fishermen in other countries that radar interference is more pronounced within offshore wind arrays, potentially making it more difficult to track other vessels within a wind array.

Fishing operations are dependent on the precise placement of gear in traditional fishing grounds. If FOW arrays are closed to fishing activity, some respondents highlighted that they would not be able to place their gear in areas of greater preference, potentially reducing their fishing efficiency. Further, even in areas not closed to fishing, respondents expressed concern that FOW could act as an obstacle to fishermen, extending travel time to traditional fishing grounds and increasing fuel costs, rendering the cost of fishing in certain areas prohibitive. One respondent discussed how transiting around FOW arrays could also have several increased costs and impacts to mental health and exhaustion, which may make trips harder on captains and crew. As a result, fishermen may become less likely to land in small ports or operate with a dealer/processor on the far side of a wind array if they can go somewhere safer and quicker. This, according to the respondent, could have cascading effects throughout the supply chain in an industry that may already only be profiting in the margins. Therefore, respondents suggested that consideration should be given not only to how FOW arrays may internally displace certain fishing activity, but also how they may limit access to external fishing grounds, complicate landing sites, and contribute negatively to the health and well-being of captains and crew.

B3.4.2 SAFETY AND INSURANCE CONSIDERATIONS

The safety of fishermen and mariners sits at the core of many concerns shared by respondents. Respondents noted that the consequences of gear entanglement and hazardous navigation are serious to the safety, health, and well-being of individuals on the water. The uncertainties surrounding these factors exacerbate the safety concerns shared by respondents. This includes concerns about the feasibility of search and rescue operations within FOW arrays. As a result of the size, scale, and movement of FOW turbines, many fishermen expressed doubt that search and rescue operations would be effective within FOW arrays, noting that greater studies ought to be conducted to ensure the safety of everyone on the water. Vessel insurance is also a key concern; whether fishermen will be able to receive insurance to fish in or around FOW arrays is not widely known. Most respondents (14 out of 23) indicated that they did not know if they would be insured to fish within the proposed Lease Areas. Many of these respondents also noted that if they were to receive insurance, they suspected that their premiums would rise dramatically, adding economic stress to their fishing operations. One noted that even if they were insured, they would not fish near FOW arrays as there is too much risk. The lack of clarity around vessel insurance is critical as it shapes wider perceptions of the perceived danger of FOW arrays. For instance, respondents questioned, if insurers are hesitant to provide coverage for vessels to fish near/around FOW arrays, what is the risk of simply navigating near these structures? Greater clarity on factors including vessel insurance is critical for fishermen to better understand FOW, and by extension, make informed decisions on the feasibility of fisheries' coexistence with FOW.

B3.4.3 CONSIDERATIONS TO IMPROVE SAFETY:

When prompted with the following questions: "What should we be looking into to determine whether fishing in a FOW is possible?" and "What would make you feel safe navigating in or around FOW arrays?," respondents noted a range of considerations to improve safety within FOW and potentially promote fisheries' coexistence with FOW. These include the following:

- Ensure adequate spacing between FOW turbines and widen transit corridors, paying particular attention to:
  - Layouts that enable multiple gear types (fixed & mobile) to operate in the same space at the same time.
  - Layouts with a minimum of 4 nautical miles of spacing between the anchor points of turbines to enable adequate room for fishing activities.
  - Layouts that consider the movement of the platforms in conjunction with strong tidal currents, enabling mariners to easily gauge the extent of a platform's watch circle.
  - Layouts for transit lanes that enable safe, and practical two-way traffic.

- Cluster or concentrate FOW turbines as closely as possible to limit the spatial spread of FOW arrays within lease areas.
- Ensure that FOW structures are visible on Automatic Identification Systems and provide systems for mariners to identify FOW structures (anchors, mooring lines, cables, etc.) underwater by, for instance, incorporating lighting fixtures on mooring buoys. This should be coupled with investments in mapping technology to better illustrate the location of underwater obstacles on navigation software.
- Explore the possibility of using FOW technology structures without a large spatial spread.
- Provide clarity on any potential radar interference within FOW and propose strategies to reduce any known impacts on fishing or navigation.
- Find avenues to create or strengthen existing relationships among stakeholders in the FOW development process, including fishermen, developers, academics, and others to explore the enhancement of fisheries, gear development and innovation, as well as other avenues to support the fishing industry.
- Cease the process of developing FOW in the Gulf of Maine altogether.

B3.5 OTHER THOUGHTS FROM STAKEHOLDERS

While not specific to the physical coexistence of fisheries and FOW, respondents noted that other important factors ought to be considered in the discussions around fisheries' coexistence with FOW. There are multiple stressors on the fishing industry and fishermen are concerned about how these may affect their livelihoods. These include changes in the climate, the economy, and the potential environmental and cumulative economic impacts of FOW development in the Gulf of Maine.

As with many industries, climate change poses a significant challenge to the fishing industry. Several respondents highlighted the increasingly unpredictable weather conditions they are experiencing while fishing in the Gulf of Maine. One fisherman described how the Gulf of Maine does not stay perfectly calm, and the weather seems to be getting worse and worse every year. Not only are weather conditions already complex, but scientific studies suggest that extreme weather events are likely to occur more frequently.[6] This presents an added stressor to fishermen in the Gulf of Maine – a stressor that is already complicated to manage in an open ocean environment, and could, according to that same fisherman, make fishing very difficult within FOW arrays. Another environmental concern raised by a respondent is how the distribution of ocean resources may shift by integrating FOW arrays into the Gulf of Maine. Scientific studies indicate that the Gulf of Maine is warming at rates faster than most of the world's, driving major fishery changes, including shifting species distributions that disrupt ecosystems[7]. Questions around whether biomass will increase/decrease around FOW arrays, if FOW arrays will act as attractants, or if FOW will spur species displacement are all not well understood. Respondents suggested more

6 United States Environmental Protection Agency. 2024. Climate Change Indicators: Weather and Climate. https://www.epa.gov/climate-indicators/weather-climate.

7 Gulf of Maine Research Institute, 2025. 2024 Casco Bay Ecosystem Monitoring Report. https://gmri.org/stories/2024-casco-bay-ecosystem-monitoring-report/

research is needed on the environmental implications of FOW development in the Gulf of Maine context.

Economic concerns were also of note. One respondent brought up the notion that FOW developers are promising job opportunities for folks in the fishing industry as a means of enhancing coexistence. The respondent disputed this claim, arguing that most jobs created by FOW would be provided to skilled, credentialed personnel from other parts of the country, leaving fewer opportunities for fishermen to receive economic benefits from FOW. Several respondents also shared concerns about how energy produced from FOW would raise electricity rates for consumers, adding additional stressors to Maine residents. Pairing these stressors with the concerns over physical gear conflicts paints a more holistic picture of the factors to consider when assessing the feasibility of fisheries' coexistence with FOW.

B4. KEY AREAS FOR FUTURE RESEARCH

Findings from the Phase 1 engagement period suggest a range of perspectives across several topics relevant to the feasibility of fisheries' coexistence with FOW. With a geographically diverse and demographically relevant response group, input provided by respondents should prove valuable in future work exploring the impacts of FOW development on fisheries in the Gulf of Maine. However, more information derived from research and construction decisions is necessary for fishermen to better understand how their operations may coexist within FOW. Areas for future research, as identified by respondents, are listed below.

- Vessel Crowding – Respondents highlighted concerns around crowding in certain fishing areas due to the potential displacement of fishermen from FOW arrays. Research into the potential for displacement of fisheries because of FOW development would facilitate more informed decision-making throughout the development process.
- Vessel Insurance – Greater clarity is necessary on whether fishermen will be insured to fish within or around FOW arrays. Additional research into the impacts on insurance premiums for vessels seeking to fish in these areas is also necessary.
- Search and Rescue Operations – Respondents call for research into the implications of FOW development on potential search and rescue operations within FOW arrays.
- Socioeconomic Impacts – Research into how stakeholders in the Gulf of Maine will be impacted by FOW development as it relates to the availability of jobs, cost of electricity, and other relevant socioeconomic factors could inform the decision-making process.
- Environmental Impacts – Respondents seek clarity on how FOW technology (e.g., platforms, mooring lines, cabling systems, anchors, cooling stations) may impact the Gulf of Maine environment. Specific concerns include:
  - The potential impacts that EMFs emitted from transmission cables may have on recruitment and migration patterns of commercially viable species.
  - The potential for FOW structures to act as attractants for certain marine species.
  - The potential impacts of FOW cooling stations and their discharge on the Gulf of Maine environment.
  - The potential impacts of seismic testing and wind turbine blade noise on commercial species migration, aggregation, recruitment, and habitat use.
  - The potential for marine species entanglement from lines associated with FOW mooring and cabling systems.
  - The potential that commercially viable species may migrate in irregular patterns because of FOW development. There is concern that this may make it more difficult to fish in areas that are traditionally well-known.
- Fisheries Assessments and Monitoring – Greater research into long-term marine species distribution is necessary to better understand future areas of importance to the fishing industry. While certain areas proposed for FOW development were chosen to reduce conflicts with the fishing industry, respondents voice concern that species distributions may shift, which may create future conflict for fishermen.

ATTACHMENT B-A DRAFT WIND ENERGY AREA PUBLIC COMMENT

Draft WEA Public Comment Summary Report

To inform existing understandings of coexistence and help define research questions, this document summarizes an assessment of the 316 public comments on the BOEM-designated Draft WEA on the Outer Continental Shelf offshore the States of Maine, New Hampshire, and Massachusetts. Public comments were posted by a range of individuals and organizations including, but not limited to, concerned citizens, fishermen, fishing organizations, non-governmental organizations, offshore wind developers, and a range of government organizations. Summaries from 12 port meetings BOEM convened and participated in during the Draft WEA phase were also included and assessed.

In evaluating comments, particular emphasis was given to understanding stakeholders' concerns with operating in and around floating offshore wind arrays. After an initial review, three key areas of concern – technology, navigation/liability, and excessive unknowns – were outlined and used to direct the assessment. Data collected include the link to the public comment, name of commenter, commenter's affiliation, assumed gear type, the comment itself, and the related area of concern.

Findings:

Most commenters expressed measurable concern regarding operability around floating offshore wind arrays. Of the 316 comments, 40 explicitly referenced concerns around coexistence including technology, navigation/liability, and/or excessive concerns. Of those 40 comments, 31 noted navigational and liability factors, 19 noted floating offshore wind technology factors, and 12 noted excessive unknowns as factors contributing to concerns regarding their ability to operate within and or around floating offshore wind arrays. Many noted a mix of several concerns (Figure 1)

Technology-Based Concerns:

- Ex: "The existence of midwater inter-array cables will prohibit coexistence with fishing."
- Ex: "There is no way a mobile gear fisherman can tow their nets through a maze of anchors, chains and electrical cable. That whole Gulf of Maine will be off limits to all except the windmill company."

Navigation and Liability Concerns:

- Ex: "Concerns about how fishermen will work around the turbines. Fishermen are steaming for hours and need to consider currents, bottom type, etc. during a tow which will make navigating around these turbines impossible."
- Ex: "It should be understood that fishermen's concerns are not so much about transiting during fair weather, but about being within a wind array when weather and sea conditions are less than ideal; for many offshore vessels transiting to and from fishing grounds occurs at the beginning or end of a fair weather window; it is not unusual for vessels fishing offshore to be chased home as the weather worsens, potentially transiting an offshore wind array under decaying conditions. Besides the fear of mishap, a secondary concern is that the potential for collision with wind towers will result, over time, in increased insurance premiums."

Concerns Regarding Excessive Unknowns:

- Ex: "Offshore wind generation is NOT compatible with fish, or fishing boats. These 2 entities CANNOT co-exist. There will be less area to fish in, therefore, fewer boats, less seafood landed and billions in lost revenue."
- Ex: "Offshore wind development will ruin fisheries and our coast and turn it into a barren industrial waste land. The pre construction testing, constriction, and operation of these wind turbines is and will continue to be a huge threat to wildlife, fisheries, fisherman and all those who transit the gulf of Maine."

The distribution of comments associated with a given gear type was also assessed (Figure 2). In the pool of 40 comments, 6 were associated with fixed gear, 10 were associated with mobile gear, and 18 were associated with both gear types. Six comments were unaffiliated with any gear type. It is important to note that these are assumptions of gear types based on the content of the comments, and thus they may not accurately reflect the actual gear type used by a commenter.

FIGURE 1: DISTRIBUTION OF COMMENTS ASSOCIATED WITH EACH AREA OF CONCERN.

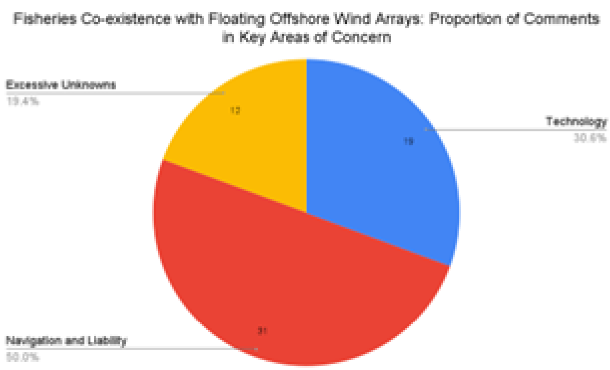
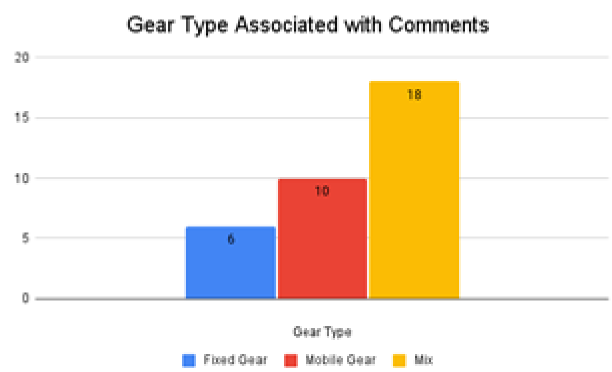


FIGURE 2: ASSUMED GEAR TYPES ASSOCIATED WITH EACH COMMENT.



While not included in the assessment, common statements noted across other comments include:

- Any potential offshore wind development will displace fishing activity, creating significant socioeconomic impacts on coastal communities.
- There is a lack of clarity regarding how the presence of subsea cables from offshore wind arrays may impact marine life and fishing effort.

- Fishermen's knowledge and expertise has been dismissed throughout the offshore wind leasing process.
- There is concern over a potential negative impact that offshore wind arrays may have on the endangered North Atlantic Right Whale.

Key Takeaways

The findings from this assessment helped the project team to understand stakeholders' concerns, enabling the project team to more effectively tailor its research questions to the interests of those involved. Questions that may help inform the direction of this project's research include:

- Will any fishing activity be permitted within floating offshore wind arrays?
- How might lobstermen operate within floating turbines given the length of their gear (up to 1.7 miles long) and what is the potential for entanglement?
- How might mobile gear fisheries navigate with a tow within a floating offshore wind array that has suspended inter-array cables and mooring lines? What is the risk of gear entanglement?
- Will fishermen be able to insure their vessels to operate within floating offshore wind arrays?
- Will fishing vessels be able to safely transit through floating offshore wind arrays in poor weather?
- Will transit lanes create unsafe crowding effects?
- Will fishermen be able to fish in transit lanes?
- Is a fishing vessel's radar system impacted within or by the presence of floating offshore wind arrays?
- Will inter-array cables be buried to allow for fishing within floating turbines?
- Could it be possible to cluster offshore wind arrays in order to create wider buffers to allow for fishing around the arrays?

ERM HAS OVER 160 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina
Australia
Belgium
Brazil
Canada
China
Colombia
France
Germany
Ghana
Guyana
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
The Netherlands
New Zealand
Peru
Poland
Portugal
Romania
Senegal
Singapore
South Africa
South Korea
Spain
Switzerland
Taiwan
Tanzania
Thailand
UAE
UK
US
Vietnam

ERM's Boston Office

One Beacon Street
5th Floor
Boston, MA 02108

T +1 617 646 7800
F +1 617 830 8975

www.erm.com

APPENDIX C DESKTOP FISHERIES ASSESSMENT

Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind

Appendix C: Desktop Fisheries Assessment

PREPARED FOR
State of Maine, Governor's Energy Office

DATE
5 September 2024

REFERENCE
0724797

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym	Description
BOEM	Bureau of Ocean Energy Management
ERM	ERM Consulting & Engineering, Inc.
FOW	floating offshore wind
LMA	lobster management area
NOAA	National Oceanic and Atmospheric Administration
OSW	offshore wind

C1. INTRODUCTION

Over the course of 2023, the Maine Offshore Wind Research Consortium Advisory Board underwent a rigorous prioritization process to identify three research topics to fund in its inaugural round of projects. This project, Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind, was one of the projects included in the competitive Request for Proposals that was issued in November 2023 by the Governor's Energy Office on behalf of the Research Consortium.

ERM Consulting & Engineering, Inc. (ERM) and GMRI were awarded the project to pursue the research and stakeholder engagement to advance understandings of floating offshore wind (FOW) and fishery coexistence. The project kicked off in February 2024. As part of this project, ERM performed a desktop fisheries assessment identifying fishing species, their commercial value, and top gear and vessel types used for fishing within the region and proposed lease areas (PA).

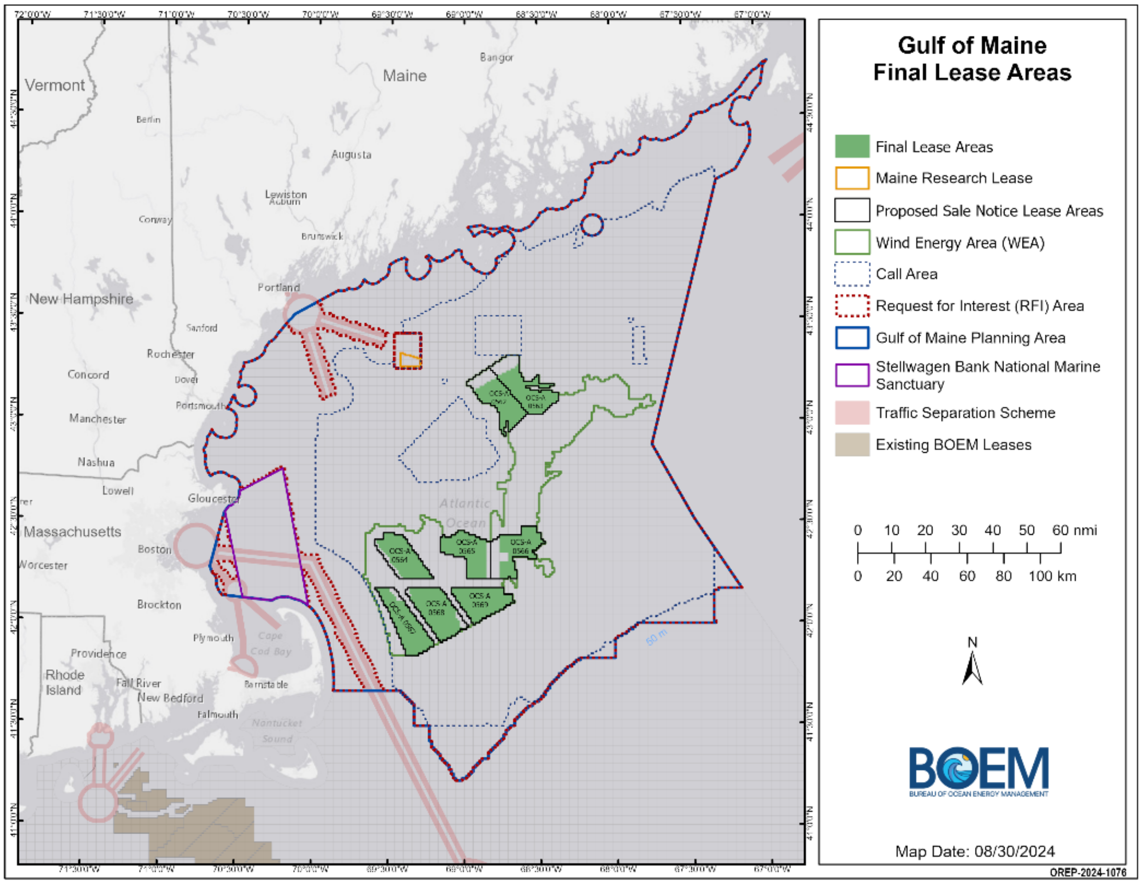
In this analysis, ERM reviewed National Oceanic and Atmospheric Administration (NOAA) Fisheries landings data for the State of Maine[1] and NOAA reports on fishing activity, gear type and vessel trends from 2008 to 2022[2] within each Proposed Lease Area. The areas addressed in the report reflect the Proposed Lease Area announced[3] by the Bureau of Ocean Energy Management (BOEM) as of April 2024.

This appendix is organized as follows:

- Section C2 provides the details of desktop assessment on the fisheries.
- Section C2.1 describes a preliminary assessment ERM conducted to identify the top species by commercial value within the State of Maine, showing weight and value.
- Section C2.2 provides an overview of the economic significance of various species within the Gulf of Maine's Proposed Lease Area and their interaction.
- Section C2.3 provides an analysis of the gear types used to land these top species by weight and value in the Gulf of Maine.
- Section C2.4 reviews the types and sizes of vessels targeting these fishing species, offering insights into fleet size trends over the past decade and future projections.
- Section C3 outlines limitations and data gaps.

[1] NOAA Fisheries Landings in the US. 2022. Fisheries One Stop Shop (FOSS) | NOAA Fisheries | Landings
[2] Socioeconomic Impacts of Atlantic Offshore Wind Development | NOAA Fisheries
[3] Interior Department Proposes Offshore Wind Sales in Oregon, Gulf of Maine | U.S. Department of the Interior (doi.gov)

FIGURE 1: GULF OF MAINE LEASE AREAS



Source: BOEM 2024

Note: On September 16, 2024, BOEM published the Final Sale Notice for offshore wind lease in the Gulf of Maine. The final lease areas (green in Figure 1 above) are slightly different than the proposed leases areas (black outlines in Figure 1 above). As stated above, the fisheries data analyzed in this report were developed on the proposed lease areas (as of April 2024) prior to the Final Sale Notice. While the exact fisheries data may change slightly with the Final Lease Area boundaries, the top ten species and common gear types will likely stay the same. Following the lease sale on October 29, 2024, four of the available eight lease areas received bids. Avangrid Renewables LLC secured OCS 562 and OCS 564. Invenergy NE OSW LLC secured OCS 567 and OCS 568.

C2. DESKTOP FISHERIES ASSESSMENT

C2.1 POTENTIAL TOP SPECIES BY COMMERCIAL VALUE

ERM assessed data from multiple sources including the State of Maine Department of Marine Resources and NOAA Fisheries Landings database to understand the top species by value or weight in the State of Maine, irrespective of where the fishing activities occurred. The commercial value of the top 10 species by weight (pounds) and value (dollars) in 2022, the latest year with complete data, are listed in Table 1 and Table 2, respectively. Based on the 2022 dataset, there are four species that are in the top 10 in both value and weight: **American lobster**, the **menhaden**, the **soft clam**, and the **green sea urchin**. These species are bolded in Table 1 and Table 2 below.

TABLE 1: MAINE COMMERCIAL LANDINGS BY **WEIGHT** (YEAR 2022)

Rank	Species (National Marine Fisheries Service Name)	Weight (Pounds)
1	**Lobster, American**	98,777,569
2	**Menhadens**	20,345,403
3	Seaweed, Rockweed	12,842,974
4	Herring, Atlantic	3,822,900
5	Crab, Jonah	2,090,924
6	**Clam, Soft**	1,410,943
7	Goosefish	1,215,250
8	Mussel, Sea	1,030,309
9	Crab, Atlantic Rock	910,180
10	**Urchin, Green Sea**	842,878
X	Withheld for Confidentiality	31,150,455

Source: NOAA Fisheries Landings database

Note: "WITHHELD FOR CONFIDENTIALITY" represents query results with no pounds or dollars which indicate that landings are present in the database for the selected species but are confidential and have been grouped into with other confidential landings in each state.

TABLE 2: MAINE COMMERCIAL LANDINGS BY **VALUE** (YEAR 2022)

Rank	Species (National Marine Fisheries Service Name)	Value (Dollars)
1	**Lobster, American**	$392,563,635.93
2	Eel, American	$20,163,965.07
3	**Clam, Soft**	$18,639,965.98
4	Scallop, Sea	$11,879,376.11

Rank	Species (National Marine Fisheries Service Name)	Value (Dollars)
5	Oyster, Eastern	$11,145,128.96
6	**Menhadens**	$8,402,899.59
7	Polychaete, Bloodworms	$4,937,990.12
8	Mussel, Sea	$4,632,350.73
9	Clam, Quahog, Northern	$3,493,313.25
10	**Urchin, Green Sea**	$2,709,901.38
X	Withheld for Confidentiality	$92,129,243.12

Source: NOAA Fisheries Landings database

The tables above summarize landings for the entire State of Maine, not specific regions (e.g., Proposed Lease Areas) of the ocean. For example, the Polychaete Bloodworms, commonly used as bait, are harvested from intertidal mud flats during low tide, and the offshore wind (OSW) developments likely would have no direct impact on this species. To understand the specific species and fisheries that are most active in the Proposed Lease Areas, ERM assessed other datasets, focusing only on the Proposed Lease Areas, as discussed in Section C2.2.

C2.2 POTENTIAL TOP SPECIES WITHIN THE PROPOSED LEASE AREAS

There are eight Proposed Lease Areas in the Gulf of Maine's: OCS-A 0562, OCS-A 0563, OCS-A 0564, OCS-A 0565, OCS-A 0566, OCS-A 0567, OCS-A 0568, and OCS-A 0569 (Figure 1; zoomed-in maps of Proposed Lease Areas presented in Attachment C-A). Based on the species review described above, these Proposed Lease Areas are ecologically and geologically diverse and each Proposed Lease Area supports commercial fishing. To identify landing quantities, top species, and fishing vessels specific to the Proposed Lease Areas, ERM analyzed data from NOAA Fisheries' socioeconomic impact studies[4] and BOEM's data on fishing activity within the lease areas[5]. ERM reviewed landings and revenue data from 2008 to 2022. In addition, Attachment C-B provides spatial density maps of commercial fishing activity from the Northeast Data Portal[6]. These maps inform understanding of the fishing areas and the potential impacts of OSW development on specific fish species, but they cannot be used to compare the value of fishing across different species, thus, they are not used in the detailed analysis.

C2.2.1 POTENTIAL TOP SPECIES WITHIN THE GULF OF MAINE LEASE AREAS

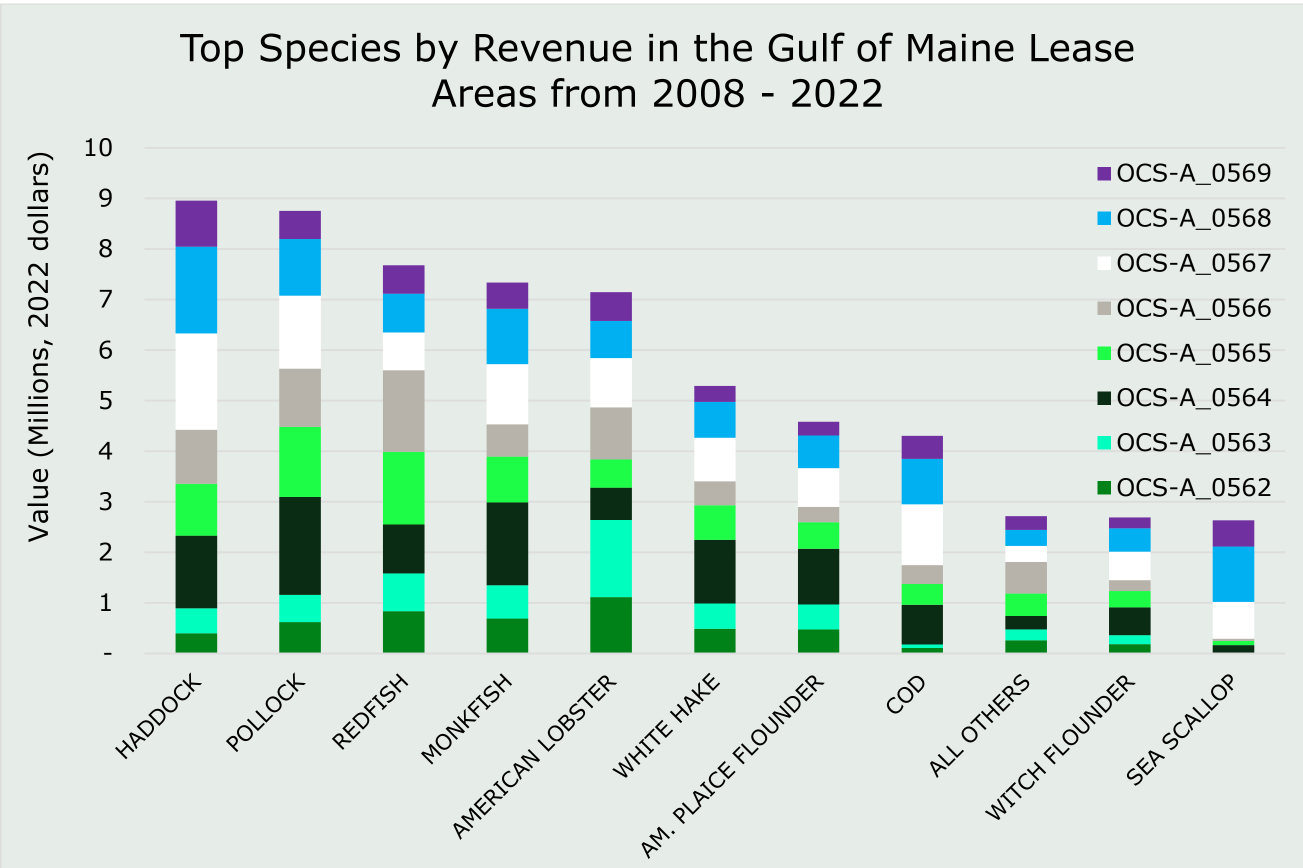
Figure 3 presents the potential most impacted species by revenue across all the Proposed Lease Areas, using data from 2008 to 2022. The top 10 species, listed from greatest to lowest value, are **haddock, pollock, redfish, monkfish, American lobster, white hake, American plaice flounder, cod, witch flounder, and sea scallop.**

[4] Socioeconomic Impacts of Atlantic Offshore Wind Development | NOAA Fisheries
[5] Gulf of Maine | Bureau of Ocean Energy Management (boem.gov)
[6] https://www.northeastoceandata.org/

The category "All Others" refers to species with less than three permits or dealers impacted to protect data confidentiality.

The top species within each individual Proposed Lease Area varies slightly from the overall top species for the combined lease areas in the Gulf of Maine. Table 3 summarizes the revenue value for the top 10 species by Proposed Lease Area – all values greater than $1 million are bolded. There are other species outside of the top 10 revenue list that also generate revenue and may be impacted by FOW development but have not been assessed in this study.

FIGURE 2: TOP SPECIES BY REVENUE IN THE GULF OF MAINE **LEASE AREAS** FROM 2008 - 2022



Note: 'All Others' represents records that do not meet the minimum required number of dealers and permits and were summarized for confidentiality by NOAA. 'All Others' does not represent all other species.

Other top species identified by project subcontractor, John Williamson, FV Sea Keeper, a fishing specialist in the Gulf of Maine, include herring and bluefin tuna. [7]

- Atlantic Herring: In 2022, commercial landings in the region totaled approximately 9.4 million pounds and were valued at $4.5 million[8]. The herring fishery occurs mostly within 30 miles of the coast and most of the harvest comes from federal waters.

[7] Invenergy NE Offshore Wind, LLC (OCS-A 0562) | Bureau of Ocean Energy Management
[8] NOAA Fisheries: Atlantic Herring Management

- Bluefin Tuna: In 2022, commercial landings in the region totaled 2.3 million pounds and were valued at $12.1 million[9]. Commercial and recreational fishing for bluefin tuna occurs almost exclusively within 30 miles of the coast.

It should be noted that the majority of identified PAs are further than 30 miles from the coast, only one of eight being approximately 21.6 nm from Massachusetts at its closest point.

[9] NOAA Commercial Landing database

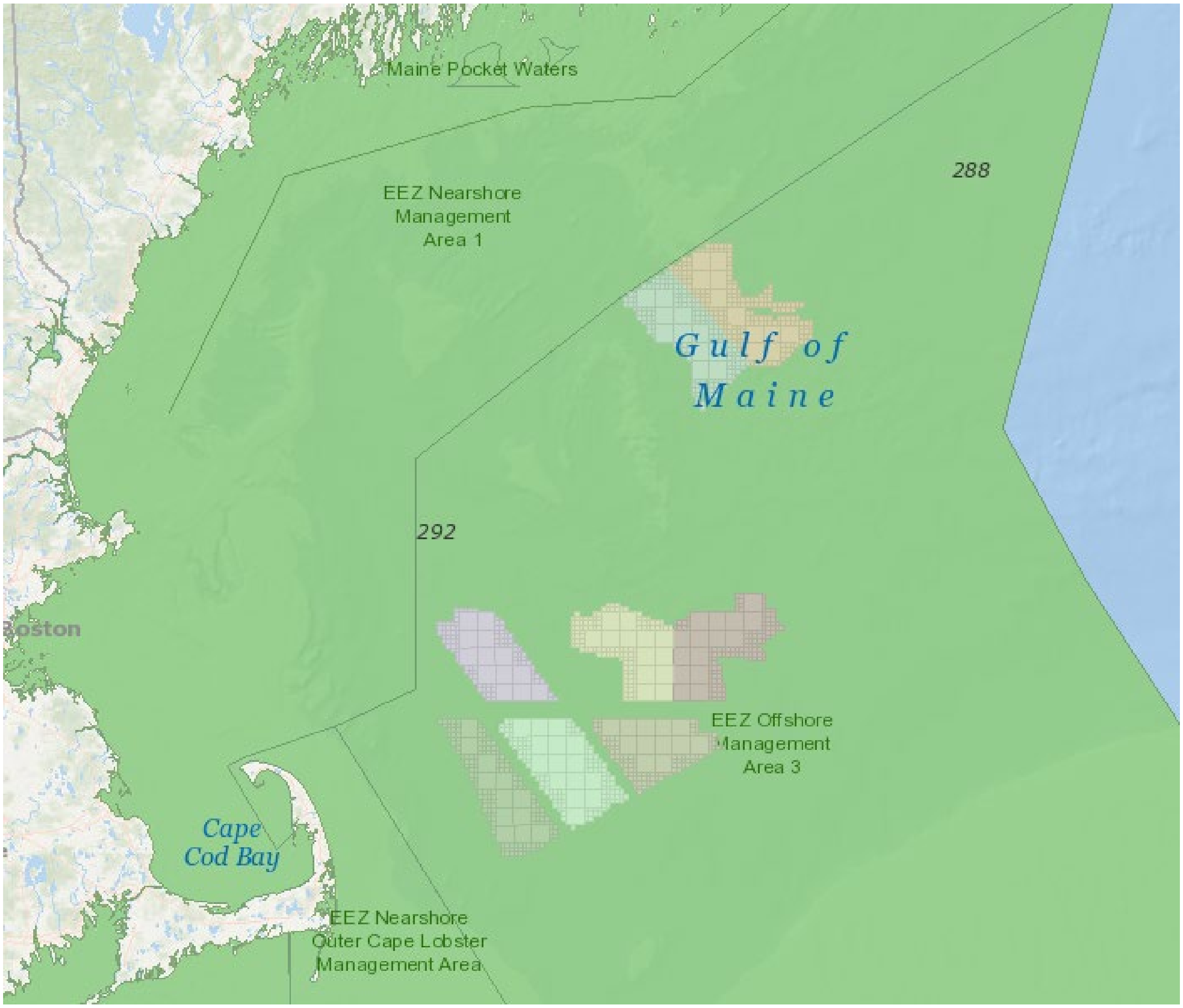
TABLE 3: TOP SPECIES ACROSS LEASE AREAS AND THEIR REVENUE GENERATED

Top Species	*0562	*0563	*0564	*0565	*0566	*0567	*0568	*0569
Haddock	$402,474	$493,678	**$1,434,115**	**$1,026,271**	**$1,067,326**	**$1,903,492**	**$1,720,249**	$906,318
Pollock	$623,790	$533,905	**$1,936,845**	**$1,387,023**	**$1,155,526**	**$1,437,130**	**$1,125,686**	$553,558
Redfish	$837,878	$744,041	$968,574	$1,438,579	$1,614,987	$746,476	$767,270	$561,538
Monkfish	$693,259	$657,646	**$1,636,667**	$904,591	$642,891	**$1,188,545**	**$1,094,738**	$519,016
American Lobster	**$1,116,072**	**$1,524,351**	$639,105	$554,727	**$1,034,898**	$976,004	$732,011	$572,536
White Hake	$491,159	$497,658	**$1,257,285**	$683,577	$476,258	$864,330	$704,548	$320,280
American Plaice Flounder	$479,465	$489,151	**$1,100,125**	$529,738	$299,094	$770,382	$645,387	$273,397
Cod	$106,448	$73,339	$781,910	$412,431	$372,742	**$1,205,722**	$894,784	$456,203
All Others	$260,045	$218,786	$263,126	$441,236	$628,875	$319,300	$313,331	$273,184
Witch Flounder	$186,398	$175,145	$553,041	$324,386	$212,303	$561,997	$463,897	$212,632
Sea Scallop	-	-	$169,173	$82,689	$43,163	$727,004	$1,091,731	$523,809

Note: bolding indicates revenue greater than one million dollars.

There are seven Lobster Management Areas (LMAs along the east coast of the U.S., each with specific management requirements. In response to fisheries engagement and advocacy by the Governor's office and the Maine Congressional Delegation, the Proposed Lease Areas are not located in LMA1. This step was taken to reduce the impacts of OSW development on commercial lobster operations. The Proposed Lease Areas are all located within LMA3 (Figure 3). A zoomed-in map is included in Attachment C-C.

FIGURE 3: PROPOSED LEASE AREAS AND LOBSTER MANAGEMENT AREAS

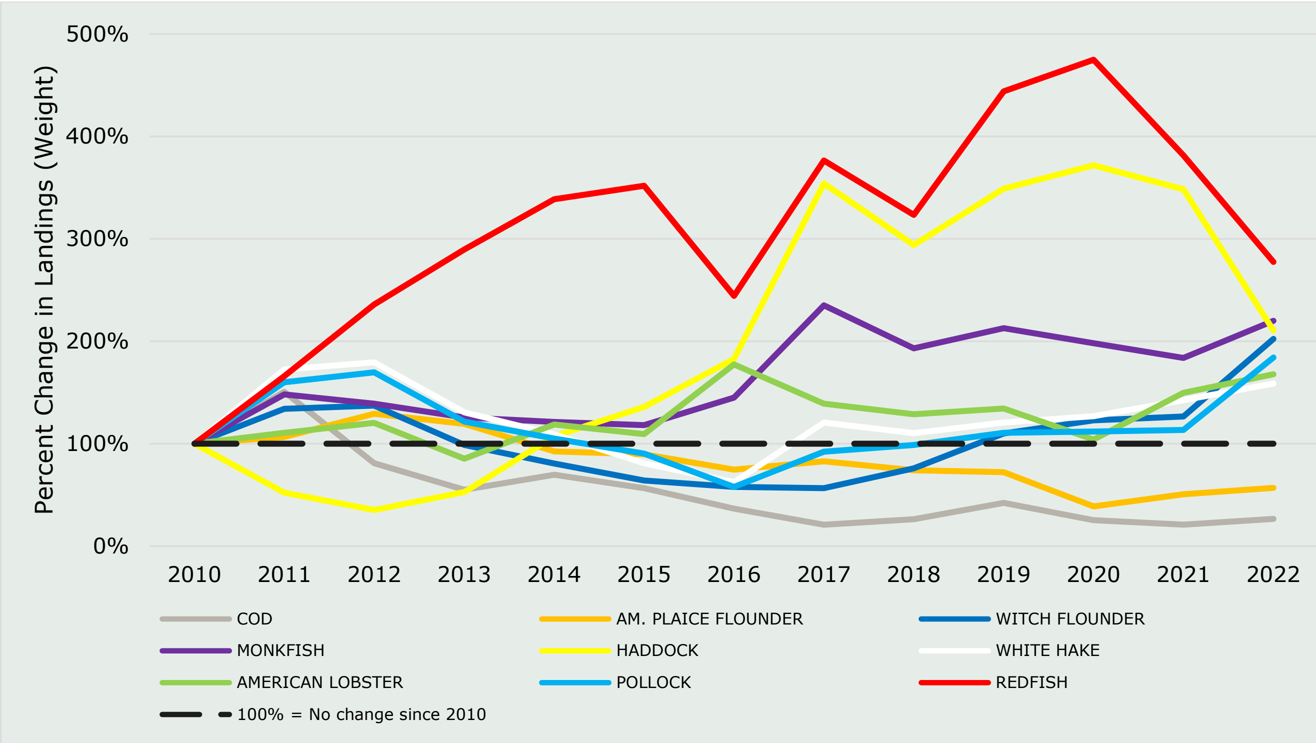


Source: Northeast Ocean Data Portal

C2.2.2 TOP SPECIES OVER TIME

Commercial landings for different species fluctuate year to year due to variations in fishing intensity, search methods, weather conditions, market conditions, and regulatory changes. To understand temporal changes in fishing in the Proposed Lease Areas, ERM assessed the variation of commercial landings (weight) from 2008 to 2022 (Figure 4) for the top 10 species. The data presented in the graph are referenced to the 2010 landing value (i.e., 2010 is 100 percent), so the graph shows temporal changes relative to 2010 landings.

FIGURE 4: PERCENT CHANGES IN LANDING TOP SPECIES IN THE GULF OF MAINE LEASE AREAS BY WEIGHT FROM 2010 TO 2022 (2010 = 100%)



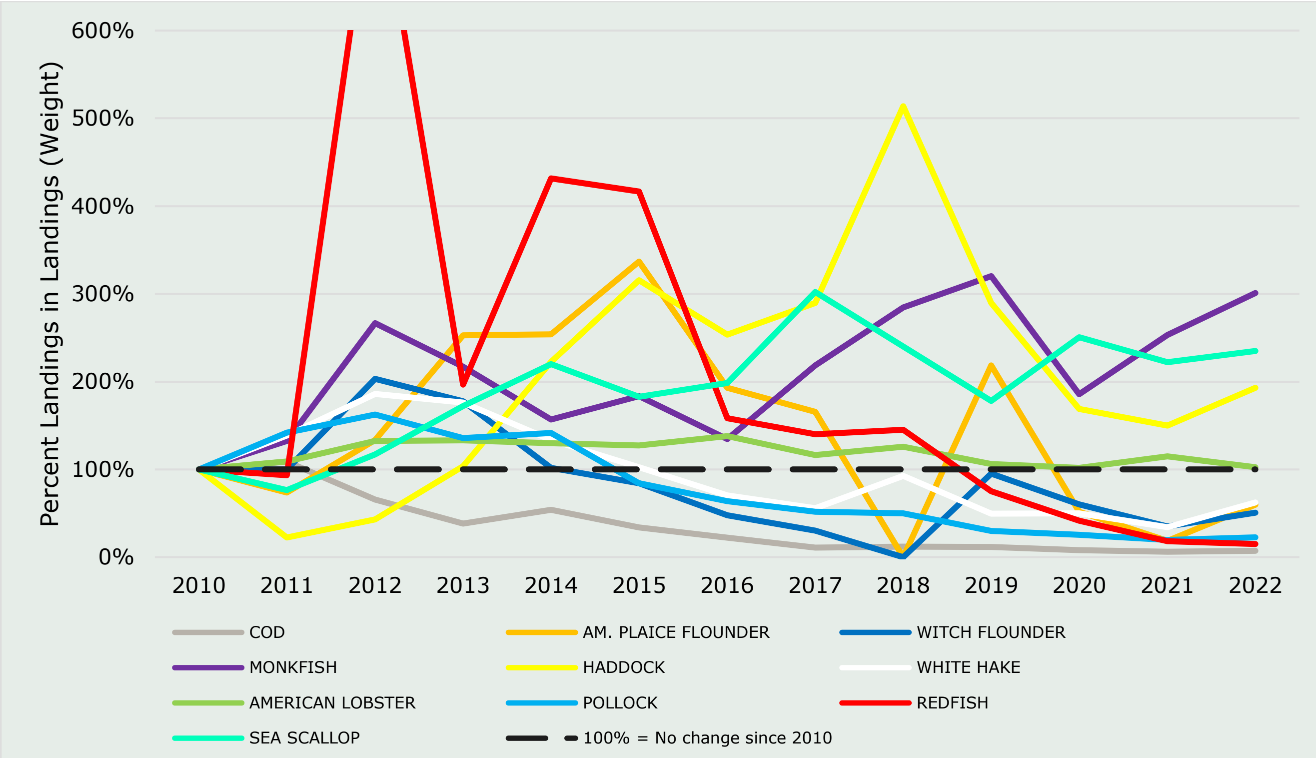
Data source: National Marine Fisheries Service 2024

Note: Sea Scallop is not included in the chart because the seasonal landings are significantly more variable than other species. In general, sea scallop landings from the lease areas have increased since 2008.

Relative to 2010, landings have increased for all ten of the top species except American plaice flounder and cod. Redfish landings have increased the most, peaking at over 400% of their 2010 level by 2020. Haddock and monkfish also saw increases, with haddock peaking at around 300% and monkfish at around 200% of their 2010 baselines. In contrast, American lobster landings remained relatively stable, showing slight growth around 2016, while cod and American plaice flounder experienced either declines or minimal changes.

For comparison, ERM also evaluated temporal changes in landings by weight for the top 10 species across the State of Maine in Figure 5.

FIGURE 5: PERCENT CHANGES IN LANDINGS IN MAINE (STATEWIDE) BY WEIGHT SINCE 2010 (2010 = 100%)



Data source: National Marine Fisheries Service 2024

Note: Redfish in 2012 is 800%. For the readability of the other species, the chart is scaled to partially exclude this data point.

Figure 5 illustrates the trends in statewide commercial landings for the same ten key species from 2010 to 2022. Since 2010, statewide landings have decreased overall for six species: white hake, American plaice flounder, witch flounder, redfish, pollock, and Atlantic cod. In contrast, statewide landings of monkfish, sea scallop, and haddock have increased. Statewide American lobster landings have remained stable.

In both the lease areas and across the state of Maine, commercial landings by weight for monkfish, sea scallop, and haddock have increased, while landings for American plaice flounder and cod have decreased.

C2.2.3 FINDINGS

In Maine, several top species by revenue and weight, such as lobster, and various crabs, are primarily harvested in nearshore environments. Landings for the nearshore species have generally been stable. In contrast, landings for species that inhabit deeper waters, including haddock, monkfish, Atlantic cod, American plaice flounder, and witch flounder, have been variable, with landings of some species increasing while landings of other species have declined.

This distinction between nearshore and deep-water landings is important because it highlights the relative economic stability of nearshore fisheries compared to the more variable and potentially less economically stable deep-water fisheries. This variability in deep-water landings suggests that the fisherman reliant on these species may be facing economic pressures due to fluctuating catch levels, making them potentially more sensitive to additional economic impacts from OSW) developments. Climate and environmental changes, including shifts in water temperature and species migration patterns, could further alter the distribution of species in the Proposed Lease Areas in the future.

Comparison of the top 10 species by value and weight lists between the Gulf of Maine and the Proposed Lease Areas suggests that some commercially valuable species in the broader Gulf of Maine (e.g., American lobster) are likely to be more impacted by OSW than other species. However, there are several commercially valuable species in the Gulf of Maine that are in the top 10 species list by value and weight (e.g., soft clam, and green sea urchin) or by value (e.g., American eel, Eastern Oyster, bloodworms polychaete, sea mussel, and Northern Quahog clam) that are not in the top 10 species by value or weight in the Proposed Lease Areas, suggesting that these economically valuable species may be less impacted by OSW. The potential economic impact of OSW on fisheries in the Gulf of Maine will vary based on species, with haddock, monkfish, and Atlantic cod fisheries experiencing potentially distinct economic effects of OSW due to the species composition within the Proposed Lease Areas.

C2.3 GEAR TYPE

ERM reviewed data on fishing gear types to better understand the activities and technologies used in the Proposed Lease Areas, to support the assessment of fisheries coexistence with FOW technologies. To understand the mobile and static gear types used for fishing the top 10 species in the Proposed Lease Areas, ERM communicated with local fishery specialist, John Williamson. Mobile gear, such as trawls and dredges, is towed behind a vessel and covers a larger area, while static gear, such as pots and gillnets, is set in place to capture fish. Fishing gear types are illustrated in Figure 6.

The primary **mobile gear** types are:

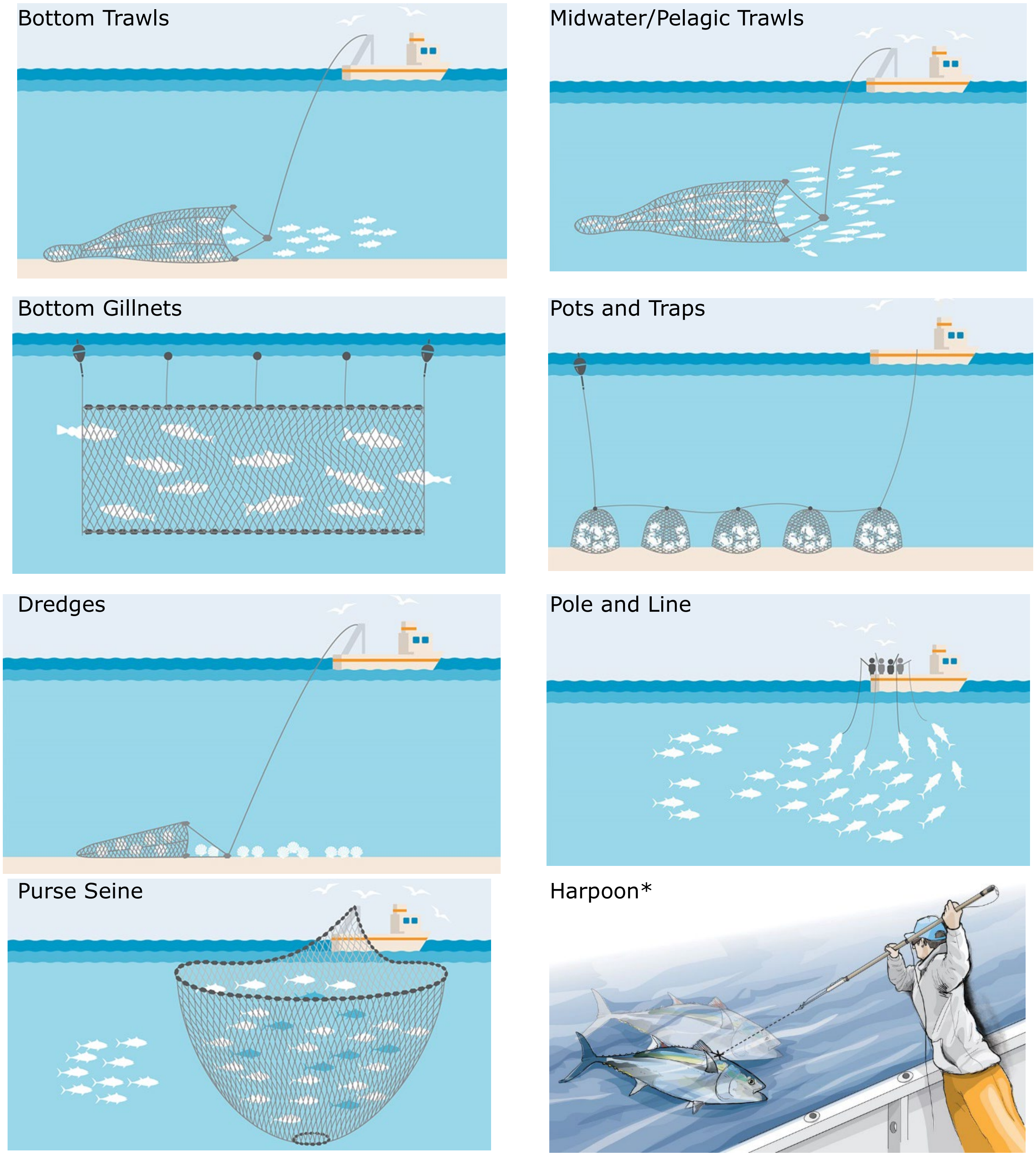
- **Bottom trawls**: target groundfish species such as haddock, pollock, monkfish, cod, hake, redfish, and flounders
- **Midwater/Pelagic trawls:** target pelagic species such as mackerel and menhaden
- **Hook and Line Vessels:** target haddock, pollock, cod, and bluefin tuna
- **Dredges**: sea scallop

Midwater trawls and purse seines are used for Atlantic herring, and harpoons are used for bluefin tuna, however, these species are not designated within the top 10 in the Proposed Lease Areas.

The primary **static gear** types are:

- **Pots and Traps:** lobster
- **Bottom gillnets:** target haddock, pollock, cod, monkfish, and hake

FIGURE 6: COMMON FISHING GEAR TYPES USED IN THE PROPOSED LEASE AREAS



Source: Marine Stewardship Council[10]
*Illustration by Mike Sudal[11]

---

[10] Fishing methods and gear types | Marine Stewardship Council
[11] Harpoon Versus Gaff

Table 4 and Table 5 summarize the gear types used to land the top species by revenue and by weight, respectively. Mobile gear, particularly bottom trawls, is the most used gear type across all lease areas. All values greater than $1 million are bolded.

TABLE 4: THE GEAR TYPES USED TO LAND TOP SPECIES, AND THEIR GENERATED REVENUE

Lease Area	Trawl-Bottom	Trawl-Midwater	All Others	Gillnet-Sink	Pot-Other	Pot-Lobster	Dredge Scallop	Handline	Total Revenue
OCS-A 0562	$3,816,000	$7,000	$254,000	$240,000	$32,000	$934,000	-	-	$5,283,000
OCS-A 0563	$3,779,000	-	$207,000	$148,000	$65,000	$1,312,000	-	-	$5,510,000
OCS-A 0564	$10,382,000	$1,000	$235,000	$67,000	$73,000	$71,000	$140,000	-	$10,970,000
OCS-A 0565	$7,012,000	$9,000	$481,000	$131,000	$49,000	$258,000	$31,000	-	$7,969,000
OCS-A 0566	$6,188,000	$7,000	$642,000	$141,000	$84,000	$760,000	-	-	$7,822,000
OCS-A 0567	$9,882,000	$189,000	$297,000	$283,000	$50,000	$87,000	$722,000	$2,000	$11,512,000
OCS-A 0568	$8,194,000	$27,000	$687,000	$171,000	$47,000	$145,000	$709,000	< $500	$9,980,000
OCS-A 0569	$4,267,000	$39,000	$477,000	$78,000	$35,000	$275,000	$313,000	$1,000	$5,485,000

Source: National Marine Fisheries Service 2024

TABLE 5: THE GEAR TYPES USED TO LAND TOP SPECIES AND THEIR WEIGHTS IN POUNDS

Lease Area	Trawl-Bottom	Trawl-Midwater	All Others	Gillnet-Sink	Pot-Other	Pot-Lobster	Dredge-Scallop	Handline	Total
OCS-A 0562	2,820,000	34,000	265,000	144,000	31,000	150,000	-	-	3,444,000

Lease Area	Trawl-Bottom	Trawl-Midwater	All Others	Gillnet-Sink	Pot-Other	Pot-Lobster	Dredge-Scallop	Handline	Total
OCS-A 0563	2,759,000	-	203,000	87,000	64,000	206,000	-	-	3,319,000
OCS-A 0564	6,508,000	7,000	190,000	45,000	100,000	12,000	8,000	-	6,870,000
OCS-A 0565	5,448,000	59,000	359,000	85,000	52,000	44,000	2,000	-	6,048,000
OCS-A 0566	5,372,000	29,000	486,000	86,000	81,000	119,000	-	-	6,173,000
OCS-A 0567	5,832,000	1,006,000	261,000	184,000	65,000	15,000	47,000	1,000	7,410,000
OCS-A 0568	5,044,000	223,000	294,000	108,000	65,000	25,000	50,000	<500	5,809,000
OCS-A 0569	2,899,000	245,000	257,000	48,000	36,000	46,000	23,000	<500	3,553,000

Source: National Marine Fisheries Service 2024

C2.3.1 FINDINGS

Mobile gear, particularly bottom trawls are the primary gear type used in the Proposed Lease Areas for groundfish species. Revenue from bottom trawls for all Proposed Lease Areas exceeds $53 million. As shown in Table 4, the highest bottom trawl revenue is from OCS-A 0564 and OCS-A 0567, where revenue exceeded $10 million and $9.8 million, respectively.

Compared to mobile gear, static gear types contribute less to the total landings but are an important gear type for certain species in certain Proposed Lease Areas, such as lobsters and groundfish. For example, pots and traps were used to land 150,000 pounds of lobster in OCS-A 0562 and 206,000 pounds of lobster in OCS-A 0563, generating around $1 million in revenue in each of the areas. Scallop dredging is prevalent in OCS-A 0567 and OCS-A 0568, highlighting the significance of sea scallop fishing in those areas. Midwater trawling, although less common, is used in OCS-A 0567, indicating its role in targeting pelagic species such as pollock.

C2.4 VESSEL SIZE AND COUNTS

To further understand fishing activity within the Gulf of Maine, ERM reviewed vessel sizes for fishing the top species. Vessel size information provides context on the type of commercial fishing vessels operating in the region, which impacts safety, navigation, and coexistence with the FOW technologies. Fishing of the top species in the Proposed Lease Areas requires specific permits and gear types, and by linking vessel sizes to corresponding permit requirements, we can understand what types of vessels are used most in the Proposed Lease Areas.

C2.4.1 VESSEL SIZE

ERM obtained data on federally permitted fishing vessels for 2014 through 2024 from the National Marine Fisheries Service. The database includes the type of permit for each vessel and specific characteristics of the vessels, including length and home port. Of the top 10 species in the Proposed Lease Areas (discussed in Section C2.2), only American lobster, monkfish, and scallops require species-specific commercial fishing permits. The other top 10 species are covered by the "Northeast Multispecies" permit, which includes several types of permits by gear type.

Note that the list of permitted vessels is likely larger than the number of active fishing vessels, therefore, it is not possible to accurately determine the active fleet size from the permitting data.

By permit, the most common vessel sizes are:

- **American Lobster:** 40 to 80 feet, with many vessels in the 70- to 80-foot range;
- **Monkfish:** 35 to 55 feet and 70 to 95 feet, which indicates that both mid-sized and larger vessels used in the monkfish fishery;
- **Scallops:** 40 to 45 feet and 80 to 85 feet, which indicates that both mid-size and larger vessels are used in the scallop fishery; and
- **Northeast Multispecies:** 30 to 55-foot vessels are most common, larger vessels in the 75- to 85-foot range are also used.

Additional information on vessel sizes is provided in Attachment C-C.

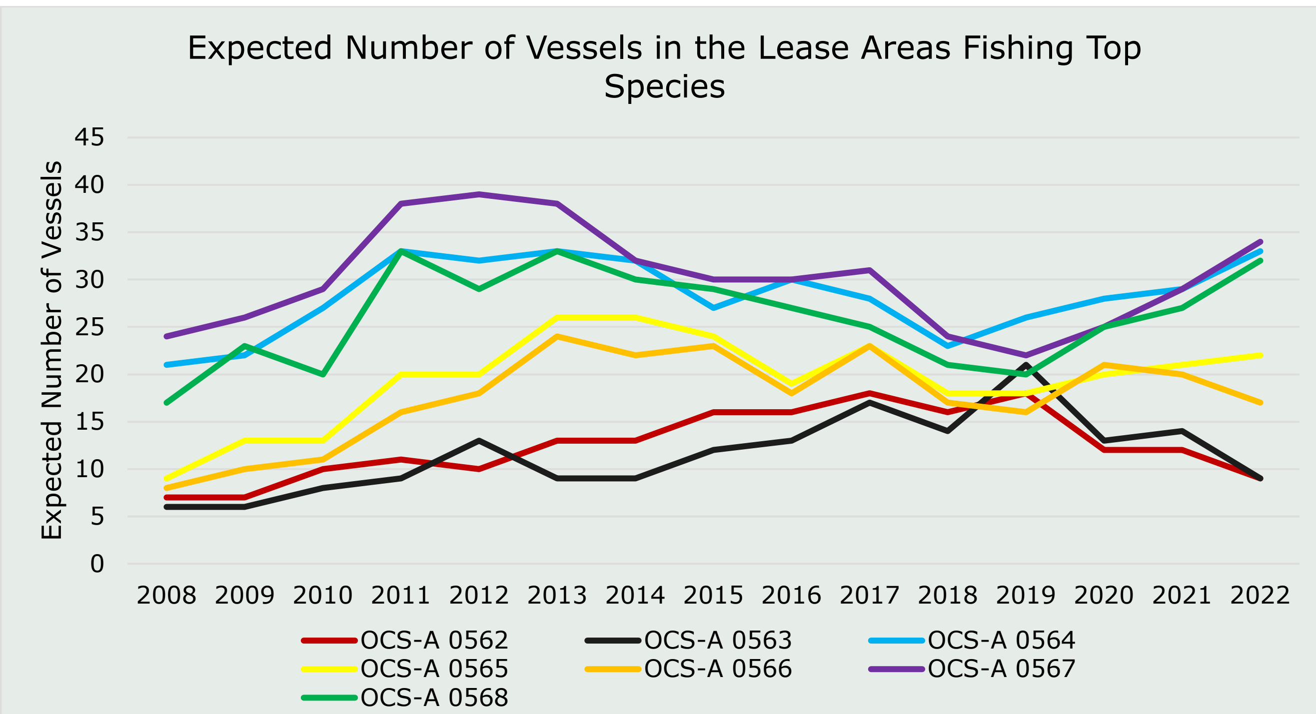
C2.4.2 VESSEL COUNTS

ERM analyzed the data from the National Marine Fisheries Service database to understand the vessel traffic density within the Proposed Lease Areas. This data included the number of trips and vessels associated with the top 10 species for each Proposed Lease Area (see Section C2.2).

Figure 7 shows the expected number of vessels taking fishing trips associated with the top 10 species within the Proposed Lease Area. Rather than using the 'Total number of trips' defined as the "*upper bound on the counts, as it does not take into account the probability of these trips actually overlapping the area of interest, and identifies all the individuals who could be displaced by wind energy development",* ERM assessed the expected count of vessels which is defined as *"count of trips and vessels weighted by the probability of overlap with the area of interest, to generate a more precise expected count of trips and vessels fishing within the area."*

Noting the above caveats, the number of vessels in most Proposed Lease Areas has decreased from 2011 to 2019. The number of vessels in the two northernmost lease areas, OCS-A-0562 and OCS-A-0563, has been relatively stable since 2008.

FIGURE 7: EXPECTED NUMBER OF VESSELS IN THE LEASE AREAS, FISHING TOP SPECIES



Source: NOAA Commercial Landings data

C2.4.3 FINDINGS

In the Gulf of Maine, fishermen use a range of vessel sizes for fishing. Smaller vessels, particularly those under 50 feet long, are used for all types of fishing. Mid-sized vessels in the 60- to 70-foot range are used for offshore lobster fishing. Larger vessels between 70 and 95 feet are used for bottom trawls targeting haddock, pollock, and cod and are also used for scallop fishing.

C2.4.4 INPUT FROM LOCAL FISHERMAN

As the study addresses the complex, real-world environments of fisheries to inform OSW development decisions, there is a need to gather expert input and cross-check data and assumptions to ensure the findings accurately reflect real-world conditions. In some cases, different data sources provided inconsistent information. For example, the maps provided on Northeast Ocean Data Portal for vessel traffic in the Proposed Lease Area in 2016 (see Attachment C-B of this appendix, and Figure 15 for example) show a low density of vessel traffic in the Proposed Lease Area compared with data that was assessed in Section C2.4.

ERM also consulted with local fisheries expert John Williamson, a subcontractor of the project, to gather insights based on his field experience. Based on John Williamson's personal experience, the number of commercial fishing vessels in the Gulf of Maine has slightly decreased over the past decade due to economic and permit restructuring. This reduction is largely a response to changes in fishery management policies, particularly the 2007 reauthorization of the Magnuson Stevens Fishery Conservation and Management Act, which made overfishing illegal. The act prompted the New England Fishery Management Council to align economic opportunities with biological limits, leading to a more regulated and reduced fleet. This trend aligns with the findings in Section C2.4.2.

John Williamson also confirmed that the vessel sizes and gear used in the Gulf of Maine align closely with the information provided in governmental datasets. Additional context provided by John Williamson on specific vessel sizes based on gear type and target species is summarized below and in Table 6 (Section C4).

- **Inshore lobster vessels:** 20 to 50 feet, targeting American lobster.
- **Offshore lobster vessels:** 40 to 70 feet, targeting American lobster.
- **Scallop dredge vessels:** 40 to 50 feet or 60 to 100 feet depending on the vessel permit.
- **Bottom trawlers:** 40 to 90 feet, targeting haddock, pollock, cod, monkfish, hake, redfish, and flounders.
- **Bottom gillnetters:** 40 to 50 feet, targeting haddock, pollock, cod, monkfish, hake, dogfish, and skate.
- **Hook-and-line vessels:** 30 to 40 feet, targeting haddock, pollock, and cod.
- **Pelagic trawlers and purse seiners:** 60 to 90 feet, targeting herring.
- **Hand-line vessels (for bluefin tuna):** 20 to 50 feet, targeting bluefin tuna.

The vessel types and sizes used in the Gulf of Maine are linked to the species they target and the gear they employ. For instance, the larger bottom trawlers are essential for harvesting groundfish such as haddock, pollock, and cod, which require extensive, mobile gear to cover large areas of the seafloor. Smaller hook-and-line vessels are used for more selective fishing, targeting specific species such as haddock and cod. The diversity in vessel size and gear type reflects the need to adapt to different species' habitats and behaviors, ensuring efficient and sustainable fishing operations.

TABLE 6: TOP SPECIES, GEAR TYPES, AND VESSEL TYPES AND SIZES

Top Species	Gear Type	Vessel Type and Size
Haddock	Bottom Trawl Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Pollock	Bottom Trawl Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Cod	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Monkfish	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Redfish	Bottom Trawl	Bottom Trawlers (40-90 feet)
American Lobster	Pots and Traps	Offshore Lobster Vessels (40-70 feet)
Sea Scallop	Dredge	Scallop Dredge Vessels (40-100 feet)
White Hake	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
American Plaice Flounder	Bottom Trawl	Bottom Trawlers (40-90 feet)
Witch Flounder	Bottom Trawl, Bottom Gillnet	Bottom Trawlers (40-90 feet), Gillnetters (40-50 feet)
Atlantic Herring (Bait)*	Pelagic Trawl, Purse Seine	Pelagic trawlers (60-90 feet), Purse seine vessels (60-90 feet)
Bluefin Tuna*	Harpoon Hook and Line	Various Vessels (20-50 feet)

*The additional species identified by local fisheries expert.

C3. LIMITATIONS AND DATA GAPS

Several limitations and data gaps could impact the accuracy and comprehensiveness of the findings presented in this desktop study. Recognizing these limitations is important to ensure transparency in the analysis and to highlight areas where further research or data collection is needed. The limitations and data gaps identified in the study are summarized below.

1. **Permit Data Complexity:** Different permit categories represent varying quotas, vessel histories, and characteristics, complicating efforts to accurately assess commercial fishing activity and fleet structure within the Gulf of Maine. Additionally, there are multiple permitting jurisdictions (i.e., state, NOAA Northeast Region, NOAA national), leading to potential overlaps and inconsistencies in data.
2. **Inactive Vessels and Permit Usage:** Vessels may hold multiple permits without actively fishing in all those categories, which makes it challenging to accurately gauge the true level of fishing activity. For example, a vessel might have permits for three species but only actively fish one species, leading to an overestimation of fleet capacity and fishing activity.
3. **Home Port vs. Fishing Grounds:** The homeport of a vessel does not necessarily correlate with where the vessel fishes. A vessel may have a homeport in one place (e.g., New Bedford, Massachusetts) but fish in a different place (e.g., the Gulf of Maine), complicating ERM's ability to assess commercial fishing activity and impacts specific to the Gulf of Maine Proposed Lease Areas.
4. **Data Duplication:** Vessels may be counted multiple times across different datasets, particularly if they hold multiple permits or are reported in multiple jurisdictions. This duplication can lead to a high bias in the reported data.
5. **Proprietary Data Limitations:** Some data, such as detailed fleet quantity and specific operational data, are proprietary and not readily available. This restricts ERM's ability to fully understand the extent of fishing activities and trends in the region. Formal data requests are needed to access more detailed information.
6. **Historical Data Gaps:** The lack of comprehensive historical data, especially before 2014, limits the ability to perform long-term trend analysis. This data gap made it challenging for ERM to assess how current trends compare to historical patterns and to make informed predictions about future developments.
7. **Confidentiality Constraints:** Some fishing species data are withheld for confidentiality, particularly in NOAA Commercial landings and vessel permit databases, which limited ERM's ability to assess the full scope of commercial landings. This restriction hinders a complete understanding of the economic and ecological impact of fishing activities in the Gulf of Maine.
8. **Generalization of Data:** Commercial value data often does not specify the regions within the ocean where the fishing or landings occurred, limiting ERM's ability to link specific commercial data to the Proposed Lease Areas.

C4. FINDINGS

Commercial fishing revenue, gear types, and vessel sizes are valuable information to understand the fishing industry in the Gulf of Maine. ERM evaluated these data in the Proposed Lease Areas to inform future phases of the study on compatibility and coexistence of FOW and fisheries technologies.

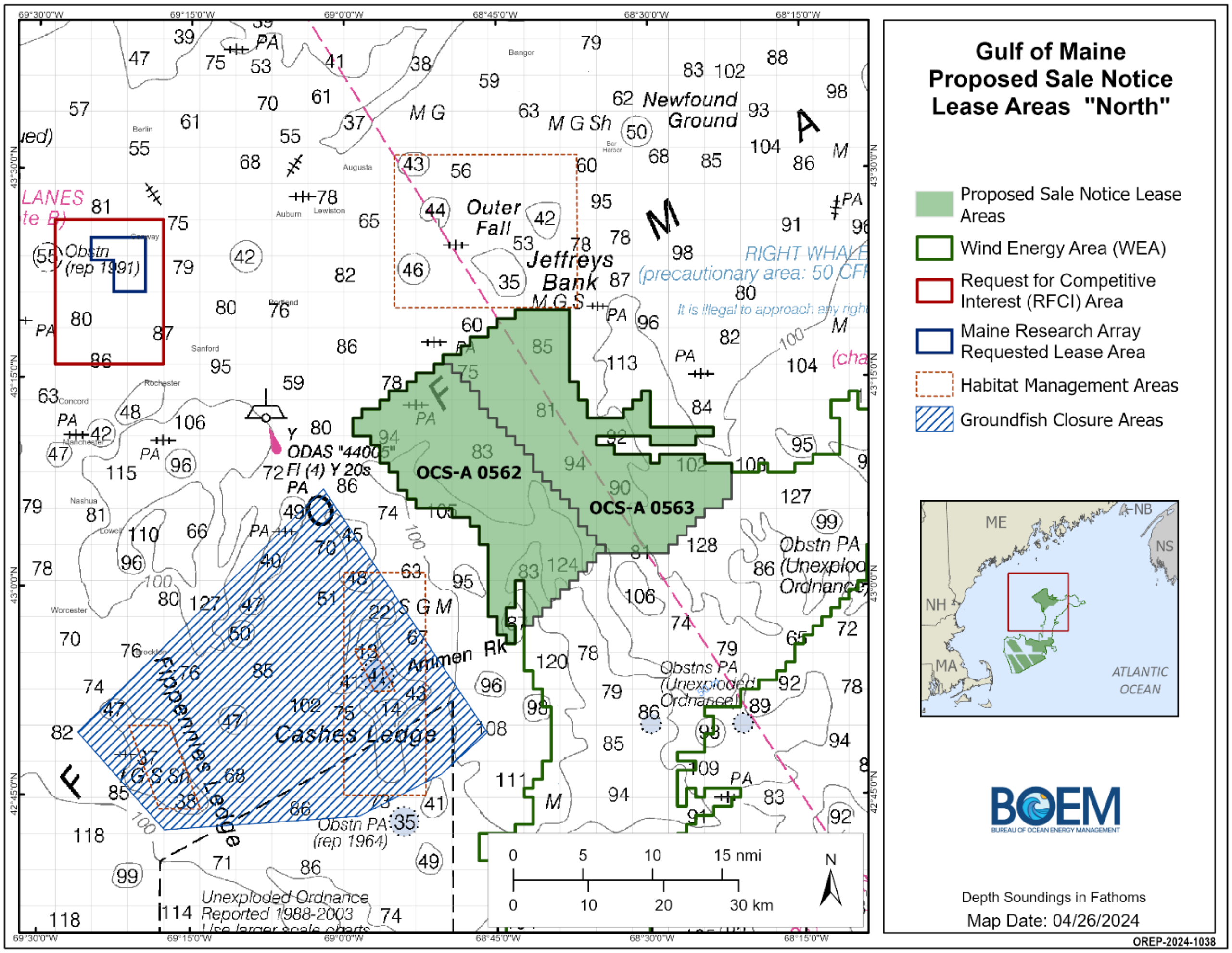
The top species by revenue in the Proposed Lease Areas are haddock, pollock, redfish, monkfish, American lobster, white hake, American plaice flounder cod, witch flounder, and sea scallops. Most of these species are fished using bottom trawlers, which is a type of mobile gear that requires large vessels capable of towing heavy trawls across the seafloor. Smaller vessels are mostly used in the lobster fishery, which uses static gear, such as pots or traps. Smaller vessels can navigate the nearshore and offshore areas more effectively, setting and retrieving pots with precision.

Table 6 summarizes the top species by revenue, corresponding gear types, and vessel type and size (reflecting local fisheries expert input) in the Proposed Lease Areas. Note that navigation considerations within the lease blocks are influenced by the upper limits of vessel size.

ATTACHMENT C-A GULF OF MAINE PROPOSED LEASE AREAS

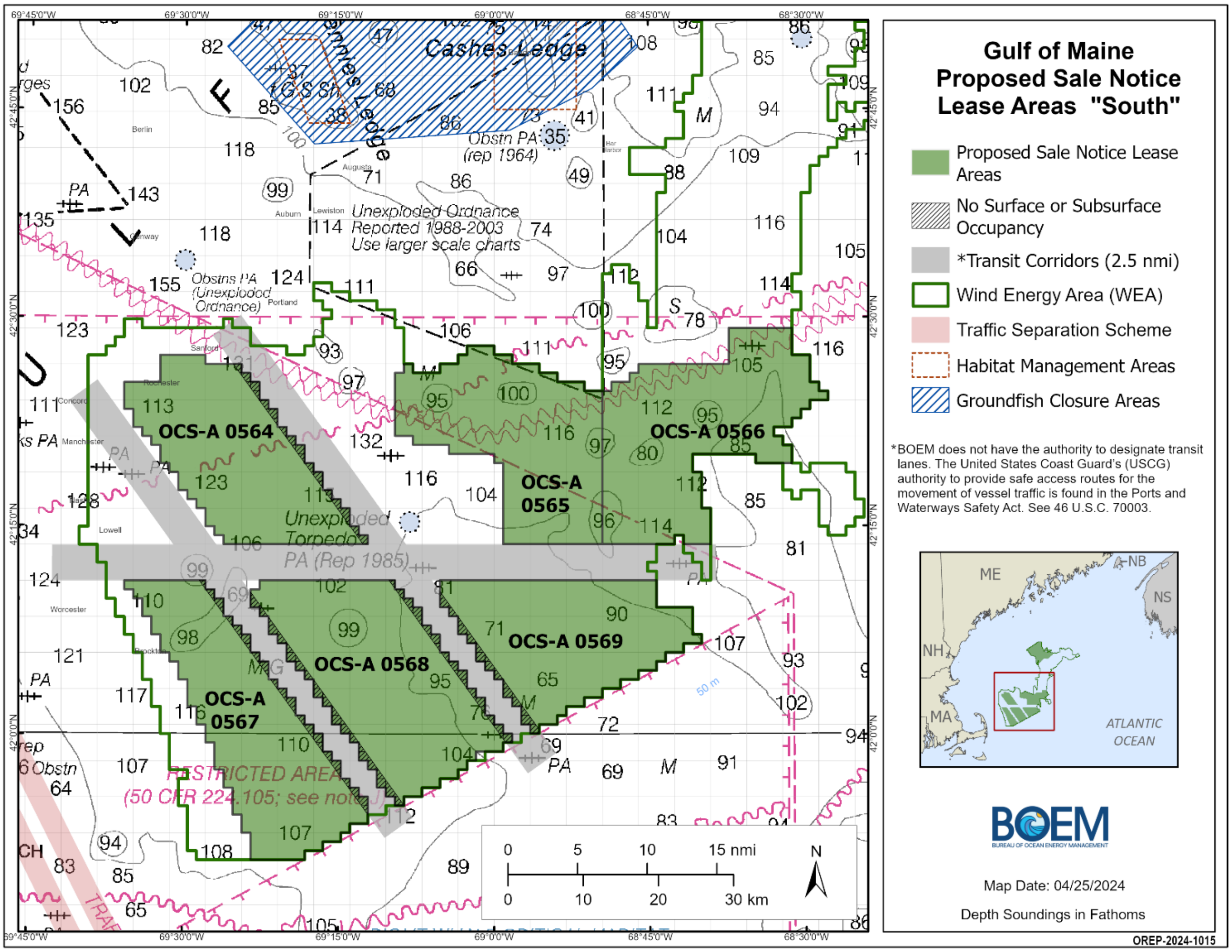
The below figures from BOEM[12] depict the Gulf of Maine Proposed Lease Areas.

FIGURE 8: GULF OF MAINE PROPOSED LEASE AREAS "NORTH"



12 Gulf of Maine | Bureau of Ocean Energy Management (boem.gov)

FIGURE 9: GULF OF MAINE PROPOSED LEASE AREAS "SOUTH"

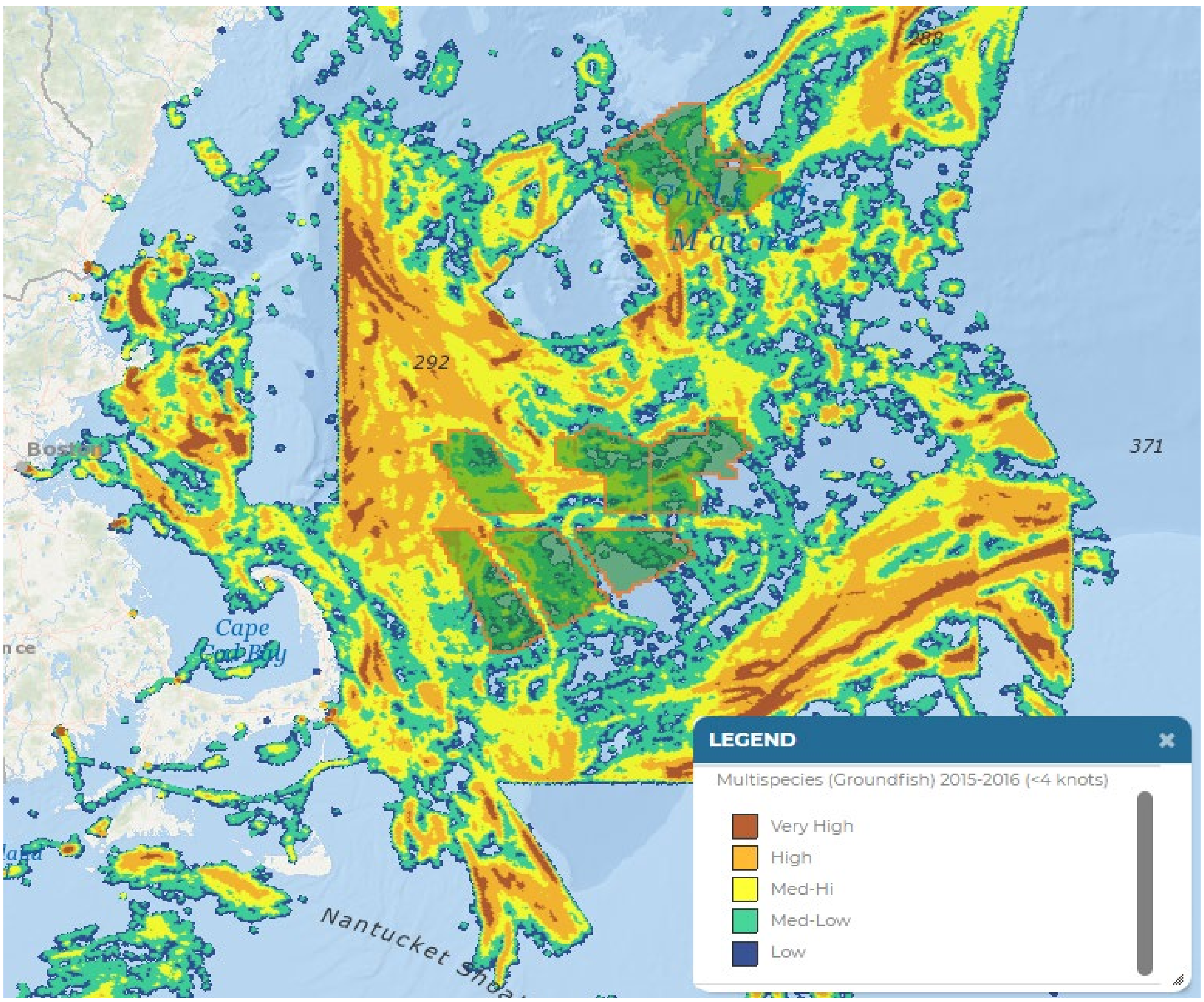


ERM

ATTACHMENT C-B VESSEL MONITORING SYSTEM MAPS

The Northeast Ocean Data Portal[13] includes a set of data layers that depict the density of commercial fishing activity for different fisheries in the Northeastern U.S. based fishing vessels with Vessel Monitoring Systems (VMS). VMS is a satellite surveillance system primarily used to monitor the location and movement of commercial fishing vessels in the United States. The data scale is normalized for each species; the relative density should not be compared between different species. The data indicates the relative levels of vessel presence for each fishery. The below maps were created by Northeast Ocean Data using VMS position records for vessels traveling at a speed of less than four knots, which was the speed threshold used to identify vessels engaged in fishing rather than transit activity. Data layers were available for the Northeast Multispecies, Monkfish, Scallop, and Herring. Additional important data considerations are included in the metadata[14].

FIGURE 10: VMS OF COMMERCIAL FISHING VESSEL DENSITY: MULTISPECIES (GROUNDFISH) 2015-2016 (<4 KNOTS)



[13] Northeast Ocean Data Portal | Maps and data for ocean planning in the northeastern United States
[14] VMSCommercialFishingDensity.pdf (northeastoceandata.org)

FIGURE 11: VMS OF COMMERCIAL FISHING VESSEL DENSITY: MONKFISH 2015-2016 (<4 KNOTS)

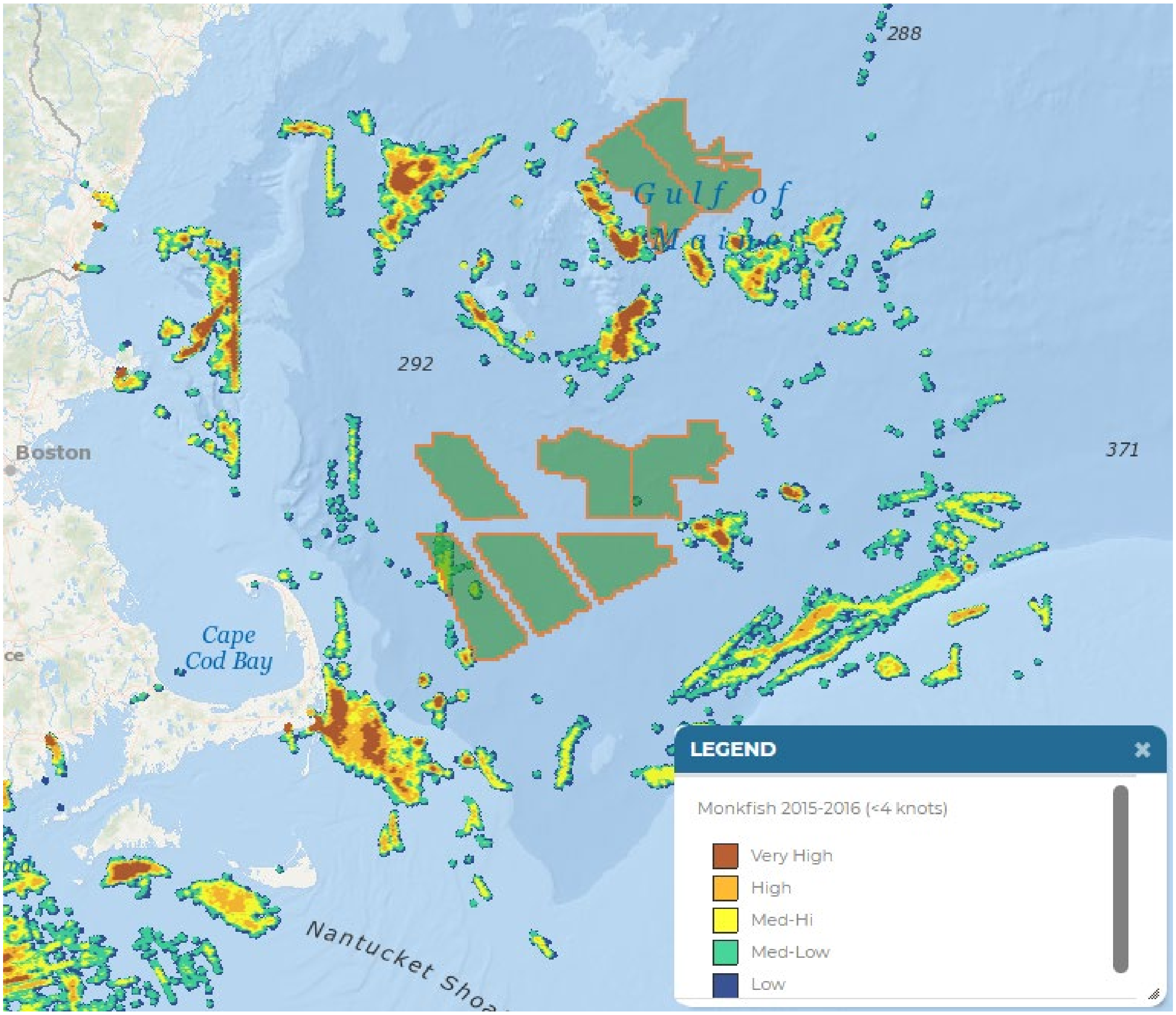


FIGURE 12: VMS OF COMMERCIAL FISHING VESSEL DENSITY: SCALLOP 2015-2016 (<4 KNOTS)

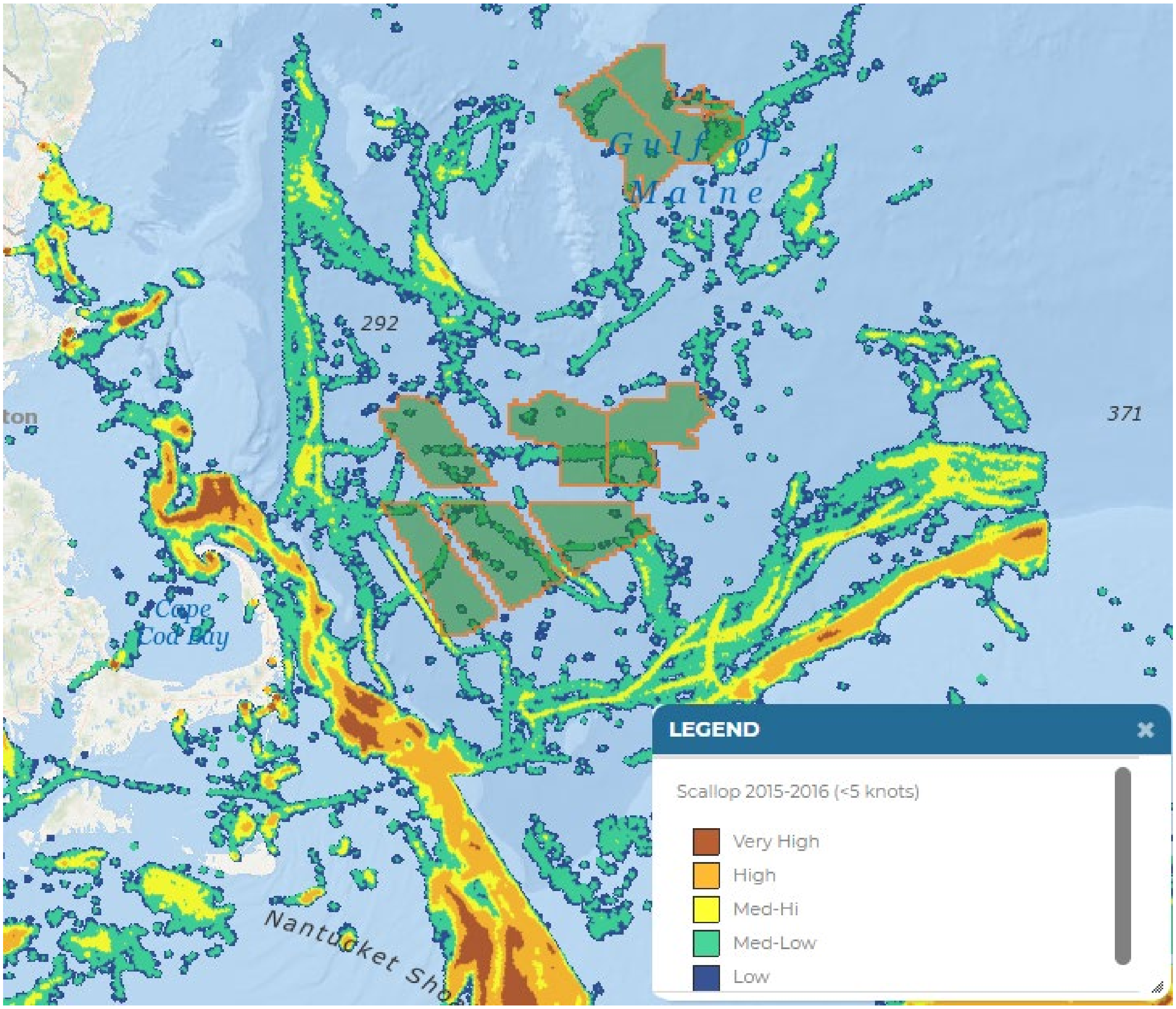
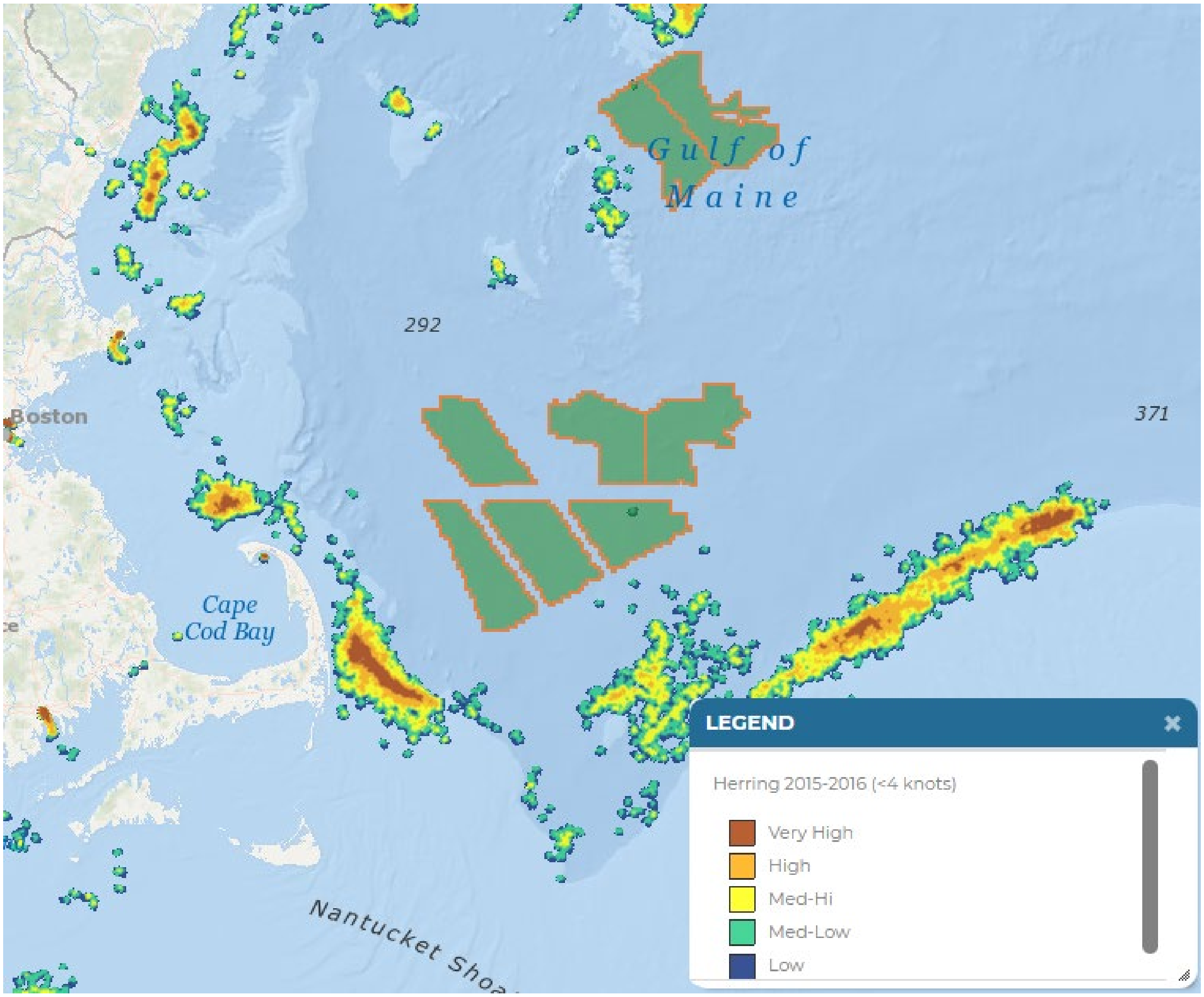


FIGURE 13: VMS OF COMMERCIAL FISHING VESSEL DENSITY: HERRING 2015-2016 (<4 KNOTS)



ERM

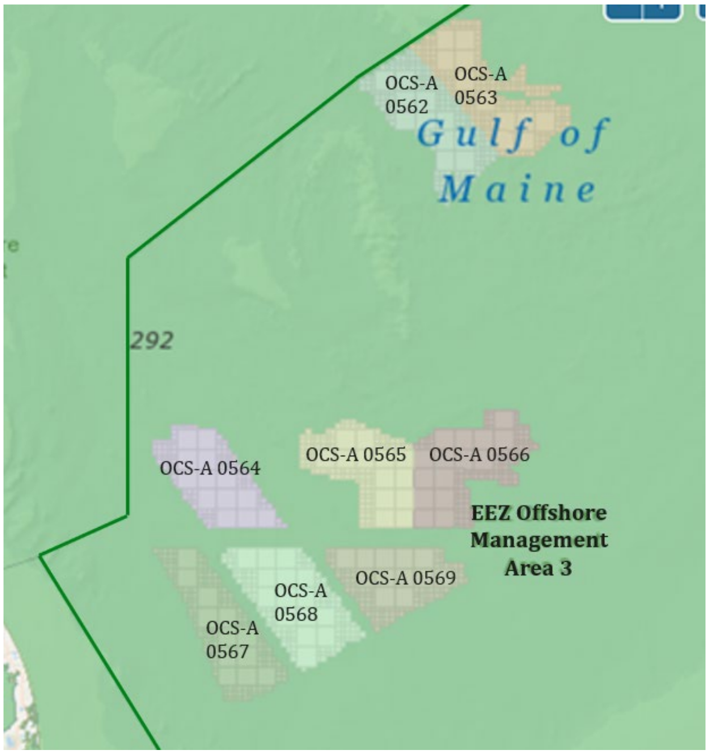
ATTACHMENT C-C VESSEL SIZE – ADDITIONAL DETAIL

Additional information detailing the distribution of vessel sizes for different permit types are provided in this section.

American Lobster

There are seven LMAs along the east coast of the U.S., each with specific management requirements. The Proposed Lease Areas are all located within LMA3 (see Figure 14 below).

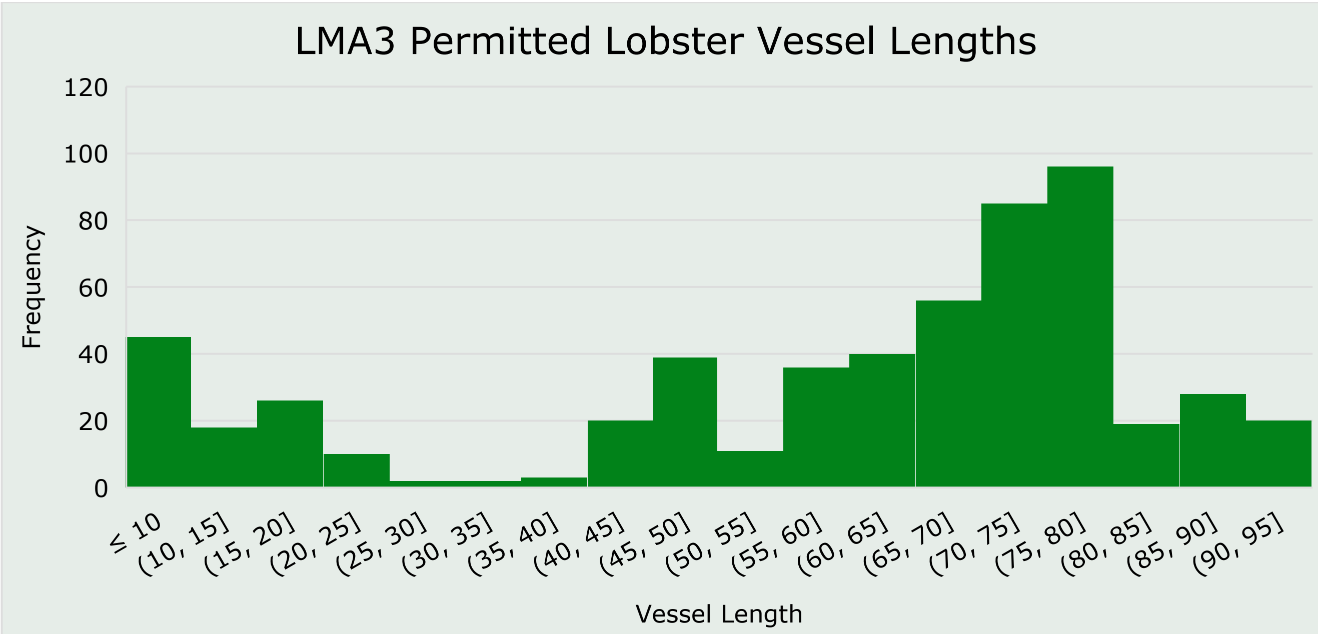
FIGURE 14: LOBSTER MANAGEMENT AREAS AND GULF OF MAINE PROPOSED LEASE AREAS



Source: Northeast Ocean Data Portal

ERM collected data on all vessels with an LMA3 permit from 2014 to 2024, focusing on those vessels with home ports in Maine, New Hampshire, or Massachusetts. Figure 15 displays the distribution of vessel lengths for lobster permits, indicating that the most common lengths are between 40 and 80 feet, with a significant number of those vessels in the 70- to 80-foot range.

FIGURE 15: VESSEL LENGTH (IN FEET) WITH SPECIFIED LOBSTER PERMITS FROM 2014 TO 2024



Sources: Greater Atlantic Region Vessel, Dealer, Operator, and Tuna Permit Data[15]

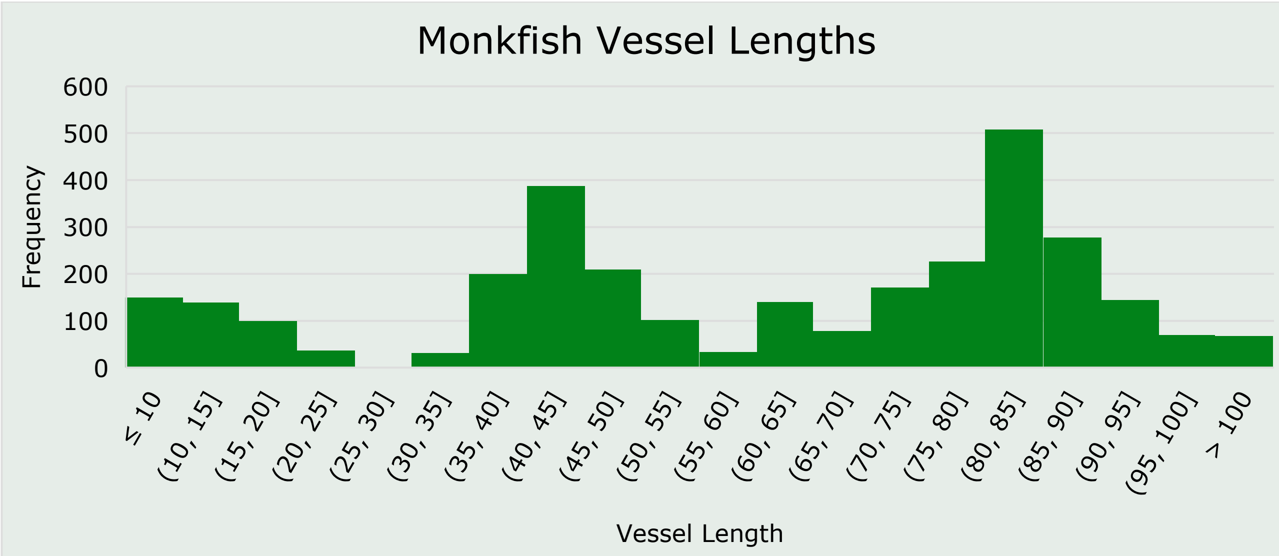
<u>Monkfish</u>

ERM evaluated data for Monkfish permits to assess the distribution of typical vessel lengths for this fishing activity. The primary permit for this fishery is identified as Category A, B, C, and D Limited access DAS permits[16]. Figure 16 shows the distribution of vessel lengths (in feet) for monkfish permits, highlighting that vessel lengths vary significantly. The data indicates that the most common vessel lengths are generally between 35 to 55 feet and 70 to 95 feet, which indicates that both mid-sized and larger vessels are used in the monkfish fishery.

[15] NOAA Fisheries Greater Atlantic Region Vessel, Dealer, Vessel Operator, and Tuna permits

[16] In the Atlantic Sea Scallop fishery, the Category A, B, C, and D Limited Access DAS (Days-At-Sea) permits are used to differentiate between vessels with different fishing capacities, histories, and operational characteristics. The permit categories (A, B, C, D) primarily determine the allowed fishing effort (days-at-sea) and are associated with different gear types, where Category A uses the largest dredges in the most productive areas, and Category D uses the smallest dredges with the most restricted access and stringent regulations.

FIGURE 16: VESSEL LENGTHS (IN FEET) FOR THE MONKFISH SPECIES FROM 2014 TO 2024

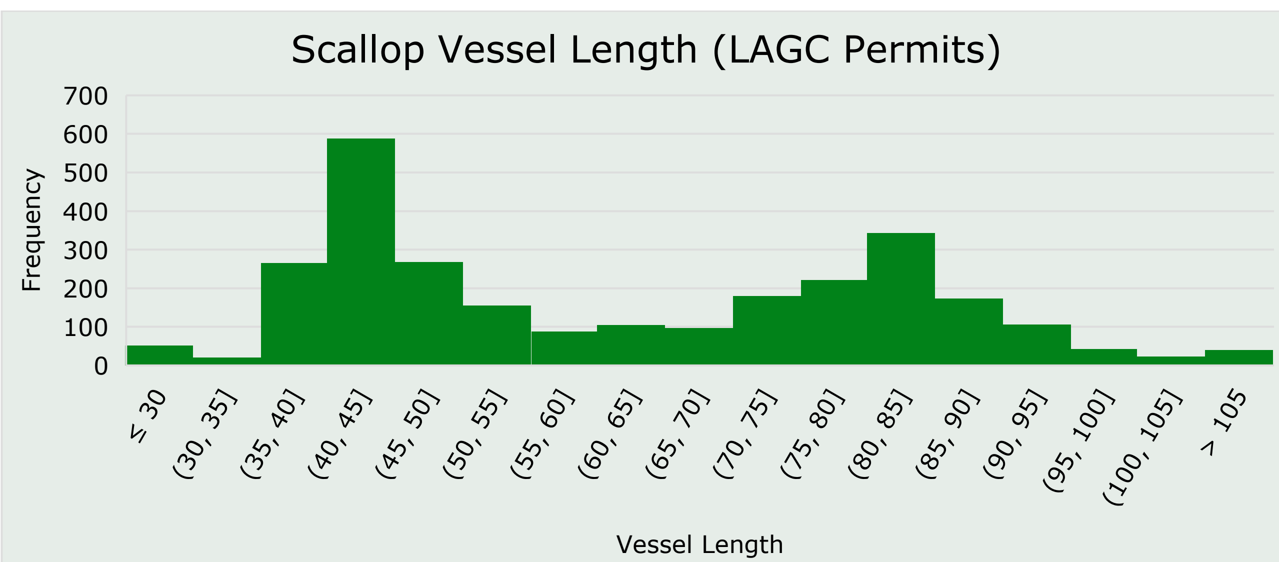


Sources: Greater Atlantic Region Vessel, Dealer, Operator, and Tuna Permit Data

Scallop

The scallop fishery requires Limited Access General Category (LAGC), or Limited Access Permits. The primary gear used by all vessels is scallop dredges. Figure 17 shows the scallop vessel lengths for LAGC permits. The most common vessel size range is 40- to 45-foot and the second most common range is 80- to 85-foot, which suggests that medium and larger vessels are used in this fishery.

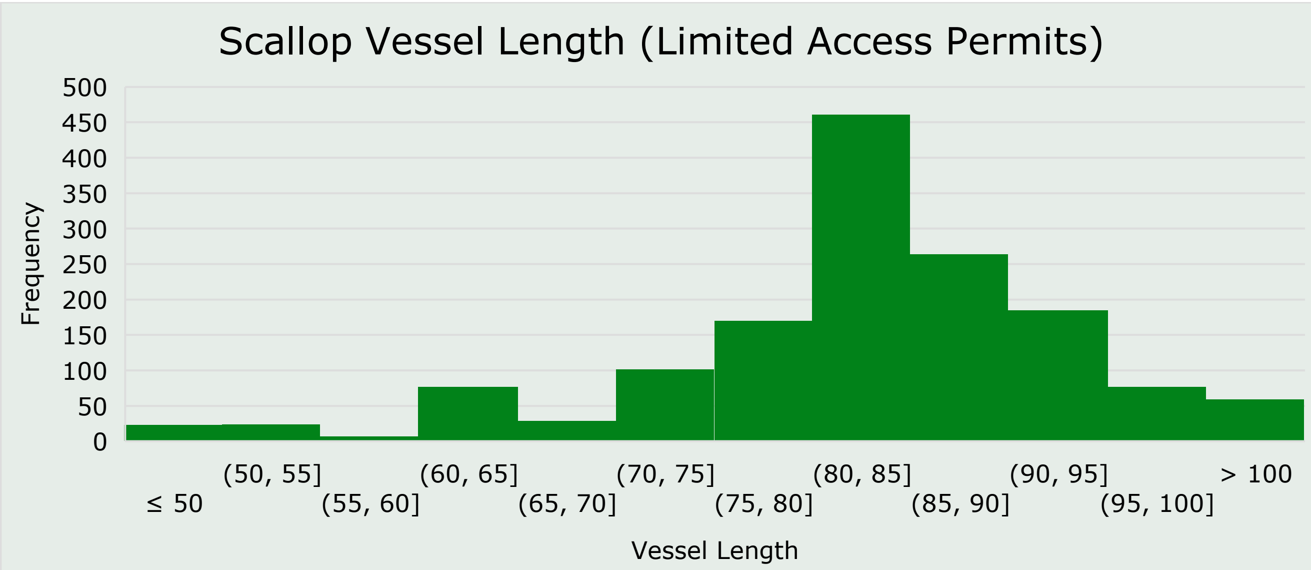
FIGURE 17: VESSEL LENGTH (IN FEET) FOR THE SCALLOP SPECIES FISHING WITH LAGC PERMIT FROM 2014 TO 2024



Sources: Greater Atlantic Region Vessel, Dealer, Operator, and Tuna Permit Data

Figure 18 shows scallop vessel lengths from 2014-2024 for vessels with a home port in Maine, New Hampshire, or Massachusetts that obtained a Limited Access 2 – 7 permits. These vessels use different types of gears and have time limits in their permits. The Limited Access 7 permit holders are the only ones authorized to use trawl nets. The graph shows the most common vessel size is in the 80 to 85-foot range, indicating that this size is most used for these fishing operations. This distribution suggests that larger vessels dominate the scallop fishery using the Limited Access permit and the typical vessel is between 75 and 95 feet.

FIGURE 18: VESSEL LENGTH (IN FEET) FISHING THE SCALLOP SPECIES FROM 2014 TO 2024



Sources: Greater Atlantic Region Vessel, Dealer, Operator, and Tuna Permit Data

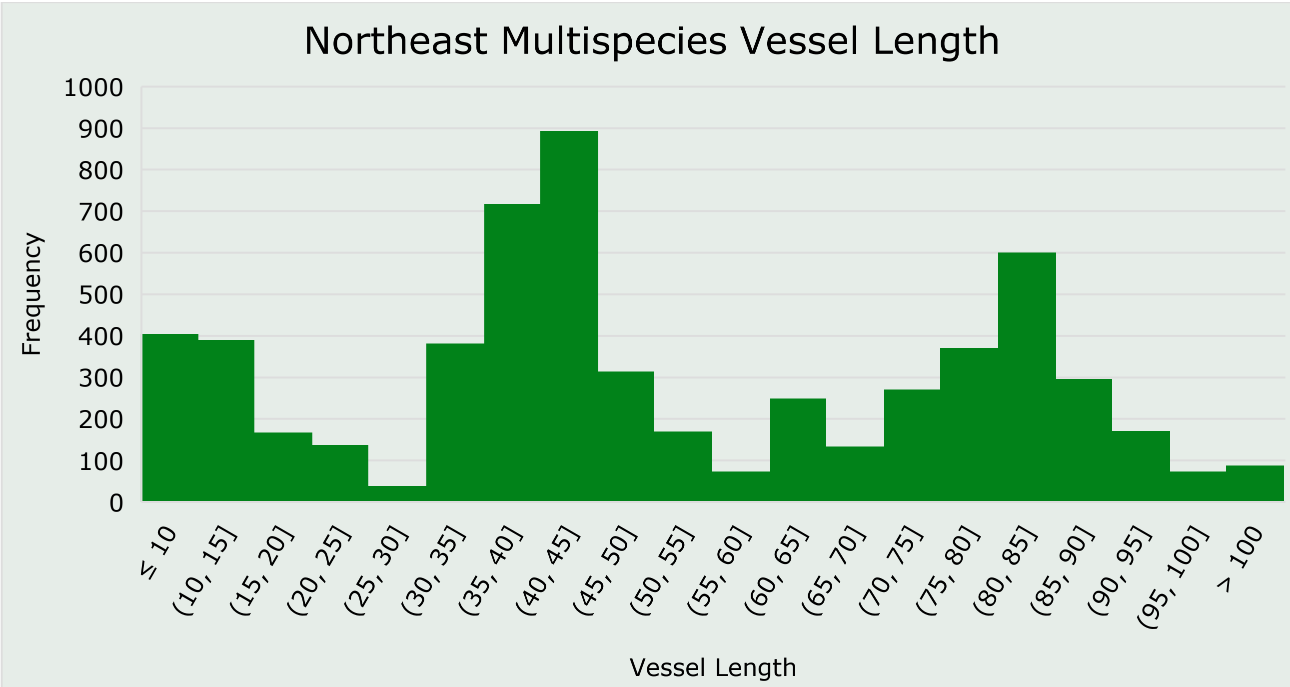
Northeast Multispecies

The Northeast multispecies (groundfish) permit covers 13 species: Atlantic cod, haddock, yellowtail flounder, pollock, American plaice, witch flounder, white hake, windowpane flounder, winter flounder, Acadian redfish, Atlantic halibut, Atlantic wolffish, ocean pout. As identified in Section C2.2, cod, haddock, pollock, redfish, white hake, American plaice flounder, and witch flounder are among the top 10 species by revenue across all the Proposed Lease Areas.

There are different types of permit 'categories' for the Northeast Multispecies including Limited Access Permits (Category A through Category F, and HA) and Open Access Permits (HB, and Category I though K).

All Northeast multispecies permits except Category D, Category I, or Hand gear A or B (HA and HB) can use **bottom trawling gillnets, and hook and line**. Figure 19 shows vessel lengths with the Northeast multispecies permit from 2014 to 2024 for vessels with a home port in Maine, New Hampshire, or Massachusetts. Vessels in the 30- to 55-foot are most common. Larger vessels in the 75- to 85-foot range are also used.

FIGURE 19: AVERAGE LENGTHS (IN FEET) OF VESSELS WITH NORTHEAST MULTISPECIES PERMITS FROM 2014-2024



Sources: Greater Atlantic Region Vessel, Dealer, Operator, and Tuna Permit Data

ERM HAS OVER 140 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina

Australia

Belgium

Brazil

Canada

China

Colombia

Denmark

France

Germany

Hong Kong

India

Indonesia

Ireland

Italy

Japan

Kazakhstan

Kenya

Malaysia

Mexico

Mozambique

Netherlands

New Zealand

Panama

Peru

Poland

Portugal

Romania

Singapore

South Africa

South Korea

Spain

Switzerland

Taiwan

Thailand

UAE

UK

US

Vietnam

ERM's Boston Office

One Beacon Street
5th Floor
Boston, MA 02108

T +1 617 646 7800
F +1 617 830 8975

www.erm.com

ERM

APPENDIX D PHASE 2 STAKEHOLDER ENGAGEMENT: UNDERSTANDING FLOATING OFFSHORE WIND TECHNOLOGY

Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind

Appendix D: Phase 2 Stakeholder Engagement – Understand Floating Offshore Wind Technology

Prepared by the Gulf of Maine Research Institute

PREPARED FOR

Environmental Resources Management and the State of Maine Governor's Energy Office

DATE

30 September 2024

CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

Acronyms	Description
AIS	Automatic Identification Systems
ERM	ERM Consulting & Engineering, Inc.
FOW	floating offshore wind
GMRI	Gulf of Maine Research Institute
RFCI	Request for Competitive Interest
TLP	tension-leg platform

Acronyms	Description
WEA	Wind Energy Area

EXECUTIVE SUMMARY

Over the course of 2023, the Maine Offshore Wind Research Consortium Advisory Board underwent a rigorous prioritization process to identify three research topics to fund in its inaugural round of projects. This project, Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind, was one of the projects included in the competitive Request for Proposals that was issued in November 2023 by the Governor's Energy Office on behalf of the Research Consortium.

ERM Consulting & Engineering, Inc. (ERM) and the Gulf of Maine Research Institute (GMRI were awarded the project to pursue the research and stakeholder engagement to advance understanding of floating offshore wind (FOW) and fishery coexistence. The project kicked off in February 2024.

This report shares findings from Phase 2 of 3 of the GMRI stakeholder engagement exploring the feasibility of fisheries' coexistence with FOW technology, *Phase 2 Stakeholder Engagement – Understand Floating Offshore Wind Technology*. During Phase 2, GMRI engaged 13 fishing industry stakeholders, gathering input on questions relating to fisheries' coexistence with FOW technologies. GMRI presented stakeholders with visuals and technical descriptions of potential FOW array designs, including platform, mooring, anchoring, and cabling concepts. GMRI then asked questions to gauge stakeholders' comfort/discomfort navigating and fishing around conceptual FOW arrays. GMRI framed questions to understand stakeholders' concerns and anticipated challenges of fishing and navigating within different FOW array designs, and to understand fishery-specific gear and co-use challenges. Stakeholders have diverse perspectives on the feasibility of coexisting with FOW technology concepts. Mariner safety, technical and operational uncertainties, gear entanglement, and environmental impacts, among others, are key concerns raised by stakeholders regarding the feasibility of fisheries' coexistence with FOW. Respondents generally prefer FOW technologies with limited spatial footprints – both above and below the sea surface. Respondents acknowledged greater research and collaboration with fisheries stakeholders as necessary to grasp a comprehensive, nuanced understanding of their perspectives.

D1. INTRODUCTION

As a nascent industry, little is known about the potential interoperability between commercial scale floating offshore wind (FOW) projects and fisheries within the Gulf of Maine. FOW in the Gulf of Maine presents a wide range of technical and logistical challenges for offshore wind and fishing industries. Fishermen are concerned about the potential impacts on their operations, including restricted fishing access, risks with navigating, and increased industry competition within limited areas of the ocean. Technology characteristics, including subsurface mooring lines and inter-array cables, may result in new challenges for fishing activity. It is crucial to continue engaging constructively with the Gulf of Maine fishing industry around the feasibility and strategies for potential coexistence between traditional fishing practices and FOW.

As such, ERM Consulting & Engineering, Inc. (ERM) and Gulf of Maine Research Institute (GMRI) are working with fisheries stakeholders to explore approaches to fisheries' coexistence with FOW. GMRI is leading the stakeholder engagement for this project, working with fishermen and fishing organizations to build an understanding of concerns, opportunities, and anticipated challenges of operating within a FOW array. This includes detailed discussions on gear and fishery-specific interoperability challenges and providing feedback on the project's findings that will inform initial guidelines. Ongoing engagement with the fishing industry is key to ensuring the findings have relevance to the practicality of the Gulf of Maine fishing industry.

D2. ENGAGEMENT METHODS

D2.1 OVERVIEW OF METHODS

To engage stakeholders effectively and constructively, GMRI employed a three-phase engagement approach for this project:

- Phase 1: engagement to test existing understandings and identify further research questions among fisheries stakeholders;
- Phase 2: engagement to understand interactions between the FOW technology scenarios specific to the various gear types used in the Gulf of Maine; and
- Phase 3: engagement to test draft guidelines with fishing stakeholders to consider their feedback, reactions, and opportunities for further research.

A subset of the Maine Offshore Wind Research Consortium Advisory Board approved this engagement approach, and the questions used in Phase 1 and 2. The subset of the Advisory Board also approved and elaborated on an initial set of associations and fishermen to participate in each phase of the project. To expand the participant base, GMRI employed a 'snowball' sampling method, a common approach in qualitative research where current participants suggest future participants from their networks.[1] The GMRI team used this method due to the highly specialized nature of the fishing community, where relationships and trust play a critical role in participation. Snowball sampling allowed the team to leverage existing connections to ensure broad, yet relevant stakeholder engagement.

D2.2 PHASE 2 ENGAGEMENT QUESTIONS

In Phase 2, the team engaged stakeholders using a semi-structured format either through an online survey (Google Forms, see Attachment D-A) sent via email or through a focus group (see Attachment D-B). Respondents were asked to review an overview of FOW technology (see Attachment D-C), which was attached to the email and visuals embedded in the survey (see Attachment D-A) prior to taking the survey or participating in the focus group. Specific questions included:

Questions for Organizations (if not gathered in Phase 1)

- What types of gear does your organization primarily represent/utilize?
- What ports are used by your fishermen? If multiple, are you able to rank which ones are used most?
- What types of gear does your organization primarily represent/utilize?
- What ports are used by your fishermen? If multiple, are you able to rank which ones are used most?
- If you are comfortable sharing, do affiliates of your organization fish or have fished in the Wind Energy Area (WEA) or the Request for Competitive Interest (RFCI) area in the last 10 years?

[1] Lopez, V., & Whitehead, D. (2013). Sampling data and data collection in qualitative research. *Nursing & midwifery research: Methods and appraisal for evidence-based practice*, *123*, 140.

Questions for Individuals (if not gathered in Phase 1)

- What type of gear do you use? In which seasons do you use certain gears for fishing?
- What is your homeport?
- If you are comfortable sharing, do you or have you fished in the WEA or the RFCI area in the last 10 years?
- Who else is important to speak with on this topic?

Survey Questions: Coexistence-specific questions were based on the FOW technology overview and visuals embedded in the survey (as seen in Attachment D-A).

- Given your review of the floating offshore wind technologies, what cabling system is most preferable to your fishing operation between buried inter-array cables or suspended inter-array cables. In essence, which design can you fish between?
- Given the following floating foundation concepts, what is your comfort level with the following foundation types? Please answer these questions given your knowledge of Gulf of Maine fisheries or on-the-water experience if relevant.
- What is your comfort level navigating around the spar concept? (Not comfortable at all, nervous, comfortable)
- What is your comfort level navigating around the semi-submersible concept? (Not comfortable at all, nervous, comfortable)
- What is your comfort level navigating around the tension-leg platform concept? (Not comfortable at all, nervous, comfortable)
- Please explain why you ranked your comfort in navigating between these floating offshore wind foundation concepts below. What could be changed to enable you to navigate comfortably? (Long answer)
- What is your comfort level fishing around the spar concept? (Not comfortable at all, nervous, comfortable)
- What is your comfort level fishing around the semi-submersible concept? (Not comfortable at all, nervous, comfortable)
- What is your comfort level fishing around the tension-leg platform concept? (Not comfortable at all, nervous, comfortable)
- Please explain why you ranked your comfort with fishing between these floating offshore wind foundation concepts below. What, if anything, could be changed to enable you to fish comfortably? (Long answer)
- Given the following mooring system concepts, what is your comfort level with the following mooring types? Please answer these questions given your knowledge of Gulf of Maine fisheries or on-the-water experience if relevant.
- What is your comfort level navigating around the catenary mooring concept? (Not comfortable at all, nervous, comfortable)
- What is your comfort level navigating around the semi-taut concept? (Not comfortable at all, nervous, comfortable)

- What is your comfort level navigating around the taut concept? (Not comfortable at all, nervous, comfortable)
- Please explain why you ranked your comfort in navigating between these floating offshore wind mooring concepts below. What, if anything, could be changed to enable you to navigate comfortably? (Long answer)
- What is your comfort level fishing around the catenary concept? (Not comfortable at all, nervous, comfortable)
- What is your comfort level fishing around the semi-taut concept? (Not comfortable at all, nervous, comfortable)
- What is your comfort level fishing around the taut concept? (Not comfortable at all, nervous, comfortable)
- Please explain why you ranked your comfort with fishing between these floating offshore wind mooring concepts below. What, if anything, could be changed to enable you to fish comfortably? (Long answer)
- Given the anchoring systems noted below - please address the following questions:
- What is your reaction to these designs? Based on these scenarios, what do you see as the most challenging with your fishing practice? Which design do you see being the least challenging? Please use anchor name if applicable. (Long answer)
- Overall, which combination of designs do you see being the least challenging? (Long answer)
- Overall, what parameters could be put in place to make coexistence a possibility? (Long answer)

D2.3 ENGAGEMENT DESCRIPTION

For initial outreach for Phase 2, GMRI contacted the same organizations and fishermen that participated in Phase 1 by phone and email. Given that respondents needed to view visuals, GMRI called fishermen to invite them to participate in an in-person focus group or to ask them to fill out the online survey. In-person engagement during Phase 2 was limited because timing corresponded with seasonal fishing activities and because there were no scheduled fisheries meetings during the Phase 2 engagement period (July 29 to August 26, 2024). To avoid stakeholder fatigue while ensuring comprehensive input, GMRI limited outreach to a maximum of three attempts per stakeholder. Two fishing associations suggested future participants from their network and shared the survey to more than 45 other fishing stakeholders. A total of 63 stakeholders were invited to participate in Phase 2. Of those contacted, eight participants responded to the online survey and five Maine-based fishermen attended a focus-group in Portland, Maine.

TABLE 1: SUMMARY OF STAKEHOLDER OUTREACH AND PARTICIPANTS

Stakeholders	Contacted	Interviewed
Fishermen	49	9
Organizations[2]	14	3
Anonymous	0	1
Totals	63	13

Participants who took the survey spent 30 to 45 minutes reading the Technology Overview and 10 to 30 minutes completing the survey, totaling 40 to 75 minutes to participate. The focus group reviewed the Technology Overview for 30 minutes and participated in a semi-structured interview for another 45 minutes, totaling a 75-minute focus group. GMRI facilitated the focus group where questions were structured similar to the online survey. Participants were encouraged to share their perspectives on the technical report and visuals, providing qualitative insights that were later incorporated into the thematic analysis. This session allowed for dynamic interaction among participants, which helped to identify common concerns and areas of consensus.

Overall, it should be noted that answers for this phase are from a small response group and do not represent broad consensus from a stakeholder group. More research over extended periods, with a larger response group would provide a more comprehensive understanding of broader perspectives.

D2.4 STAKEHOLDER DEMOGRAPHICS

Respondents from the Phase 2 engagement period represent organizations and individuals from Midcoast and Southern Maine; coastal New Hampshire; and North Shore, South Shore, Greater Boston, and Cape Cod, Massachusetts. It is important to note that, for some respondents, these regions represent their homeport and not necessarily where they land their catch. For instance, a fisherman may be based in South Shore, Massachusetts, but land most of their catch in Portland, Maine, or vice-versa. All respondents either fish, represent a fishing industry, or are directly connected to fishing activity in the Gulf of Maine.

The respondents use diverse gear types. Of the 13 respondents, seven use mobile gear, seven use fixed gear, and two use line gear (some respondents use more than one gear type). Mobile gear includes both bottom and midwater trawls and targets groundfish, scallops, squid, and herring. Mobile gear fisheries are generally characterized by their ability to cover large areas and capture significant quantities of target species. Fixed gear includes gillnets and lobster pots/traps. Fixed gear is typically more selective as they are set in determined locations. Line gear includes longlines and jigging gear, and can be set in place, drift, or move slowly. Many respondents use various gear types or represent an industry that employs multiple gear types. Further, eight

[2] Engagement included reaching out to individual fishermen and leaders of fishing associations/organizations. Organization leaders often represent groups of fishermen by geographic area, fishery, or gear type. Organization leaders were asked the same questions as individuals and were not asked to specify whether their answers were their own perspectives or represented input from their membership/organizational base. Therefore, use caution if interpreting input from organizations as a broader group of fishermen.

respondents have fished or represent fishermen who currently fish or have fished in the Gulf of Maine WEA or RFCI area in the last 10 years. Note, engagement during this period occurred prior to the Gulf of Maine offshore wind lease sale on October 29, 2024. The leased areas in the Gulf of Maine consist of 439,096 acres of the 2,001,902-acre WEA. The 10-year time frame was chosen to align closely with fisheries data used in the document, A Wind Energy Area Siting Analysis for the Gulf of Maine Call Area, which was conducted by National Oceanic and Atmospheric Administration's National Centers for Coastal Ocean Science and Bureau of Ocean Energy Management. These results suggest that the fishing activities of many stakeholders engaged may overlap with areas for future FOW development in the Gulf of Maine.

D2.5 ANALYSIS METHODS

The GMRI team employed a thematic analysis approach to process the qualitative data collected during Phase 2. This method involved identifying, analyzing, and reporting patterns within the data, allowing the team to organize and describe the data sets in detail.[3,4] The thematic analysis approach is widely used in social science research and was chosen for its effectiveness in accurately interpreting stakeholder input in this context.

[3] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.;
[4] Clarke, V., & Braun, V. (2017). Thematic analysis. *The journal of positive psychology*, *12*(3), 297-298.

D3. EMERGING THEMES FROM RESPONSES

GMRI asked respondents about their preferences around platform, mooring system, cabling system, and anchoring system designs as described in the sections below. It should be noted that design concepts are not independent of one another and must be considered holistically. For instance, preference of mooring design is dependent upon whether inter-array cables are buried or not. Similarly, preference on anchor design may be dependent on which platform design is being implemented in the region. As is discussed in Section D4, more information on which combination of platform, mooring system, cabling system and anchoring system will be implemented in the Gulf of Maine could better equip stakeholders with the information needed to provide constructive feedback.

D3.1 PERCEPTIONS OF PLATFORM DESIGNS

Respondents expressed varying comfort levels regarding the prospects of navigating and fishing around FOW platform designs (Attachment D-A), with the majority expressing discomfort ("not comfortable at all" or "nervous") both navigating and fishing around each of the three platform designs presented. Navigating refers to not having fishing gear in the water/not actively fishing (i.e., getting to and from a location) while fishing is characterized by having gear in the water and actively targeting fish. When presented with the semi-submersible, spar, and tension-leg platform (TLP) designs, respondents expressed greater discomfort fishing than navigating around the designs. Once again, it should be noted that answers for this phase are from a small response group and do not represent broad consensus from a stakeholder group. More research over extended periods with a larger response group would provide a more comprehensive understanding of broader perspectives.

Navigating

- Four of eight survey respondents noted feeling "not comfortable at all," three noted "comfortable," and one noted "nervous" navigating around the **semi-submersible concept**.
- Three of eight survey respondents noted feeling "not comfortable at all," three noted "comfortable," and two noted "nervous" navigating around the **spar concept**.
- Four of eight survey respondents noted feeling "not comfortable at all," three noted "comfortable," and one noted "nervous" navigating around the **TLP concept**.

Focus group: Most of the fishermen in the group noted that they would have to exercise significant caution navigating around all FOW platform concepts. No fishermen explicitly mentioned "comfort" with regards to navigating around these concepts. However, fishermen expressed greater preference toward concepts with smaller spatial footprints, such as the tension-leg platform and spar designs, for ease of navigation.

Fishing

- Five of eight survey respondents noted feeling "not comfortable at all," three noted "nervous," and no respondents noted "comfortable" fishing around the **semi-submersible concept.**
- Four of eight survey respondents noted feeling "not comfortable at all," four noted "nervous," and no respondents noted "comfortable" fishing around the **spar concept.**

- Four of eight survey respondents noted feeling "not comfortable at all," two noted "comfortable," and two noted "nervous" fishing around the **TLP concept.**

Focus group: Fishermen in this group expressed significant unease at the idea of fishing around all three platform concepts, without expressing preference for one platform over another.

Explanations for Responses on Navigation and Fishing

In addition to listing their comfort, respondents were also asked to explain their answers. The following key themes arose in their responses:

Safety Concerns

The top concern shared by respondents was mariner safety. Respondents listed overcrowding, poor weather, radar interference, and unpredictable operational mishaps as potential hazards to mariners that contribute to discomfort with all FOW platform designs (i.e., semi-submersible, spar, and TLP).

Respondents pointed out that the FOW lease areas in the Gulf of Maine sit in existing fishing grounds and in navigation routes to further offshore fishing grounds, like Georges Bank. Respondents are concerned that FOW arrays in these areas will limit fishing grounds, which in turn, could lead to overcrowding of fishing vessels in other areas. Many respondents emphasized that overcrowding would add economic stress by concentrating operators into a smaller area and would also create navigational safety risks. As one respondent discussed, multiple vessels will be travelling through these areas and even if you have Automatic Identification System (AIS), time lapses with AIS may reduce your ability to observe obstacles. "With lots of vessels in close proximity, you might as well be going down the highway blindfolded, knowing that there is traffic ahead of you," they noted. Respondents indicated that navigational concerns would be heightened by the poor weather individuals have experienced while fishing in the lease areas. Another respondent noted, the "weather makes me feel uncomfortable steaming through a transit corridor." Several respondents, from both the focus group and survey pool, also alluded to concerns about potential radar interference in FOW arrays, which could create safety hazards for vessels navigating these areas. These concerns illustrate that many respondents are not just concerned with platform designs, but more broadly the area that multiple platforms may occupy in a lease area.

> *"Power or steering loss on any vessel in the vicinity of the columns is a potentially life and/or property damaging hazard regardless of foundation type."*

Three respondents, each of which listed "nervous" or "not comfortable at all" to all questions surrounding navigating and fishing around the three platform concepts, referenced potential operational failures as explanations for their discomfort. One respondent noted that it only takes the failure, or impairment, of one of the multitude of systems on a vessel to cause it to lose control and that current and wind then take over, limiting the time necessary to address problems. Another respondent anecdotally recounted being aboard a vessel and losing power steering while on the water. The vessel drifted over a mile before the issue could be mitigated. They noted that this would "probably be incredibly stressful near a wind site." The third respondent highlighted a similar concern, "power or steering loss on any vessel in the vicinity of the columns is a potentially life and/or property damaging hazard regardless of foundation type." In their responses, respondents did not reference individual platform concept designs, but rather the presence of multiple platforms in a lease area as a source of concern.

Technical and Operational Uncertainties

Another response theme, regardless of respondents' listed comfort, is the inability to predict how these platform concepts are going to react in the Gulf of Maine. Without any commercial-scale FOW developments operating in the Gulf of Maine, several respondents noted that they did not have enough relevant information to develop an informed opinion on the potential to navigate or fish around a FOW platform, regardless of platform design. Specifically, respondents referenced a lack of 1) knowledge around how FOW platforms may move while in the water (e.g. the size of a platform's watch circle), 2) information on whether fishing is allowed within FOW arrays, 3) information regarding the impacts of large scale commercial FOW projects, and 4) knowledge on what the impacts of the failure of one mooring array may have on the rest of the arrays (e.g. if a mooring line breaks, will a platform drift into other turbines?).

For insight on research to address these knowledge gaps, see Section D4: Key Areas for Further Research.

Greater Comfort Navigating than Fishing

For the three individuals who listed "comfortable" in response to questions regarding navigating around the platform concepts, one noted that "they are all the same navigation-wise," another noted that "visual sighting and radar should be sufficient for safe navigation," while the last provided no explanation for their response. For the two individuals who listed "comfortable" in response to questions regarding fishing around the listed platform types, the individuals did not explain their response. GMRI received more responses referencing comfort navigating than fishing, suggesting greater respondent comfort with navigating around the platform types than fishing.

D3.2 PERCEPTIONS OF MOORING SYSTEM DESIGNS

Respondents noted a range of comfort levels with potentially navigating and fishing around FOW mooring designs (Attachment D-A). Among the catenary, semi-taut, and taut concepts, respondents noted equal levels of discomfort ("not comfortable at all" or "nervous") navigating around each concept. Most respondents also noted discomfort fishing around the catenary and semi-taut concepts, with more comfort noted fishing around the taut concept.

Navigating

- Five of eight survey respondents noted feeling "not comfortable at all," three noted "comfortable," and no respondents noted "nervous" navigating around the **catenary concept.**
- Four of eight survey respondents noted feeling "not comfortable at all," three noted "comfortable," and one noted "nervous" navigating around the **semi-taut concept**.
- Four of eight survey respondents noted feeling "not comfortable at all," three noted "comfortable," and one noted "nervous" navigating around the **taut concept.**

Focus Group: Fishermen in the group expressed discomfort with the prospects of navigating around all three concepts, but noted preference for designs with limited spatial footprints, such as the taut and semi-taut concept.

Fishing

- Seven of eight survey respondents noted feeling "not comfortable at all," one noted "nervous," and no respondents noted "comfortable" navigating around the **catenary concept.**
- Six of eight survey respondents noted feeling "not comfortable at all," two noted "nervous," and no respondents noted "comfortable" navigating around the **semi-taut concept.**
- Three of eight of survey respondents noted feeling "not comfortable at all," three noted "nervous," and two noted "comfortable" navigating around the **taut concept.**

Focus Group: Like thoughts shared on navigating around these concepts, the group preferred designs with limited spatial footprints and expressed frustration at the thought that fishing would be possible near any of the mooring system concepts.

Explanations for Responses on Navigation and Fishing

In addition to listing their comfort, respondents were also asked to explain their answers. The following themes emerged from their responses:

Gear Entanglement

The most prominent theme is gear entanglement. Fishermen or representatives of industries employing both fixed and mobile gear expressed entanglement concerns with all mooring concepts. Respondents indicated this concern is because all mooring lines, regardless of concept, are hidden below the water, making it difficult for fishermen to predict their location. Respondents explained how the gear that they set (both fixed and mobile gear) often moves after it is deployed, making it challenging to know specifically where gear might be. One respondent noted that, given the currents, their trawl could be 0.25 mile to one side of the vessel, so even if they were not directly on top of the mooring line with their vessel, their gear might be. Another respondent discussed how the mooring concepts are similarly worrisome to the foundation types/cabling combination as they present unseen navigational challenges. Respondents indicated that for mobile fisheries, the inability to predict locations of FOW mooring lines can be hazardous as gear may become entangled with unmarked mooring lines. Respondents indicated that fixed gear, such as lobster traps, may carry a smaller risk of entanglement, particularly with semi-taut and taut mooring systems as these gear types can operate more discretely. However, one respondent pointed out that large tidal events and weather have the potential to move fixed gear. They also discussed how fishermen would likely have to innovate to guarantee that their gear did not move. A common strategy for this is using welded railroad tie anchors, adding two 150 pound anchors to each trawl. This, however, introduces an additional labor cost to folks employing fixed gear. Respondents therefore expressed concerns with gear entanglement risks associated with the mooring concepts for both mobile and fixed gear fisheries. Summarized feedback from respondents on each mooring concept can be found below.

Catenary

Catenary mooring systems appear to be the most difficult concepts to fish around for both fixed and mobile gear types as they require the largest surface area below the water. Respondents described the prospects of fishing around this mooring design as "*frightening*," "*a nightmare*," and "*too scary*." Respondents noted that the combination of this mooring system with suspended inter-array cables compounds the concern for potential risk of entanglement between fishing gear and FOW infrastructure.

Semi-taut and taut

Respondents noted that semi-taut and taut mooring designs appear to take up less surface area below the water, potentially reducing – but by no means eliminating – the risk of gear entanglement and minimizing impacts on fisheries. Some respondents noted these designs may be the only ones conducive to fishing. However, as is discussed in Section D3.5, this depends on which platform type is selected. If a semi-submersible platform employs a taut mooring system, the surface area below the water consumed by the moorings may be similar to that of a catenary concept. On the other hand, if a taut mooring design is employed with a spar or TLP platform concept, the mooring footprints appear to be smaller than other concepts.

Based on the input above, responses suggest a greater preference for the taut and semi-taut designs (when paired with a spar or TLP platform concept) over the catenary design for fishing activities due to the smaller spatial spread of the mooring lines in the water column. Respondents had mixed opinions on navigation with several expressing concerns navigating around all mooring concepts and others preferring the semi-taut and taut over the catenary concepts. In part as a result of the potential consequences of gear entanglement, several respondents also expressed significant opposition to the implementation of any FOW technology in the Gulf of Maine. For greater detail on respondents' suggestions to address concerns with the mooring concepts, see Section D3.5.

D3.3 PERCEPTIONS OF CABLING SYSTEM DESIGNS

After reviewing cable designs (Attachment D-A), all survey respondents noted greater preference for buried inter-array cables versus suspended inter-array cables with regards to fishing and navigation activities. All fishermen in the focus group also preferred buried cables.

According to respondents, buried cables are preferred as they reduce the potential for gear entanglement or interference of fishing and navigation activities. As one respondent noted, "*the fact that the cables, no matter the distribution, are unseen under the water and are unfamiliar impediments, makes them daunting.*" Respondents indicated that for mobile fisheries, which often employ trawls in fishing operations, unmarked suspended cables present the same gear entanglement hazard as unmarked mooring lines. Several respondents also alluded to concerns around how suspended cables may move within the water column because of ocean currents, adding unpredictability that could be dangerous for vessels employing mobile gear.

A final point raised by respondents is that, regardless of mooring technology, inter-array cables could have a larger spatial spread in the water column than mooring lines if they are not buried. One respondent noted that this makes the radius of the cable more important to think about than the mooring lines because the cables may extend beyond the radius of the mooring lines. A different respondent shared concerns with the idea that if their gear were to come into contact with an exposed cable, they could potentially be electrocuted.

When discussing if buried inter-array cables would reduce their concern with fishing around FOW, respondents shared skepticism to the idea. One respondent noted how they felt that buried cables will become unburied over time because of natural ocean conditions. They further described how they felt the methods (e.g. concrete mattresses) used to bury cables are equally frightening and would also create snagging risks for certain gear types (e.g. bottom trawls). Another respondent shared concerns about cable failure, alluding to how the ocean environment exerts significant wear and tear on gear and that cables would be no exception to such a dynamic. While respondents prefer buried inter-array cables, some are skeptical about the efficacy and safety of proposed burial methods.

D3.4 PERCEPTIONS OF ANCHORING SYSTEM DESIGNS

Survey respondents and focus group participants shared a diverse mix of perspectives on what anchoring system (Attachment D-A) would be the least challenging to their fishing practice. Respondents' preferences of anchor systems can be based around two main factors: 1) potential environmental impacts and 2) disruptions to fishing activity.

Several respondents shared environmental-related concerns about the drag anchor, pointing out that it has the greatest potential to disrupt the seabed. Two respondents described how drag anchors seem impactful because they "drag" on the seabed to become secure. Respondents also had environmental-related concerns for the driven pile, suction pile, and torpedo pile because these anchors, according to one respondent, would likely have to be driven into the seabed, putting the Gulf of Maine ecosystem at risk of impact from pile-driving related activities including disruptive underwater noise.

Respondents also expressed anchor design preferences based on potential to disrupt fishing activities. Two respondents noted that designs with the least anchor exposure above the seabed would be preferable, one of these respondents noted that the drag anchor best fits this category and is thus preferred. Respondents indicated that limiting the amount of anchor exposure is ideal as it reduces the risk of gear entanglement for fisheries including those using bottom trawls. Another respondent noted that the suction pile would not be preferred as it, according to them, is the most difficult to remove from the seabed once installed. Further, one respondent discussed how the bottom type and soil conditions in the Gulf of Maine will ultimately decide which anchor options are most feasible and safest, and that personal preferences will not be considered as a result.

Several respondents provided a preference for anchor type but did not explain why. Of these respondents, one noted preference for a clump weight, another for a drop weight, another for a torpedo anchor, and one noted that they all carry similar risk. Overall, respondent feedback suggests that anchor designs ought to be chosen with consideration to their impacts on the Gulf of Maine ecosystem and fishing activity for both fixed and mobile gear fisheries.

D3.5 OVERALL PERCEPTIONS OF COEXISTENCE

The final two questions posed to survey respondents and focus group participants were: "Overall, what parameters could be put in place to make coexistence a possibility?" and "which combination of designs do you see being the least challenging?" Summarized responses from individuals, some of whom provided multiple suggestions, to these questions can be found below. Various parties including, but not limited to, State government, Federal government, developers, and the maritime industry will need to be involved in collaboratively implementing these suggestions.

Parameters to Enhance Potential Coexistence

- Require a 1-mile separation between the perimeter of the mooring and cabling systems of turbines to allow for fishing activities.
- Require a 4-mile separation between the turbine platforms to allow for fishing activities.
- Require vessels involved in the maintenance or operations of FOW turbines to yield to fishermen with gear in the water.

- Equip any vessel likely to transit through or access a FOW array, at minimum, with detailed maps on their chart plotter of turbine watch circles and the field of potential encounter with anchoring systems for each turbine location.
- Install marker buoys on FOW moorings and anchors to mark their subsurface locations. These could be placed around the perimeter of a turbine platform's watch circle or the point on the mooring line of deepest draft for local vessels.
- Plot all FOW technology on AIS.
- Address any potential radar interference that could arise for vessels navigating/fishing within or around FOW arrays.
- Ensure that the US Coast Guard can carry out its activities in a safe and effective manner.
- Support policies that ensure fishermen are not held liable for gear entanglement or collisions with FOW components.
- Bureau of Ocean Energy Management and US Coast Guard should provide clarity on whether fishing will be allowed within FOW arrays.Improve communication between the wind energy industry and fisheries to understand feasible FOW design combinations in the Gulf of Maine context. This could take shape as facilitated meetings between FOW developers/engineers and fisheries stakeholders.

The feedback explains what spacing some respondents think is needed to fish and navigate in a FOW array and provides specific suggestions on how to 1) reduce navigation concerns, 2) reduce the economic burden placed on fishermen, and 3) offer next steps that would better inform stakeholder engagement. In response to the question, five respondents also noted that there is nothing that would make coexistence between FOW and fisheries a possibility.

Design Combinations

Individuals proposed a variety of FOW technology design combinations in response to the question, "Overall, which combination of designs do you see being the least challenging?" Included below are summarized comments of proposed combinations of platform, mooring, anchoring, and cable concepts that respondents suggested to be the least challenging to fishing practices.

While responses vary, respondents generally stated preference for design combinations with the smallest spatial footprint, both above and below the water level. Multiple respondents indicated that the combination of a spar or TLP platform, taut mooring system, buried inter-array cables, and the least obstructive anchoring systems would be the least challenging to fishing operations. Some respondents suggested that these design combinations may also have smaller potential environmental impacts in the Gulf of Maine, whether that be by minimizing the drag of mooring lines on the seabed or reducing the amount of cabling and mooring lines in the water. It must also be noted, however, that several respondents noted opposition to all design options, pointing to concern that any turbine in the Gulf of Maine introduces risks to individuals on the water. For instance, one respondent stated they could not endorse any design options, while another noted that "*they all present unmistakable challenges*." Respondents with this perspective also anecdotally recounted stories of witnessing or hearing past experiences of equipment failures in fixed-bottom offshore wind turbines, making them skeptical about the efficacy of any turbine technology.

D4. KEY AREAS FOR FUTURE RESEARCH

Findings from the Phase 2 engagement period provide a range of suggestions on how FOW technologies may or may not enable coexistence between fisheries and FOW. Like with Phase 1, respondents' feedback from Phase 2 identified knowledge gaps. Areas for future research, as identified by respondents, are listed below.

- Gear innovation - Adaptability from both fishing and FOW industries appears necessary to enable potential coexistence strategies. As such, further exploration into gear innovation or mooring and cabling technologies could shed light on potential strategies to allow for effective fishing within FOW arrays. Stakeholders may explore mechanisms for collaboration for this work.
- Navigation technology (radar and AIS) improvements – Respondents are concerned about potential for radar interference within FOW arrays. Research into radar interference and potential mitigation measures would better inform stakeholders.
- Vessel insurance – Respondents want to know the insurance implications for fishermen who fish within or around FOW arrays. Clarity on insurance would help fishermen to provide greater feedback on the prospects of coexistence.
- Gulf of Maine-specific research – Respondents want more clarity on how FOW technology may interact with the Gulf of Maine environment to understand the technology and its potential implications on the environment, fishing activity, and greater Gulf of Maine region.
- Environmental Impacts – Respondents want to understand the potential environmental impacts of the FOW technology, specifically how FOW platforms, cables, moorings, anchors, and other components may impact the Gulf of Maine ecosystem. Respondents listed the following potential environmental concerns: Electromagnetic fields, impacts from FOW transmission cables, FOW mooring line and anchor drag on the seabed, coolant discharge from FOW cooling stations, potential for oil spills, pile driving impacts of anchor installation, and marine animal entanglement from mooring and cabling systems.
- Design specifics – Respondents want specific information from developers about the mooring and cable radius for their platform designs to understand how fishing operations may interact with FOW technology. Respondents also want to know which design combinations (e.g. spar platform with taut mooring lines and buried inter-array cables) are most likely to be implemented in the Gulf of Maine.
- Dialogue – Respondents want opportunities to engage in open, constructive dialogue on FOW matters throughout the extent of the potential FOW development process.

More research is necessary to understand what potential coexistence between fisheries and FOW may look like. Continued collaborative research and engagement with stakeholders is crucial for ensuring effective, equitable, and informed decision-making around the FOW development process in the Gulf of Maine.

ATTACHMENT D-A GOOGLE FORM SURVEY

Note: The Google Form survey includes the red, amber, green matrix for the technology concepts. This matrix shows the results of a preliminary technical compatibility assessment and additional information about this assessment is provided in Attachment D-C.

Floating Offshore Wind Technology Review

During our second phase of engagement for the Maine GEO-funded project we are seeking input specific to the floating offshore wind technology concepts from the fishing industry. This survey encapsulates questions to help the State of Maine better understand the feasibility of fisheries coexistence with floating offshore wind technology. Your input ensures that important perspectives are elevated and considered throughout this process.

All responses will be kept anonymous and you will not be held accountable for anything you share regarding specific floating technologies. Further, **while on-the-water expertise is valuable, knowledge of the Gulf of Maine fisheries is sufficient for answering these questions.** If you think someone else can provide important feedback on this topic, please feel free to share this survey with them as well.

We are looking for your response **by August 26th.**

Thank you so much for taking the time out of your day to complete this survey.

1. Name and Affiliation/Association

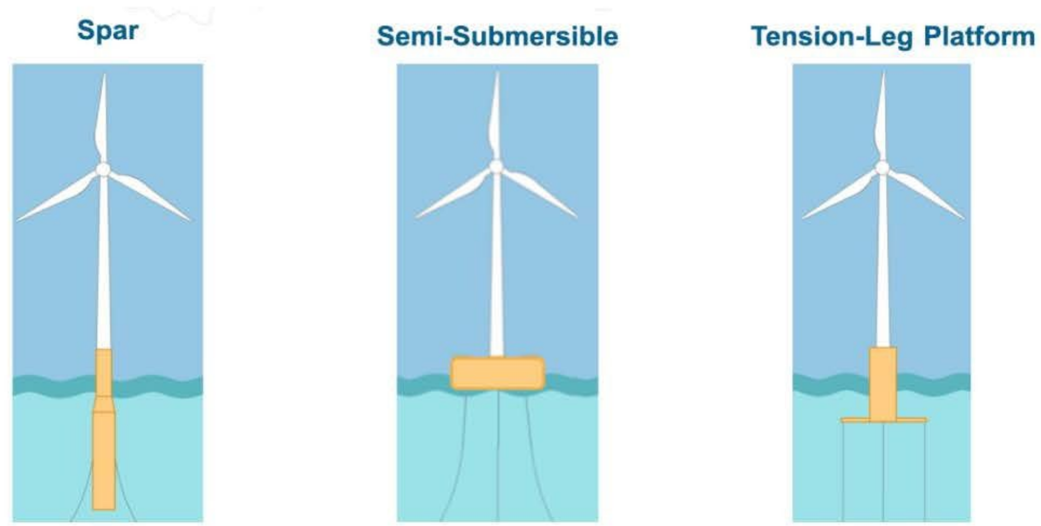
____

2. Given your review of the floating offshore wind technologies, what cabling system is most preferable to your fishing operation between buried inter-array cables or suspended inter-array cables. In essence, which design can you fish between? (see graphics in PDF in email for background)

Mark only one oval.

- ◯ Suspended inter-array cables
- ◯ Buried inter-array cables
- ◯ Other: ____________________________

Given the following floating foundation concepts, what is your comfort level with the following foundation types? Please answer these questions given your knowledge of Gulf of Maine fisheries or on-the-water experience if relevant.



Red-Amber-Green (RAG) scoring of each core foundation concept

Metric	Spar	Semi-Submersible (+Barge)	Tension-leg Platform
Description	Weight-buoyancy stabilized structure with deep draft	Free-surface stabilized structure with shallow draft	Tension restrained structure with relatively shallow draft
Stability in operations and motions	Advantage	Minor Constraint	Advantage
Structural Material Weight	Minor Constraint	Minor Constraint	Advantage
Fabrication complexity	Minor Constraint	Major Constraint	Minor Constraint
Seabed Footprint	Minor Constraint	Minor Constraint	Advantage
Sensitivity to soil conditions	Advantage	Advantage	Major Constraint
Mooring and anchor requirements	Advantage	Advantage	Major Constraint
Assembly and Port Constraints	Major Constraint	Minor Constraint	Minor Constraint
Transport Constraints	Minor Constraint	Advantage	Advantage
Transport Complexity	Advantage	Advantage	Minor Constraint
Stability During Installation	Advantage	Advantage	Major Constraint

RAG Key: Advantage | Minor Constraint | Major Constraint

3. What is your comfort level **navigating** around the **spar** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

4. What is your comfort level **navigating** around the **semi-submersible** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

5. What is your comfort level **navigating** around the **tension-leg platform** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

6. Please explain why you ranked your comfort in **navigating** between these floating offshore wind foundation concepts below. What could be changed to enable you to navigate comfortably?

7. What is your comfort level **fishing** around the **spar** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

8. What is your comfort level **fishing** around the **semi-submersible** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

9. What is your comfort level **fishing** around the **tension-leg platform** concept?

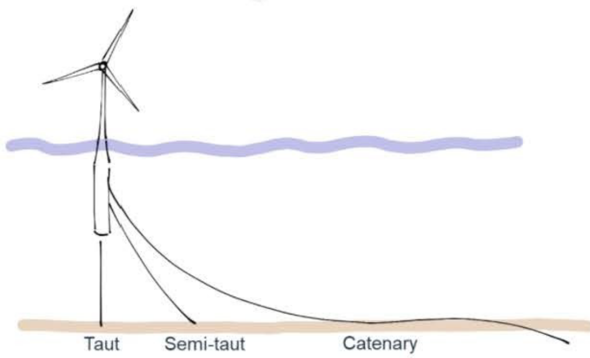
Mark only one oval.

- not comfortable at all
- nervous
- comfortable

10. Please explain why you ranked your comfort with **fishing** between these floating offshore wind foundation concepts below. What, if anything, could be changed to enable you to fish comfortably?

Given the following mooring system concepts, what is your comfort level with the following foundation types? Please answer these questions given your knowledge of Gulf of Maine fisheries or on-the-water experience if relevant.

Mooring Systems



Mooring Type	Approximate Mooring radius in 400ft water depth (ft)
Catenary	1600 – 2300
Semi-taut	330 – 100
Taut	0

In terms of the requirements for different floating wind foundation types:

- **Spars and semi-submersibles** only require station-keeping constraints (i.e. keeping the unit at a given set of coordinates). Hence catenary mooring is a feasible option and anchor requirements are not demanding.
- **Tension-leg platforms (TLP)** rely on taut mooring lines and vertical loaded anchors to ensure stability, whereby the mooring tension is large enough so any overturning moment cannot remove the tension in any of the tendons or mooring lines.

Metric	Catenary	Semi-taut	Taut
Footprint and length			
Sensitivity to depth (length increases with depth)			
Load at anchor point			
Constraining of roll, pitch and heave movements at substructure (vertical movement and tilting)			
Constraining sway and surge movements at substructure (horizontal movement)			

RAG Key:

Advantage	Minor Constraint	Major Constraint

11. What is your comfort level **navigating** around the **catenary mooring** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

12. What is your comfort level **navigating** around the **semi-taut** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

13. What is your comfort level **navigating** around the **taut** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

14. Please explain why you ranked your comfort in **navigating** between these floating offshore wind **mooring** concepts below. What, if anything, could be changed to enable you to navigate comfortably?

15. What is your comfort level **fishing** around the **catenary** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

16. What is your comfort level **fishing** around the **semi-taut** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

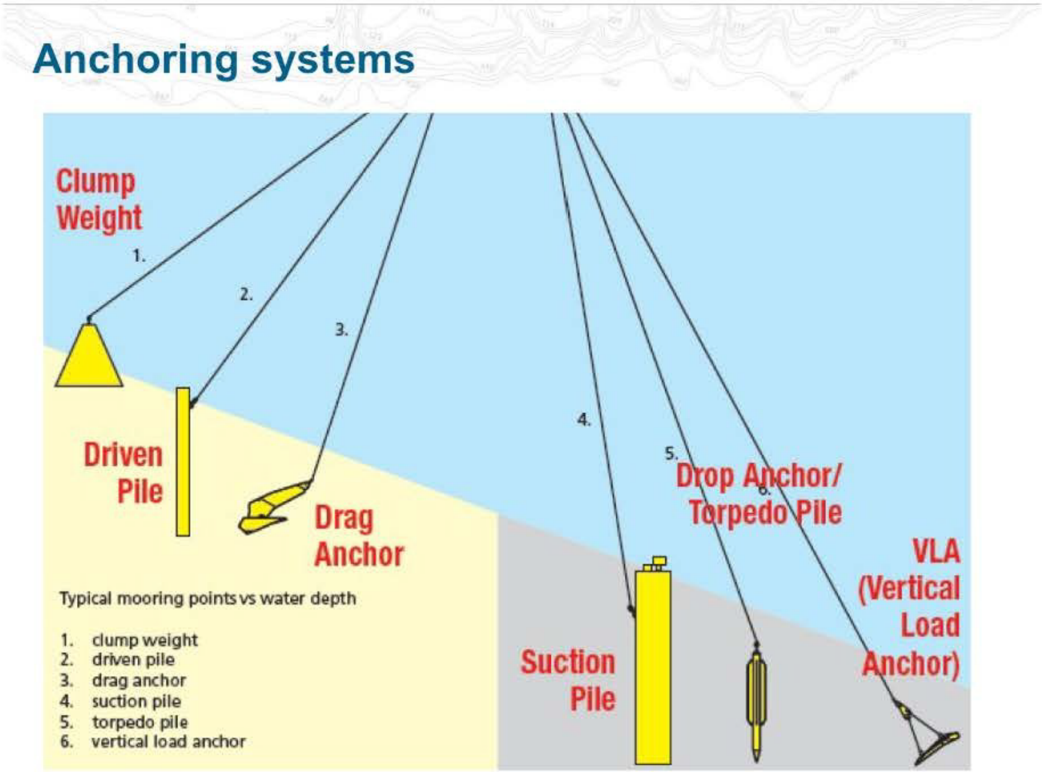
17. What is your comfort level **fishing** around the **taut** concept?

Mark only one oval.

- not comfortable at all
- nervous
- comfortable

18. Please explain why you ranked your comfort with **fishing** between these floating offshore wind **mooring** concepts below. What, if anything, could be changed to enable you to fish comfortably?

Given the anchoring systems noted below - please address the following questions:



19. What is your reaction to these designs?
Based on these scenarios, what do you see as the most challenging with your fishing practice?
Which design do you see being the least challenging? Please use anchor name if applicable.

20. Overall, which combination of designs do you see being the least challenging?

21. Overall, what parameters could be put in place to make coexistence a possibility?

ERM

ATTACHMENT D-B TECHNOLOGY OVERVIEW HANDOUT AT FOCUS GROUP

Phase 2 Engagement Questions

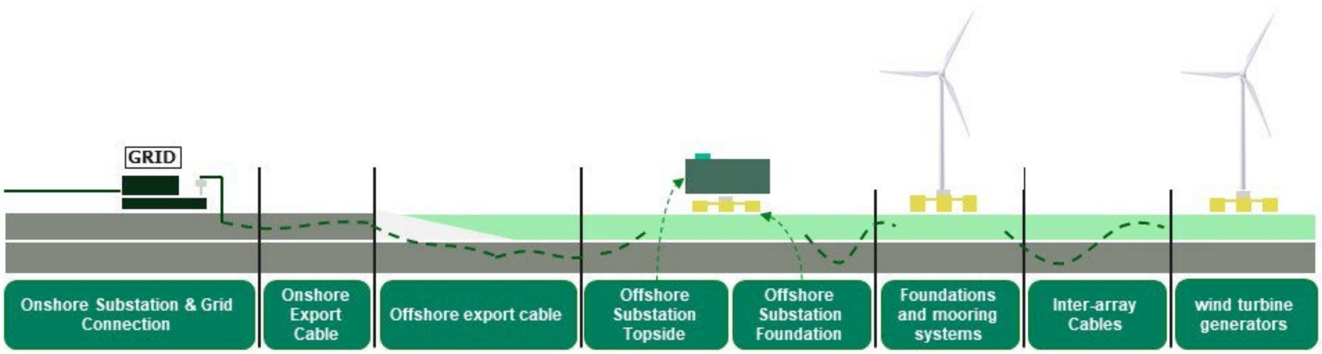
Group images (Spar, TLP, Semi and Moorings)

- What is your reaction to these designs?
- Based on these scenarios, what do you see as the most challenging with your fishing practice?
- Which design do you see being the least challenging?
- What parameters could be put in place to make coexistence a possibility?

Individual images

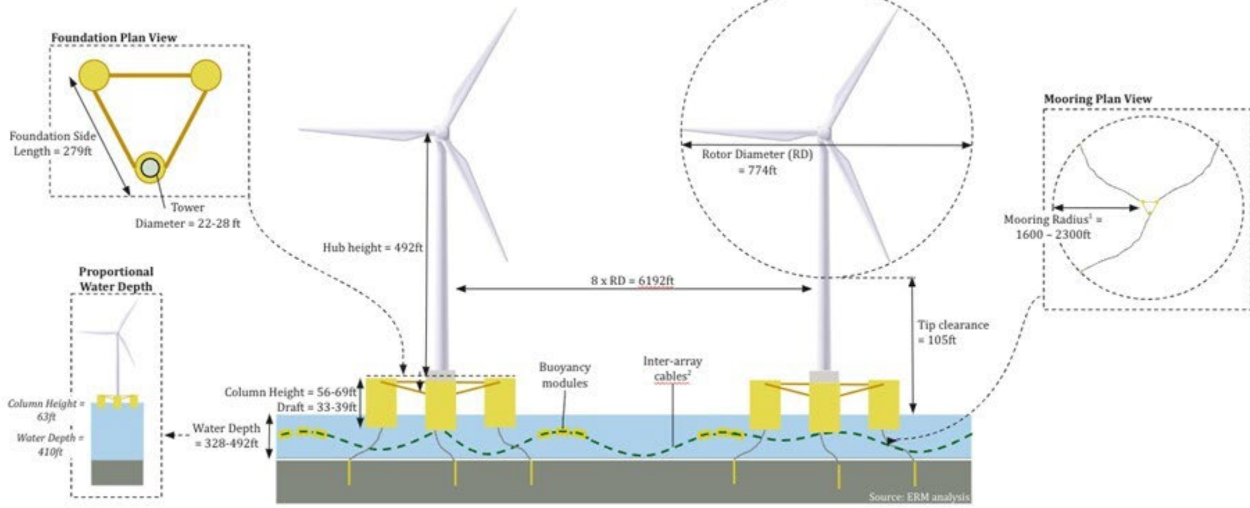
- What is your comfort level (not comfortable at all, nervous, or comfortable) in navigating between this technology? If not comfortable or nervous, can you explain why?
- What is your comfort level (not comfortable at all, nervous, or comfortable) in fishing between this technology? If not comfortable or nervous, can you explain why?
- What - if anything - could be changed to enable you to coexist comfortably?

Technology Overview

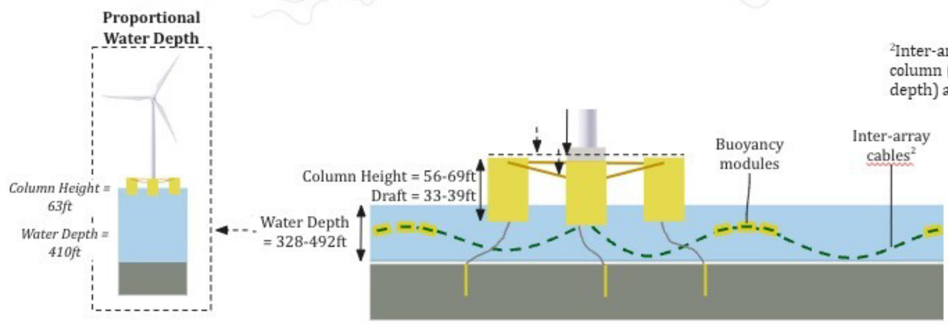


Typical Component Dimensions (15MW Turbines)

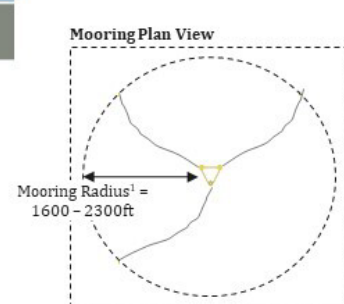
The figure below outlines illustrative dimensions for a Floating Offshore Wind array in the Gulf of Maine (not drawn to scale), considering, for example, a 15 MW wind turbine generator capacity and a generic semi-submersible foundation design. The exact values will vary according to project-specific considerations, and this graph is only a schematic.



Below Sea Surface

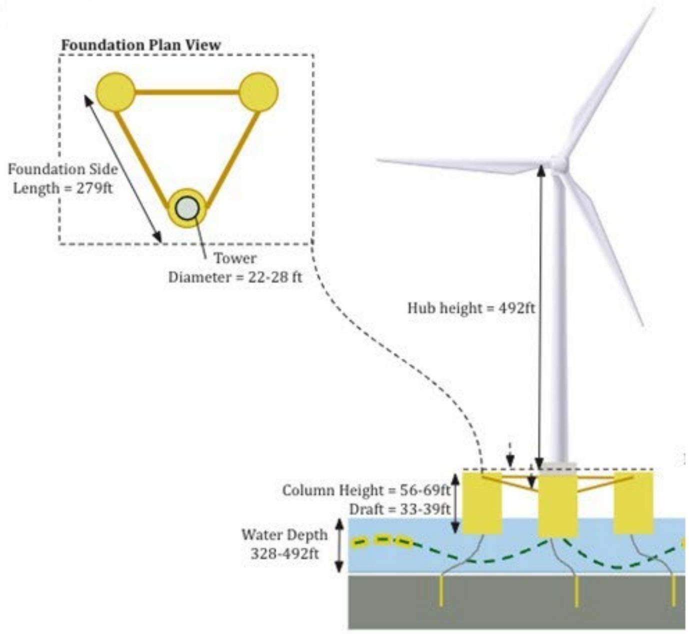


[2]Inter-array cables are often suspended in the mid-water column (approximately 160-250ft for the assumed water depth) and can be partially buried.

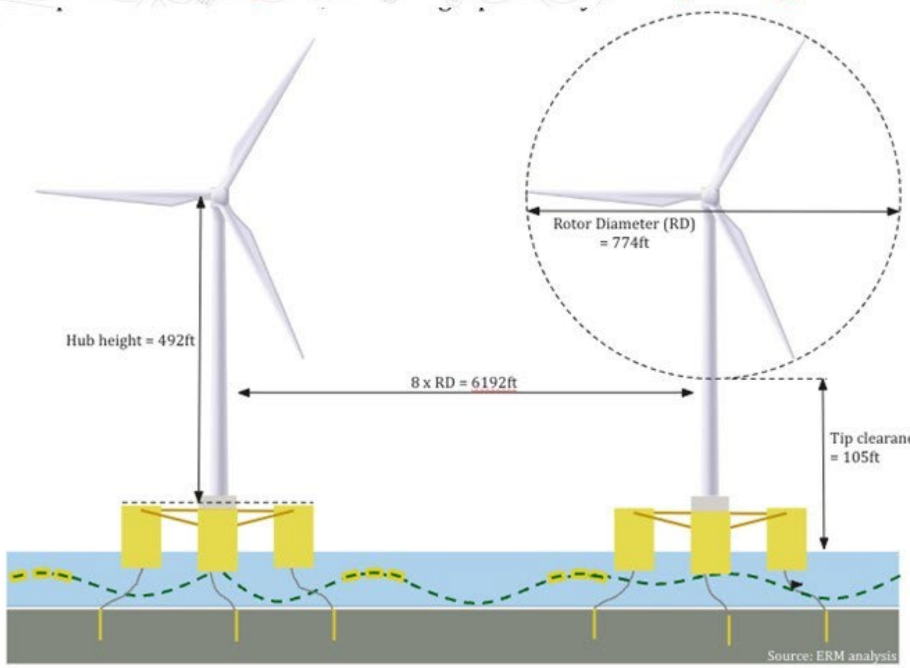


[1]Mooring radius is defined as the distance from the center of the floating platform to the point where a mooring line is anchored to the seabed. A catenary mooring system has been assumed for this value.

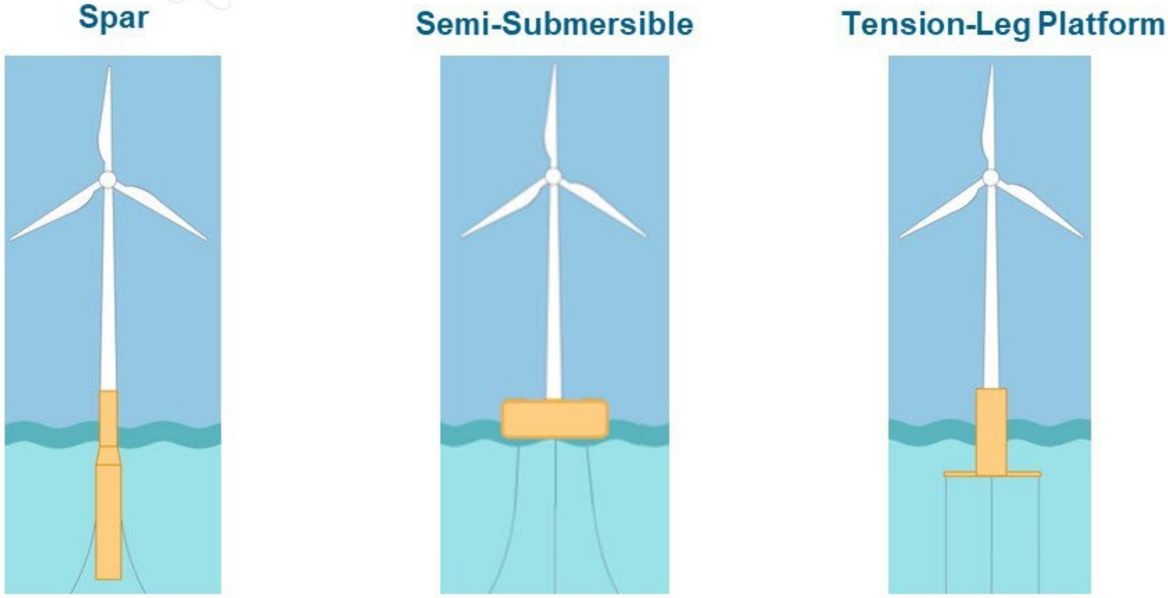
Above Sea Surface - Tower and Foundation Specs



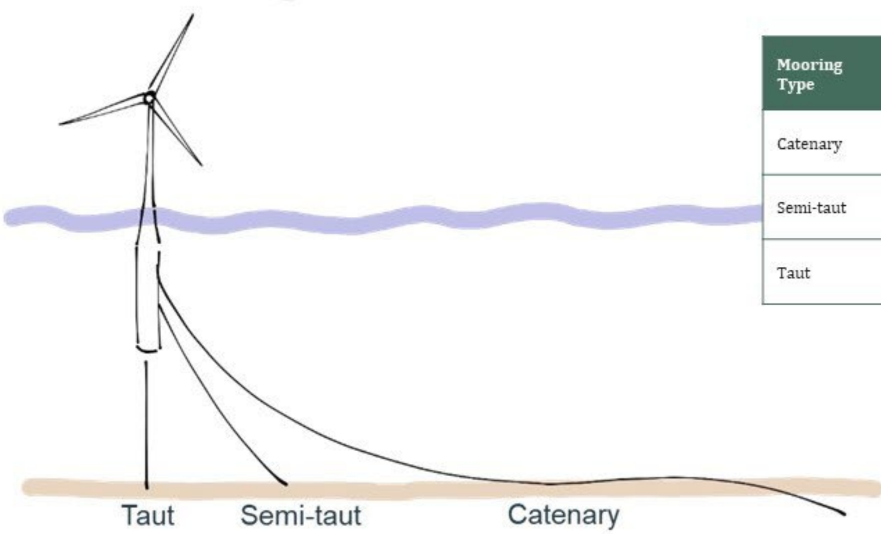
Above Sea Surface - Tip Clearance and Rotor Spacing



Foundation Concepts

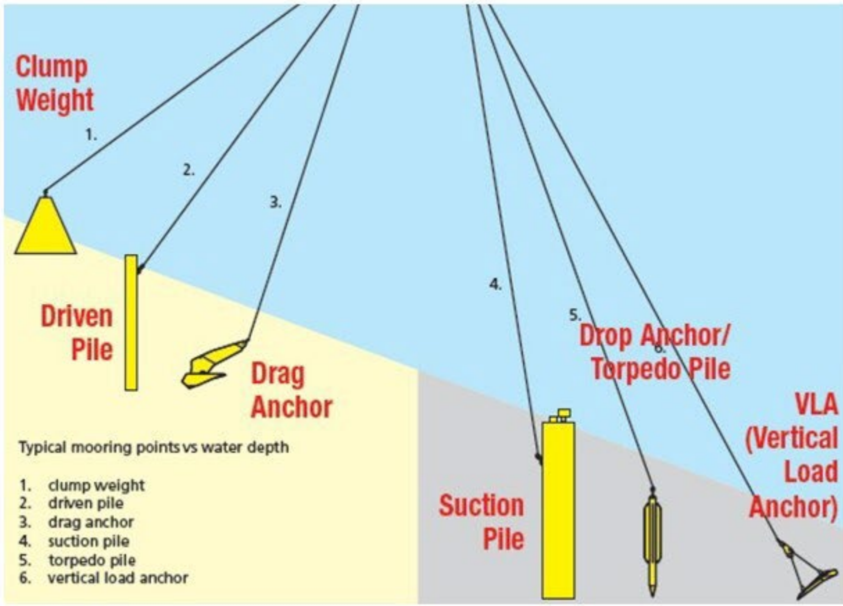


Mooring Systems



Mooring Type	Approximate Mooring radius in 400ft water depth (ft)
Catenary	1600 – 2300
Semi-taut	330 – 1000
Taut	0

Anchoring systems



ERM

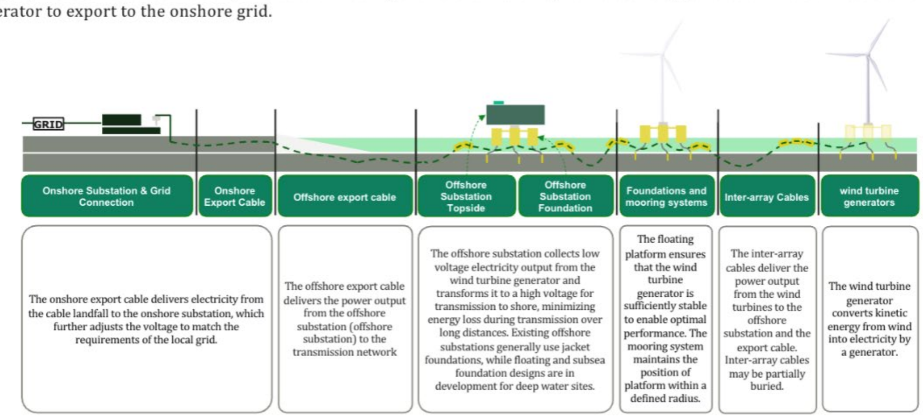
ATTACHMENT D-C TECHNOLOGY OVERVIEW SENT IN EMAIL ATTACHED TO SURVEY

Floating Offshore Wind Technology Review

BREAKDOWN OF THE KEY FLOATING OFFSHORE WIND COMPONENTS

Summary of Major Floating Offshore Wind Farm Components

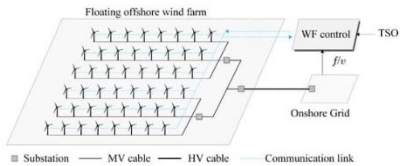
This graphic outlines the core components of a Floating Offshore Wind farm, from electricity generation in the wind turbine generator to export to the onshore grid.



Offshore Wind Farm Example Layout

Typical spacing between turbines is 6-8 rotor diameters (RD), and spacing is independent of anchor spread.

Wind Farm Example Layout Schematic[1]

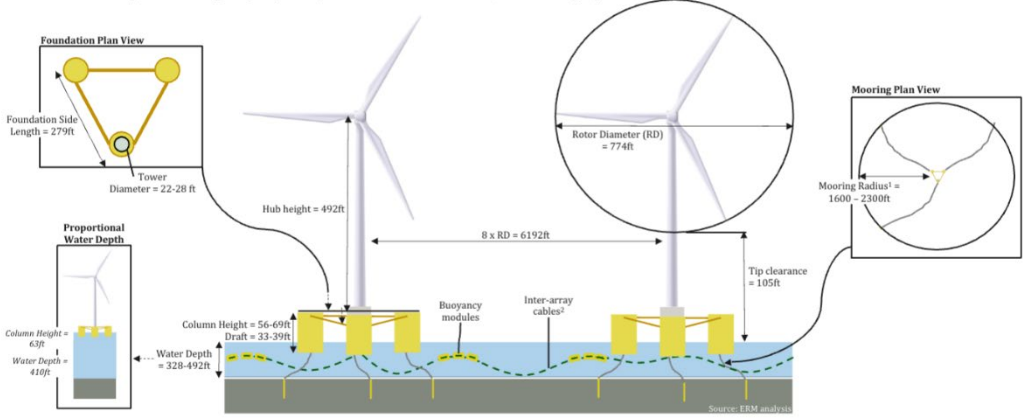


Wind Farm Example Layout

[1]Energies | Special Issue : Distributed Control of Wind Farm System (mdpi.com),
TSO = Transmission System Operator, WF = Wind Farm, MV = Medium Voltage, HV = High Voltage

Typical Component Dimensions (15 MW Turbines)

The figure below outlines illustrative dimensions for a Floating Offshore Wind array in the Gulf of Maine (not drawn to scale), considering, for example, a 15 MW wind turbine generator capacity and a generic semi-submersible foundation design. The exact values will vary according to project-specific considerations, and this graph is only a schematic.



[1]Mooring radius is defined as the distance from the center of the floating platform to the point where a mooring line is anchored to the seabed. A catenary mooring system has been assumed for this value.
[2]Inter-array cables are often suspended in the mid-water column (approximately 160-250ft for the assumed water depth) and can be partially buried.

Foundation Concept Comparison

Red-Amber-Green (RAG) scoring of each core foundation concept

The adjacent table provides an overview of the characteristics of different foundation types. This is a concept-level view, however specific designs may score differently under each category and hybrid designs exist as well.

Tens of different floating foundations are under development at varying levels of commercial readiness, however, most can be classified in three main categories:

1. Semi-submersibles (Semi-Submersible or floaters), defined to include semi-submersible (e.g., Principle Power's WindFloat and The University of Maine's patented VolturnUS) and barge concepts (e.g., Ideol's Damping Pool design), which have very similar characteristics
2. Spar buoys (also known simply as spars)
3. Tension Leg Platforms

To date, most of the demonstration units are either semi-submersible (or barge) designs or spar concepts. Only one tension-leg platform demonstration project has been installed to date.

Concept selection requires an understanding of technical constraints (i.e., shallow draft), commercial considerations (i.e., concept readiness and materials pricing), and siting constraints (i.e., environmental and stakeholder impacts). Fabrication constraints must also factor into project planning, often benefitting more modular concepts, where sub-components can be manufactured separately, and only final assembly work occurs in the vicinity of the potential sites.

Semi-submersibles and tension-leg platforms are worth considering in the context of the Gulf of Maine site, however, spars are likely to be incompatible due to the requirement for ultra-deep ports and navigation.

Metric	Spar	Semi-Submersible (+Barge)	Tension-leg Platform
Description	Weight-buoyancy stabilized structure with deep draft	Free-surface stabilized structure with shallow draft	Tension restrained structure with relatively shallow draft
Stability in operations and motions	Green	Amber	Green
Structural Material Weight	Amber	Amber	Green
Fabrication complexity	Amber	Red	Amber
Seabed Footprint	Amber	Amber	Green
Sensitivity to soil conditions	Green	Green	Red
Mooring and anchor requirements	Green	Green	Red
Assembly and Port Constraints	Red	Amber	Amber
Transport Constraints	Amber	Green	Green
Transport Complexity	Green	Green	Amber
Stability During Installation	Green	Green	Red

RAG Key:

Advantage	Minor Constraint	Major Constraint
Green	Amber	Red

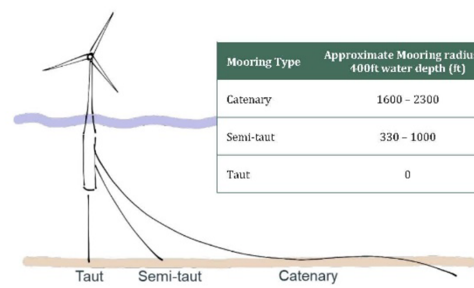
Moorings

There are three main types of mooring lines: Catenary, Semi-taut and Taut.

Metric	Catenary	Semi-taut	Taut
Footprint and length	Red	Amber	Green
Sensitivity to depth (length increases with depth)	Red	Amber	Green
Load at anchor point	Green	Amber	Red
Constraining of roll, pitch and heave movements at substructure (vertical movement and tilting)	Amber	Green	Green
Constraining sway and surge movements at substructure (horizontal movement)	Amber	Green	Green

RAG Key:

Advantage	Minor Constraint	Major Constraint
Green	Amber	Red



Mooring Type	Approximate Mooring radius in 400ft water depth (ft)
Catenary	1600 – 2300
Semi-taut	330 – 1000
Taut	0

Mooring lines provide opportunities to leverage existing Oil and Gas experience, however new requirements for wind loads, cost effectiveness, and large networks of moorings will require further innovation.

Site constraints will further shape mooring design choices. A non-uniform seabed is likely to affect the ability to position anchors in ideal layouts, further affected by environmental constraints such as commercial fishing and seabed disturbance.

In terms of the requirements for different floating wind foundation types:

- **Spars and semi-submersibles** only require station-keeping constraints (i.e. keeping the unit at a given set of coordinates). Hence catenary mooring is a feasible option and anchor requirements are not demanding.
- **Tension-leg platforms (TLP)** rely on taut mooring lines and vertical loaded anchors to ensure stability, whereby the mooring tension is large enough so any overturning moment cannot remove the tension in any of the tendons or mooring lines.

Anchors

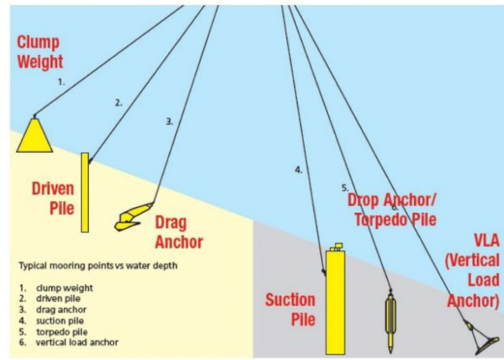
A variety of anchor options are available, with design driven by soil conditions and mooring loads

There are a variety of mature anchoring solutions developed in the Oil and Gas industry, as shown in the adjacent graphic. The selection of anchor points depends significantly on the soil conditions at a given site and loading requirements from the mooring lines.

From a geotechnical point of view, drilled piles are usually installed in rocky conditions, suction piles and drag embedded anchors in sandy soils and some clays, and clump weights (gravity-based anchors) used as an alternative in most types of soils. As such, anchor designs are available for all ground conditions, and must be selected following more detailed knowledge of mooring design and soil conditions.

Seismic risk would need to be considered for certain markets for the mooring and anchor system design, likely requiring conservative anchor sizing, potentially deeper-penetrating anchor solutions, and monitoring following earthquake events. The primary risk is that soil liquefaction could lead to anchors slipping, a greater concern for systems under high tension. Seismic activity is not considered a major risk to overall project costs or operations but must be considered during design and may lead to more expensive anchor solutions, however this is unlikely to be a major consideration for Gulf of Maine sites.

Example Anchor Types



Inter-Array Cables and Export Cables Design

Function: The inter-array cables deliver the power output from the wind turbines to the offshore substation and the export cables deliver the power output from the offshore substation to the transmission network.

Standard subsea cables used in offshore wind are made up of a stranded, profiled conductor with a combination of sealing layers, insulation, fillers, and protective armoring. Subsea alternating current (AC) cables have three cores (one per phase), and onshore AC cables have single cores and are laid in groups of three. Direct current (DC) cables have two single cores (one positive and one negative, for each circuit). DC transmission is more efficient over long distances, however, the high cost of DC converter stations means that AC is favored over shorter distances (the cut-off is around 75 km for projects over 1 GW).

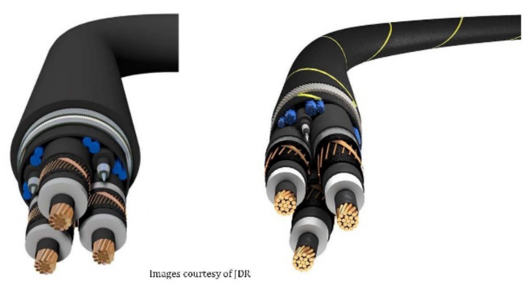
Low voltage (LV) refers to cables rated up to 11 kV, medium voltage (MV) refers to cables rated up to 66 kV, high voltage (HV) refers to cables rated up to 220 kV, and extra high voltage (EHV) refers to cables rated higher than 220 kV. Transmission networks and export cables are generally HV and EHV, whereas inter-array cables are typically MV. Inter-array cables are currently 66 kV but are expected to increase to 132 kV to efficiently accommodate 16+ MW wind turbine generators and to reduce the number of array cable strings required. wind turbine generators generate at LV and a transformer at the base of the tower steps up exported power to MV.

There are three main insulated power core design types:

- **Dry:** with an extruded lead sheath over the insulation
- **Semi-wet:** with a polyethylene sheath over a non-fully impervious metallic screen,
- **Wet:** without a sheath over a non-fully impervious metallic screen.

Wet designs have the advantage of being lighter and more flexible, however, cables with voltages above 66 kV are currently only available as dry designs.

Dynamic inter-array cables (Left) and Static export cable (Right)



Images courtesy of JDR

Inter-Array Cable and Export Cable Considerations

Array networks are generally configured as "strings" which connect several turbines to the substation. Export cables are buried where possible to minimise impacts on fishing activities and ecosystems.

Array Cables

Array networks can be designed in strings or loops to increase redundancy. Array cables have a dynamic cable length between the seabed and the floating substructures, which has lazy wave configuration to allow for the dynamic movement of the floating substructure, including lateral movements of the floating wind turbine generator. At the seabed, the cable is either buried or sits on the seabed anchored using rocks or protective matting.

The choice of inter-array cables configuration depends on the relative costs of static and dynamic cables, the additional costs of using field joints or connectors, and the impact of additional potential points of failure at field joints or connectors. In shallow water, the dynamic section of array cable for floating offshore wind farms is:

1. A single length of dynamic cable between turbines.
2. Dynamic lengths at each turbine connected to a static length in between using either field joints or connectors.
3. A single cable assembly using dynamic cable at each end with a length of static cable in between, assembled using factory joints (so manufactured and installed as a single length of cable).

In deep water, array cables could be suspended across their whole length. This would put greater loading on the cable due to water current-induced movement of the cable but would reduce the length of cable required. The water depth at which this becomes attractive expected to be in water depths of around 1640ft (which is beyond the approximately 328ft water depth in the Gulf of Maine search areas).

Export Cables

Dynamic export cables are not yet proven, therefore fixed offshore substations (offshore substation) with static export cables are expected to be used for early floating projects until floating offshore substation and dynamic export cables designs are implemented. After landfall, the subsea export cable is jointed to the onshore export cables in a transition joint bay.

Existing HV AC export cables are typically rated at 220 kV, allowing the export of approximately 300 MW per three-core subsea cable. Future wind farms are expected to use higher voltages of up to 275 kV. The voltage chosen balances the cost of the cable, the number of circuits required, and the number of offshore substation required. Wind farms tend to have more than one export cable circuit for redundancy.

Burying export cables is common practice, as this protects the cables, avoids interference with activities (such as fishing), minimises impacts on marine ecosystems, and is often a regulatory requirement. However, burial is sometimes technically/economically unfeasible, for example in seabed areas with significant hard rock, in which case the export cables are heavily armoured to protect the cables from physical impacts.

Geotechnical/geophysical assessments of the seabed in likely export routes from the Maine search areas are likely to be required to determine the viability of export cable burial.

Inter-array Cable Layout Considerations

Array networks are generally configured as "strings" which connect several turbines to the substation.

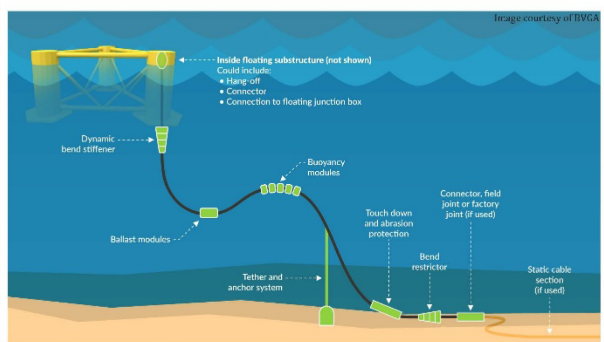
Array networks can be designed in strings or loops to increase redundancy. Array cables have a dynamic cable length between the seabed and the floating substructures, which has lazy wave configuration to allow for the dynamic movement of the floating substructure, including lateral movements of the floating wind turbine generator. At the seabed, the cable is either buried or sits on the seabed anchored using rocks or protective matting.

The choice of inter-array cables configuration depends on the relative costs of static and dynamic cables, the additional costs of using field joints or connectors, and the impact of additional potential points of failure at field joints or connectors. In shallower water, the dynamic section of array cable for floating offshore wind farms can be:

1. A single length of dynamic cable between turbines.
2. Dynamic lengths at each turbine connected to a static length in between using either field joints or connectors (see adjacent diagram).
3. A single cable assembly using dynamic cable at each end with a length of static cable in between, assembled using factory joints (so manufactured and installed as a single length of cable).

In deep water, array cables could be suspended across their whole length. This would put greater loading on the cable due to water current-induced movement of the cable but would reduce the length of cable required. Floating projects have not yet used this approach, meaning that the water depth at which this becomes attractive is not well understood, but it is likely to be in water depths of around 500 m (which is beyond the approximately 100m water depth in the Gulf of Maine search areas).

Floating Offshore Wind Dynamic Cable System[1]



[1]It should be noted that actual system would not use all of these elements at the same time. The horizontal distance between the floating substructure and the touchdown point is typically around 200 m

ERM HAS OVER 160 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina
Australia
Belgium
Brazil
Canada
China
Colombia
France
Germany
Ghana
Guyana
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
The Netherlands
New Zealand
Peru
Poland
Portugal
Romania
Senegal
Singapore
South Africa
South Korea
Spain
Switzerland
Taiwan
Tanzania
Thailand
UAE
UK
US
Vietnam

ERM's Boston Office

One Beacon Street
5th Floor
Boston, MA 02108

T +1 617 646 7800
F +1 617 830 8975

www.erm.com

ERM

APPENDIX E FLOATING OFFSHORE WIND CABLES AND CONCEPTUAL MODEL SCENARIOS

Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind

Appendix E: FOW Cables and Conceptual Model Scenarios

PREPARED FOR
State of Maine, Governor's Energy Office

DATE
28 October 2024

REFERENCE
0724797

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym	Description
ERM	ERM Consulting & Engineering, Inc.
FOW	floating offshore wind
m	meter
mm	millimeter
MW	megawatt
TLP	tension-leg platform
WTG	wind turbine generator

E1. INTRODUCTION

Over the course of 2023, the Maine Offshore Wind Research Consortium Advisory Board underwent a rigorous prioritization process to identify three research topics to fund in its inaugural round of projects. This project, Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind, was one of the projects included in the competitive Request for Proposals that was issued in November 2023 by the Governor's Energy Office on behalf of the Research Consortium.

ERM Consulting & Engineering, Inc. (ERM) and Gulf of Maine Research Institute were awarded the project to pursue the research and stakeholder engagement to advance understandings of floating offshore wind (FOW) and fishery coexistence. The project kicked off in February 2024.

As part of this project, based on outputs from the fishing technology assessment, and Phase 2 fishery stakeholder engagement, ERM consolidated the applicable FOW technologies in the Gulf of Maine and identified the interference risks related to documented fishing activities used in the lease areas in the Gulf of Maine to better understand the coexistence. This study, *FOW Cables and Conceptual Model Scenarios*, considers current FOW technology and fishing gear and does not consider future technology and gear types that may be available when a commercially viable FOW project would become operational in the Gulf of Maine. The content of this report draws on ERM's industry knowledge and expertise, including insight from professionals with extensive experience in offshore wind, engineering, and related fields.

FOW technologies are built around three primary components: the platform, the mooring systems, and the electrical cables that connect the wind turbines. FOW designs are optimized for water depths where conventional fixed-bottom wind turbines are not feasible. The FOW platforms are anchored by different mooring systems, depending on the depth and environmental conditions. The electrical cables are typically buried or laid on the seabed and are engineered to withstand marine environments. FOW designs are determined based on site-specific geotechnical conditions, and the known environmental conditions in various regions, such as wave load, wind strength, and seabed characteristics.

With advancements in both materials and engineering techniques, FOW technology is expected to evolve in the future, particularly as FOW farms are being deployed in deeper waters. FOW technologies have implications for fisheries; understanding the spatial footprint, material requirements, and the impact of installation and operation on the marine environment is critical for mitigating potential conflicts with fishing activities.

For this research, ERM analyzed the components and design of FOW systems to assess their compatibility with existing fisheries in the Gulf of Maine, particularly within the wind energy areas. This report compliments the FOW technologies presented in the main report. Possible FOW farm cable layout and layout scenarios developed for different mooring technologies are discussed in this appendix.

E2. MOORING TECHNOLOGIES

ERM developed conceptual models for three mooring configurations (catenary, taut, and tension-leg platform [TLP]) and two wind turbine generator (WTG) sizes for a total of four scenarios to demonstrate different mooring designs. Geotechnical conditions are a key factor in determining which mooring type is best suited for a particular site. This study did not evaluate the relative suitability of different mooring technologies for individual Proposed Lease Areas within the Gulf of Maine based on site conditions, cost, or availability, but rather considered each mooring technology as it relates to fishing activities.

The semi-taut mooring concept was not developed because the space claim of the semi-taut mooring is between that of the catenary and taut moorings in the neutral position, so the catenary and taut models can be used to infer the results for the semi-taut mooring. The designs are indicative, and the sketches presented show the platform in its neutral position when the mooring is un-loaded.

When wind, wave, and water current forces are applied to the platform, the platform will move and load the mooring lines. Typically, a mooring is designed to limit platform movement to about 30 percent of the water depth.[1] Therefore, in water that is 100 meters (m) deep, the mooring will be designed so that the platform may move approximately 30 m from its neutral position (i.e., the platform's natural position without application of external forces). Platform movement is an important design consideration because the mooring and cable will also move. Mooring design scenarios, which consider the WTG, water depth, foundation type, and mooring types are presented in Table 1. WTG between 12 and 18 megawatts (MW) were evaluated to represent the current lower and upper end of the technology sizing for WTG. The designs presented are approximate and provide a range for consideration. With detailed engineering design, the mooring would be optimized and refined to more accurately suit the site conditions and project requirements. Details about each scenario, including schematics, are provided in Section E4.

TABLE 1: MOORING CONFIGURATION CONCEPTUAL MODELS

Scenario	WTG Size (MW)	Water depth (m)	Type of foundation	Type of mooring system
1	12	100	Semi-sub	Catenary
2	18	100	Semi-sub	Catenary
3	18	260	Semi-sub	Taut
4	18	260	TLP	TLP mooring

m = meter; MW = megawatt; TLP = tension-leg platform; WTG = wind turbine generator

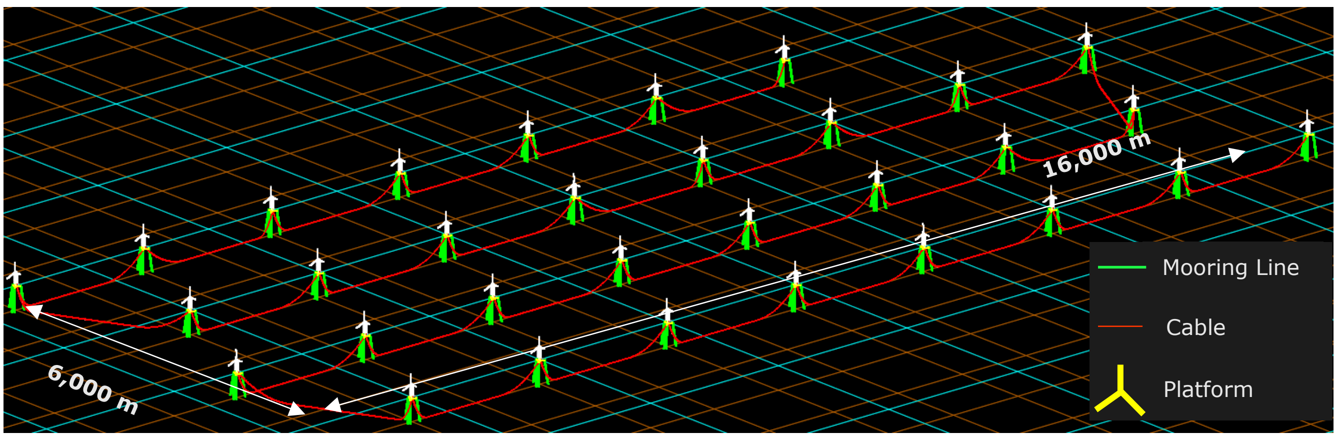
[1] B.3 Mooring system | Guide to a floating offshore wind farm

E3. CABLING

At a commercial project scale, electrical cables connect all the FOW WTG units to an offshore substation[2]. The design of the cabling depends on the mooring type and the amount of motion on the platform. For indication purposes, schematic cabling is presented for the TLP (Section E4.4) in Figure 1, where a cable (also called an 'inter-array cable') is laid in one large string[3]. The TLPs have good station keeping and a simple catenary layout of the cable from the floating platform to the seabed might be possible. Where the cable is on the seabed, it can be protected with concrete mattresses, rocks, or buried.

In very deep waters (i.e., greater than 1,000 meters like off the California coast) all the cable may be in the water column, and none of the cable will be on the seabed. As the water depth increases, the amount of cable on the seabed decreases. At water depths less than 300 meters (i.e., like the Gulf of Maine lease areas) it is almost certain that most of the cabling will be on the seabed. This study assumes that the length of inter-array cabling on the seabed will be buried. However, in practice this design consideration will depend on environmental conditions within each site.

FIGURE 1: CABLING FOR TLP MOORING FOR 576 MW FARM, 18 MW WTG



Note: This is a conceptual, schematic representation that does not reflect site-specific conditions. For more details see Section E4.4.

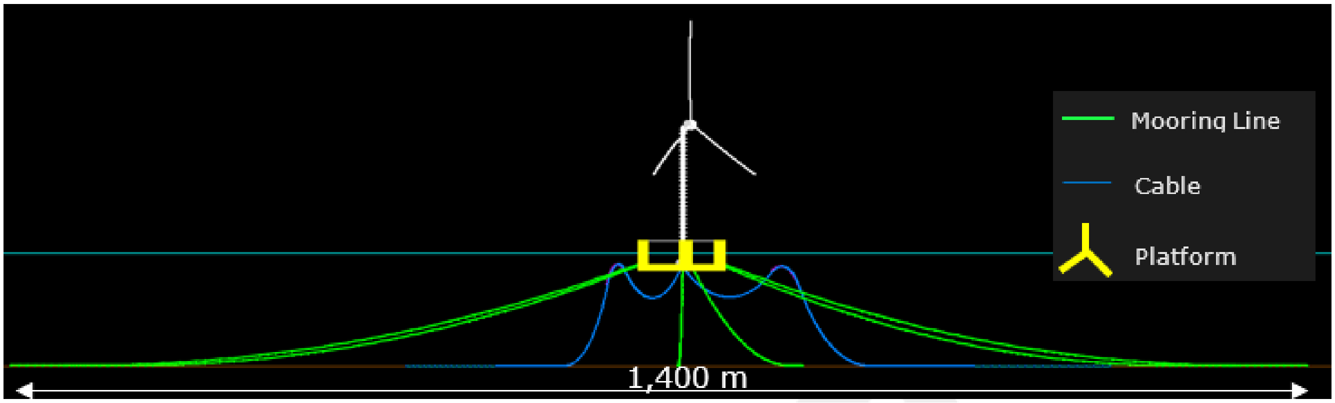
Cabling for catenary and taut mooring differs from cabling for TLP moorings because catenary and taut moorings move more. To accommodate movement of the mooring, more of the cable must be in the water column. To keep the cable in the water column, buoyancy modules are added at discrete locations along the cable to provide the necessary buoyancy. The cable then forms an arch or a 'lazy wave' that can accommodate platform movement (Figure 2). In Figure 3, a lazy wave cable (typically used for a taut or catenary mooring) and a catenary cable (typically used for a TLP mooring) are compared. In Figure 3 you can see that the amount of cable in the water column is almost double for the lazy wave cable compared to the catenary cable. Note that the

[2] Typically, there is one offshore substation for one FOW project (possibly two for very large projects).

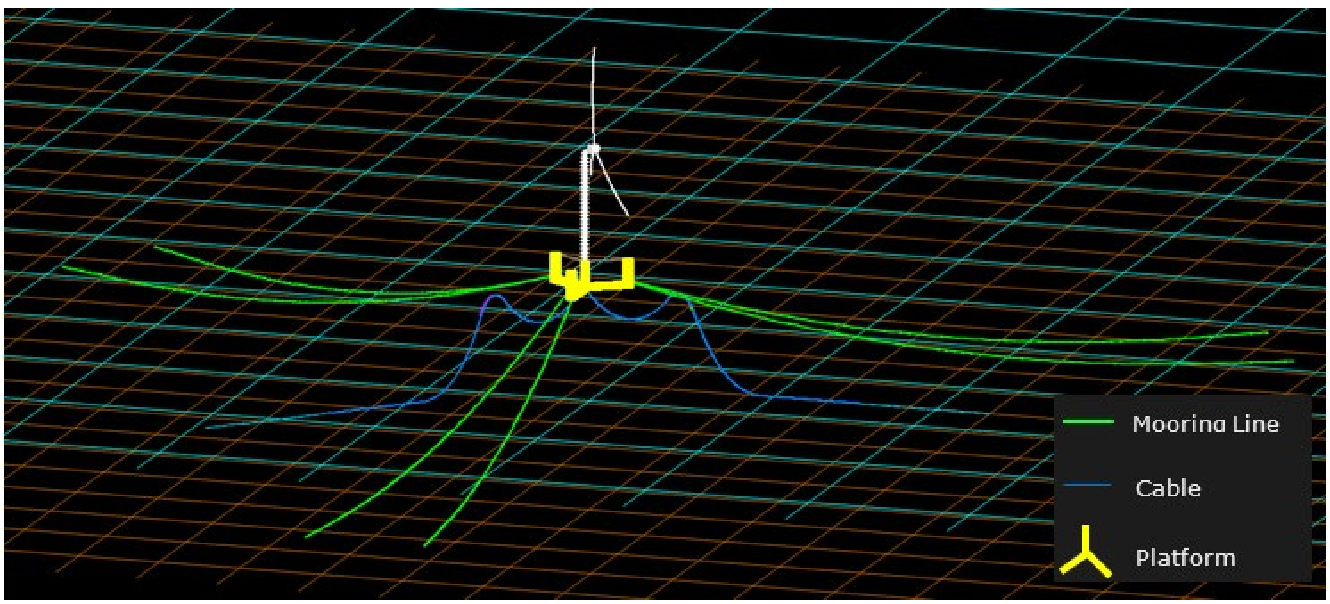
[3] Realistically the cabling would be more complicated, with up to 8 turbines on a string and looped into one offshore substation.

percentage of the cable that is in the water column generally increases with water depth (i.e., in deeper water, more of the cable will be in the water column). The cable that is on the seabed will need to be protected (i.e., with rocks, concrete mattresses, or burial).

FIGURE 2: CABLING (IN BLUE) FOR TAUT MOORING 18 MW WTG (SCENARIO 3)



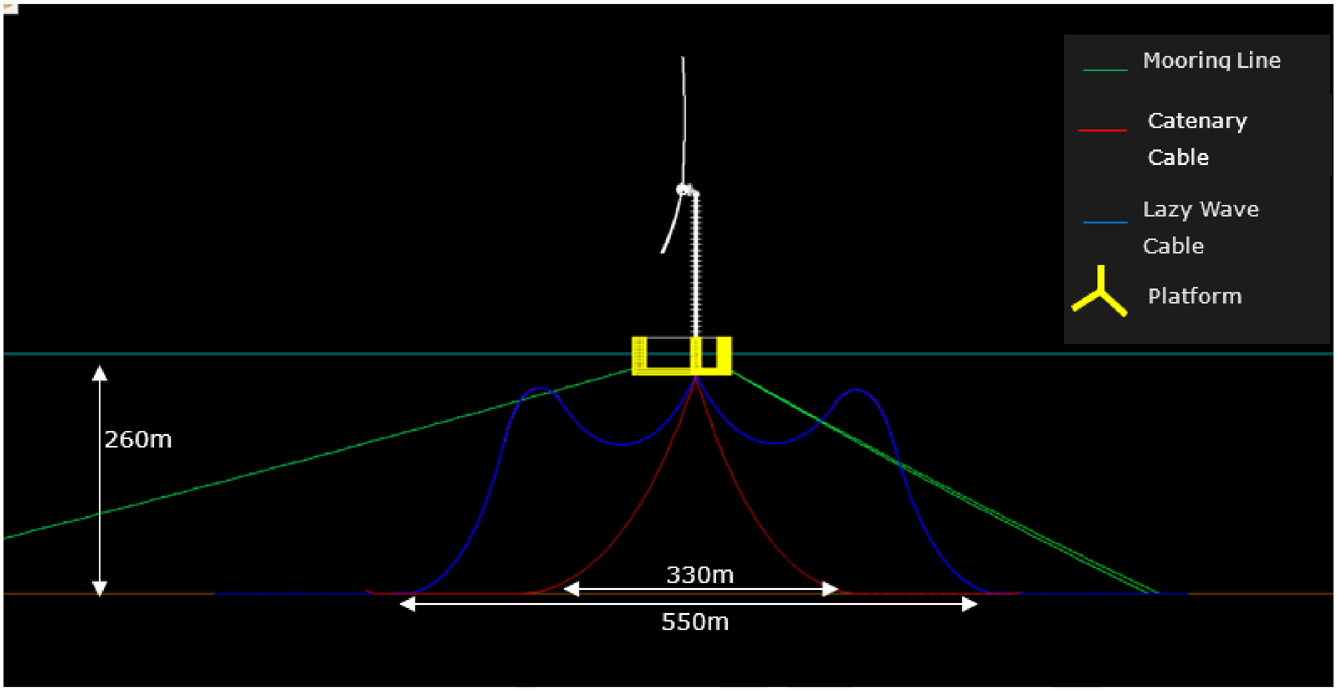
Elevation view



Isometric view

Note: This is a conceptual, schematic representation that does not reflect site-specific conditions. For More details see Section E4.3.

FIGURE 3: COMPARISON OF LAZY WAVE CABLE (IN BLUE) AND CATENARY CABLE (IN RED FOR TAUT MOORING) 18MW WTG; ELEVATION VIEW.



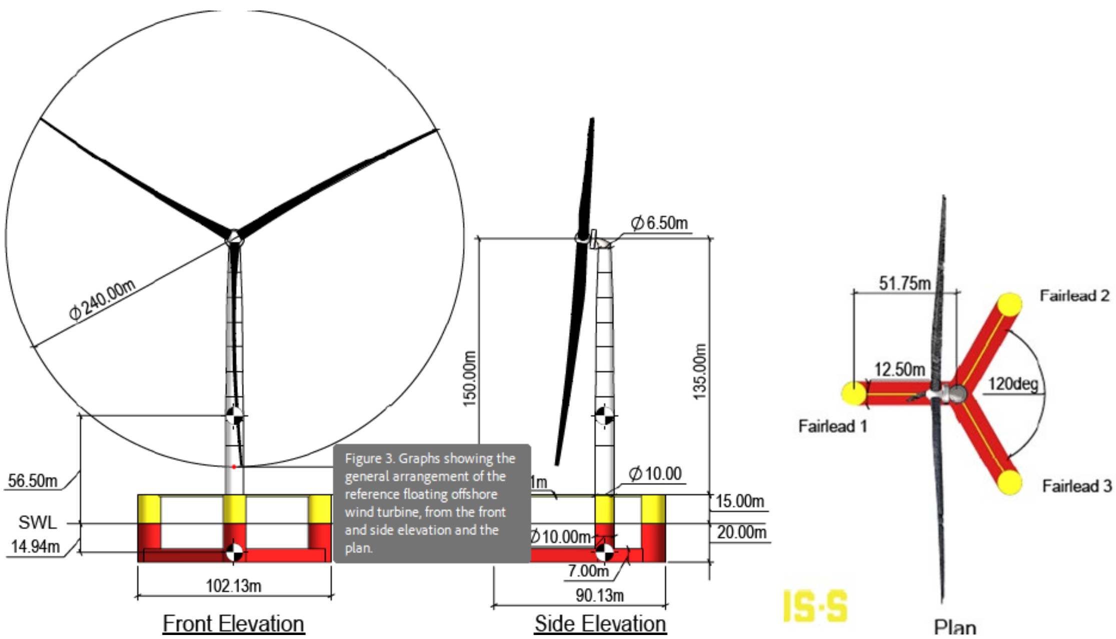
Note: In this example, the distance between adjacent WTGs is 2,000 meters, and about 10-15% of that distance the cable should be floating (i.e., not on the seabed). This is a conceptual, schematic representation that does not reflect site-specific conditions. For more details see Section E4.3.

E4. SCENARIOS

For this study, ERM chose the semi-sub type as a base case foundation technology to reference the various mooring types, since this platform is most common. The reference semi-sub in this study is the VolturnUS, a three-legged semi-sub with a central spar, with about 8,000 tons of mass, developed by the University of Maine (Figure 4). Detailed information about this platform is widely available and is not restricted by corporate patents. The VolturnUS is likely to be considered for the Gulf of Maine, though design decisions concerning foundation technology will be made for each site based on a variety of factors, including geotechnical, environmental, logistical, and supply chain considerations.

This study does not consider site specific suitability, which will be based largely on geotechnical conditions. Each scenario provides a simplified model of the selected mooring technology for a given water depth.

FIGURE 4: VOLTURNUS SEMI-SUB PLATFORM DETAILS[4]

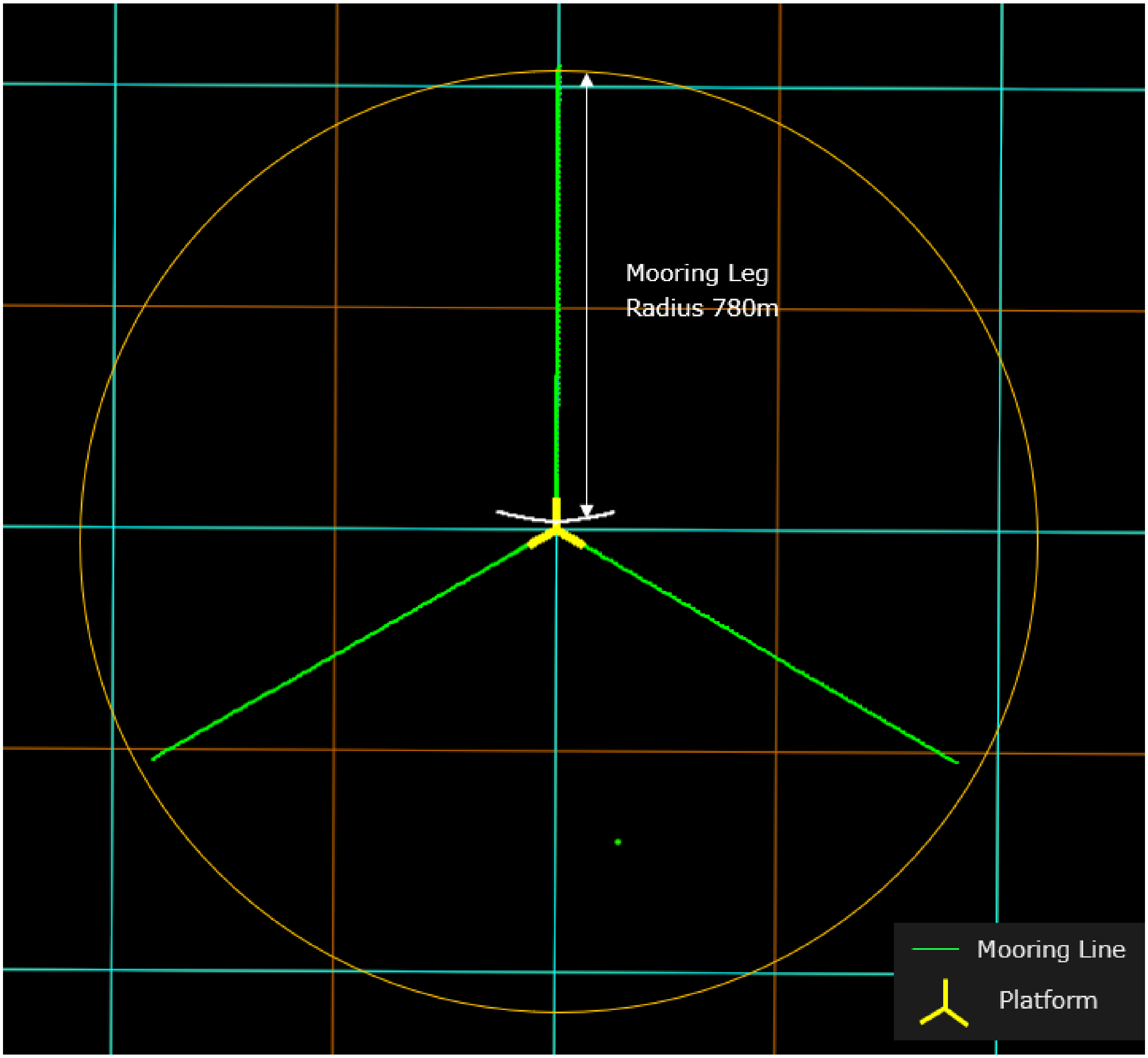


E4.1 SCENARIO 1

Scenario 1 is a 12 MW WTG on a semi-sub (VolturnUS) platform in 100 m water with a catenary mooring system (Figure 3). The mooring line is 124-millimeter (mm) chain[5] that is 775 m long and weighs 337 kg/m. Three mooring lines (120 degrees apart) secure the platform. The orange circle denotes the mooring circle which is approximately 1,750,000 square meters.

[4] Source: July 2020 IEA Wind TCP Task 37 Definition of the UMaine VolturnUS-S Reference Platform Developed for the IEA Wind 15- Megawatt Offshore Reference Wind Turbine
[5] 124 mm is the diameter of the steel bar used to make the chain

FIGURE 5: PLAN VIEW OF CATENARY MOORING FOR 12 MW PLATFORM



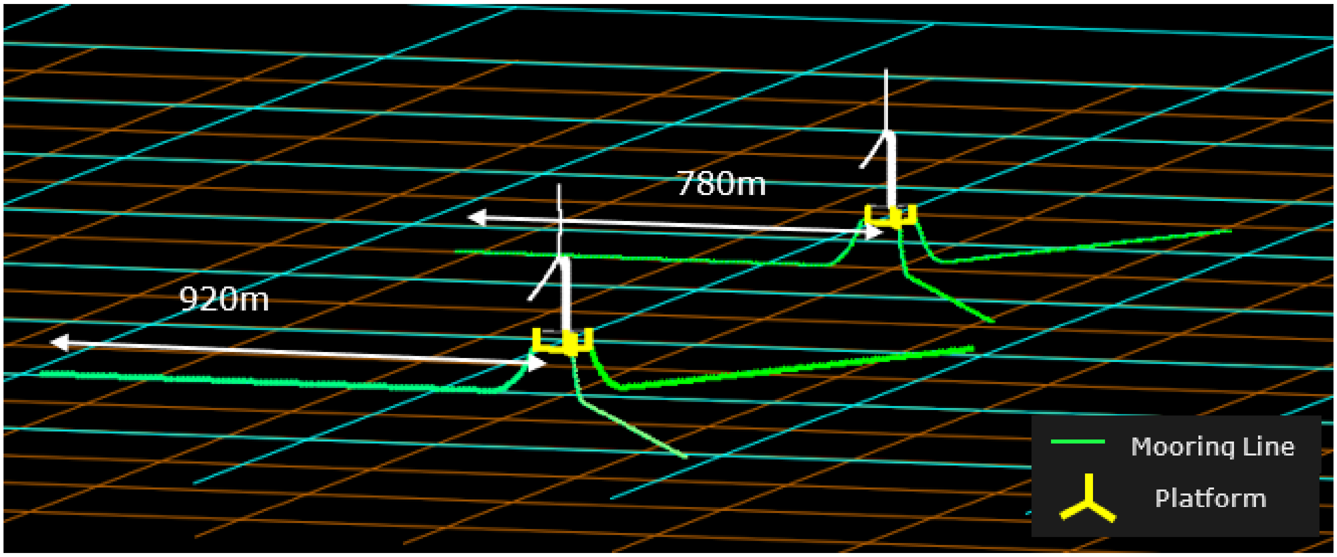
E4.2 SCENARIO 2

Scenario 2 is an 18 MW WTG on a semi-sub (VolturnUS) platform in 100 m of water with a catenary mooring system (Figure 6). The mooring lines are approximately 15 percent longer[6] than in Scenario 1 and the chain is 15 percent bigger (~148 mm chain), which means the chains will also be 50 percent heavier. This type of chain is uncommon, expensive, and hard to handle; so practically, the chain may be two smaller chains sitting side by side. The plan view configuration is

[6] Increasing the WTG by 50 percent (i.e. from 12 to 18 MW) increases the mooring line by 15 to 20 percent. The mooring line length for 15 MW WTG would be approximately halfway between that of a 12 MW WTG and an 18 MW WTG.

the same as Scenario 1 (Figure 3), except the mooring leg radius is 920 m in Scenario 2 compared to 780 m in Scenario 1. A three-dimensional illustration of Scenarios 1 and 2 is presented in Figure 7.

FIGURE 6: THREE-DIMENSIONAL COMPARISON OF SCENARIO 1 (RIGHT) AND 2 (LEFT)

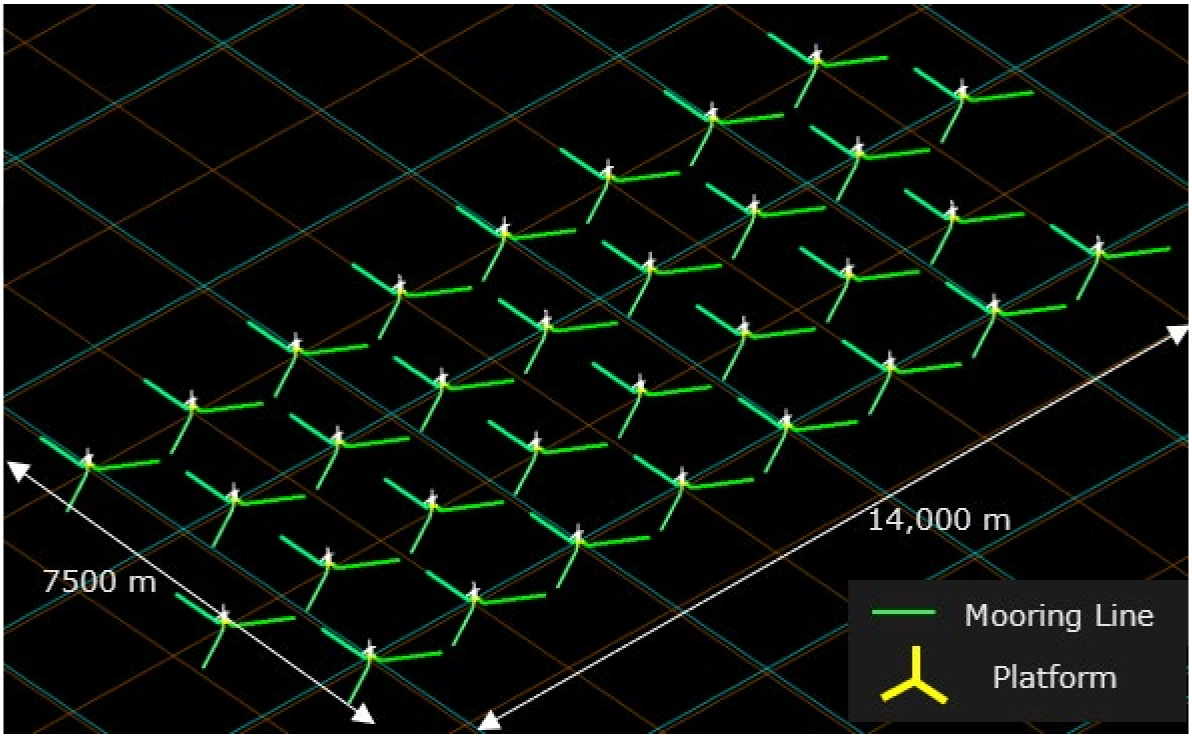


Note: This is a conceptual, schematic representation that does not reflect site-specific conditions.

To compare the different types of mooring systems, ERM used 18 MW WTG as the baseline. The spacing between WTGs is typically eight times[7] the rotor diameter (RD). For an 18 MW turbine, the rotor diameter is approximately 250 m, so the spacing between WTGs is approximately 2,000 m.

[7] Specific spacing can be smaller or larger depending on the design condition; the purpose of the spacing is to minimize the effects of turbulent flow and wind recovery on turbines located in the wake of the front WTG.

FIGURE 7: ISOMETRIC VIEW OF CATENARY MOORING FOR 576 MW PROJECT (18 MW WTG, SCENARIO 2)



Note: This is a conceptual, schematic representation that does not reflect site-specific conditions.

E4.3 SCENARIO 3

Scenario 3 is an 18 MW semi-sub platform with a taut mooring in 260 m water (Figure 8). Taut moorings achieve their motion keeping properties by stretching the mooring lines, which are synthetic materials (primarily 260 mm diameter polyester rope) that have some elasticity (catenary mooring chains do not stretch at all). The design and size of the mooring line allows some motion , which reduces the load in the mooring. A taut mooring for an 18 MW platform is likely to require more lines than a catenary mooring to achieve the right amount of stretch yet still have enough strength to keep the platform on station. The synthetic ropes are almost neutrally buoyant, and as they are preloaded (i.e., tensions are applied to the mooring line before it is put into operation), the taut mooring line is effectively a straight line from the anchor to the platform (Figure 9).

For the same WTG scenario, the mooring line radius is about the same for catenary moorings and taut mooring. The main difference is that most of the catenary mooring line is on the seabed, while the entire taut mooring line is in the water column.

FIGURE 8: PLAN VIEW OF TAUT MOORING FOR 18 MW PLATFORM (SCENARIO 3)

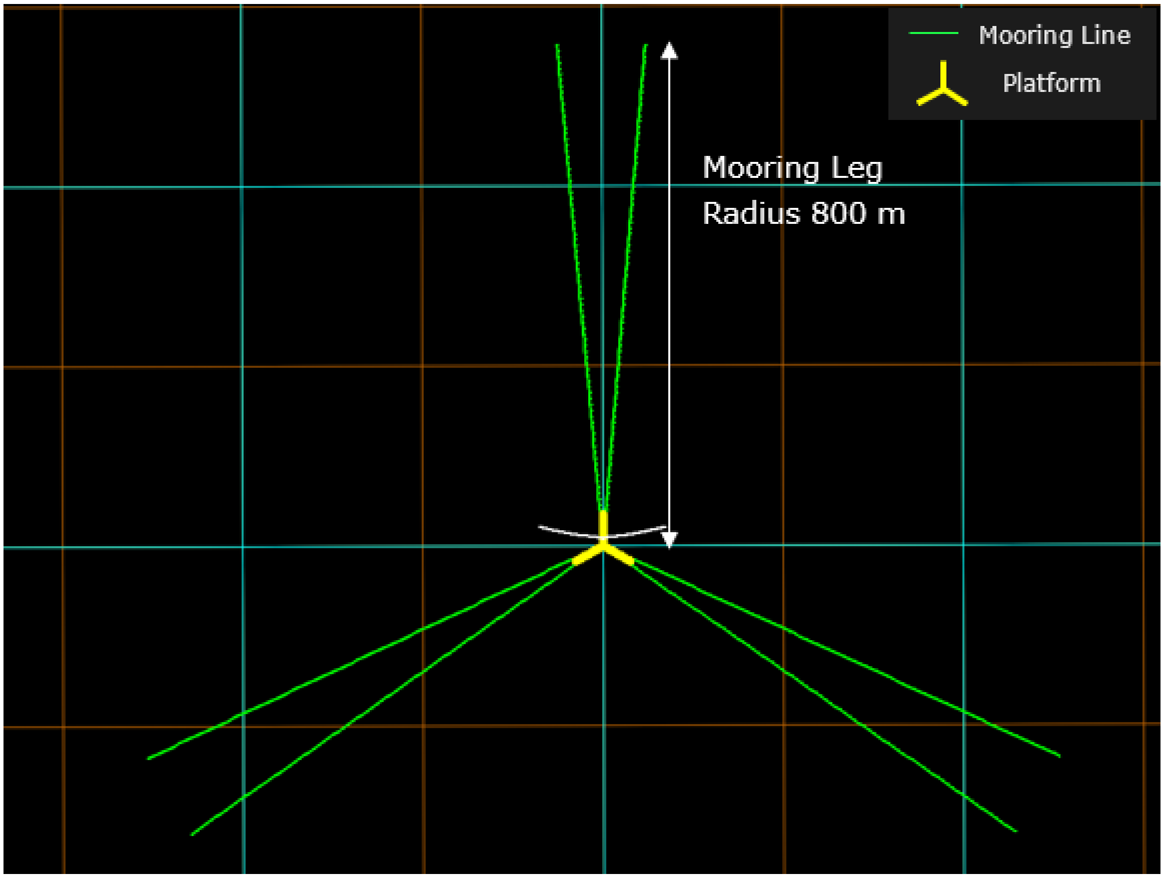
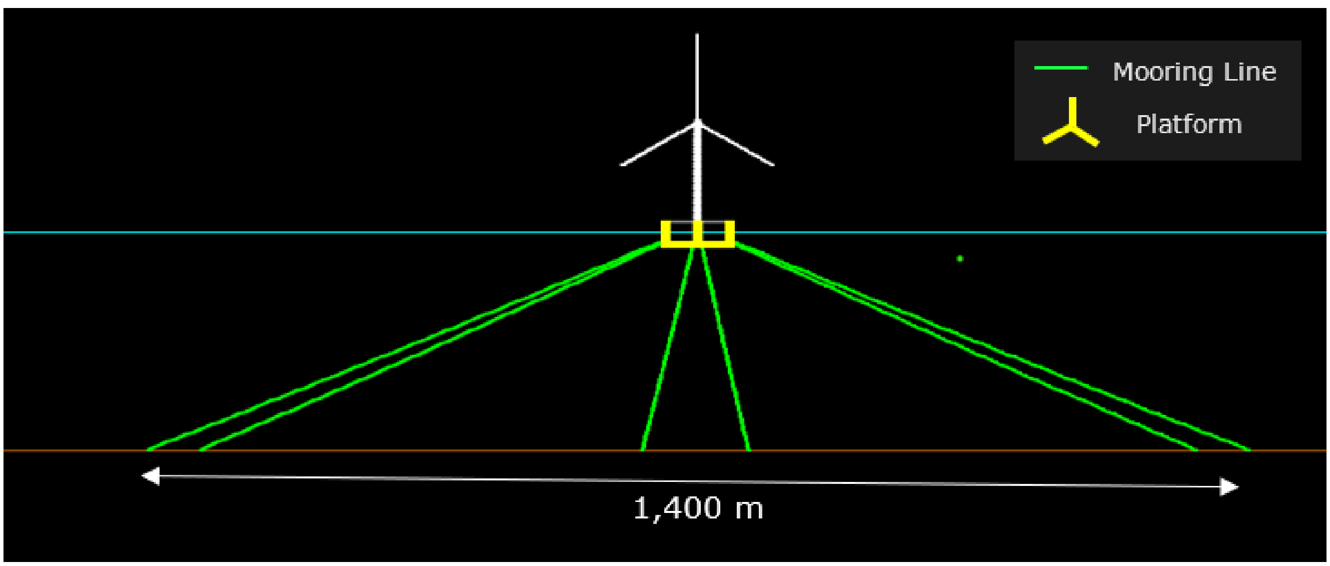


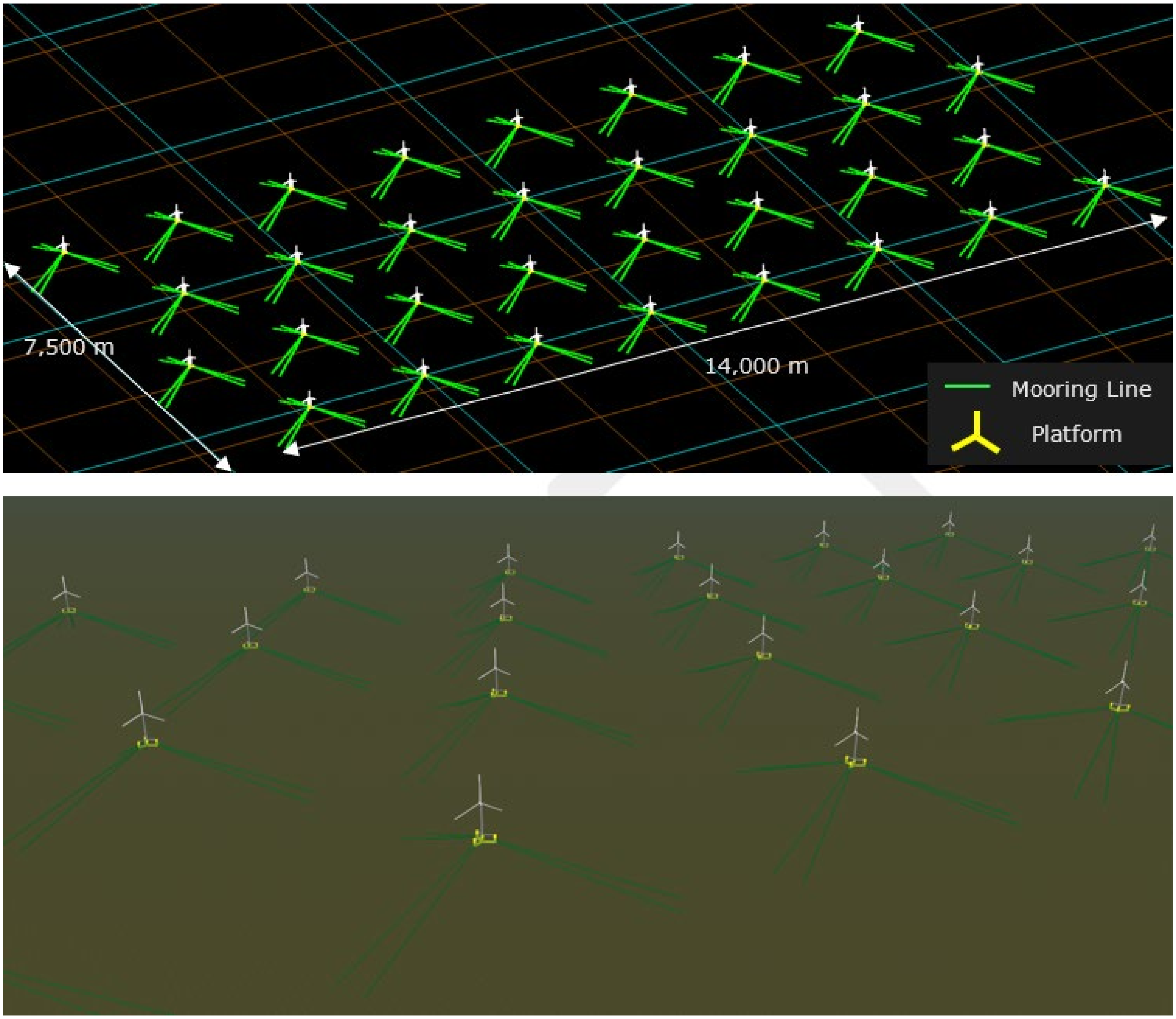
FIGURE 9: PROFILE VIEW OF TAUT MOORING FOR 18 MW PLATFORM (SCENARIO 3)



Note: This is a conceptual, schematic representation that does not reflect site-specific conditions.

An example FOW farm using the 18 MW WTG with the same total capacity of 576 MW is represented in Figure 10. The space claim is the same as the catenary mooring model.

FIGURE 10: THREE-DIMENSIONAL VIEW OF TAUT MOORINGS FOR 576 MW PROJECT (18 MW WTG), AND ZOOM-IN AT THE BOTTOM (SCENARIO 3)



Note: This is a conceptual, schematic representation that does not reflect site-specific conditions.

E4.4 SCENARIO 4

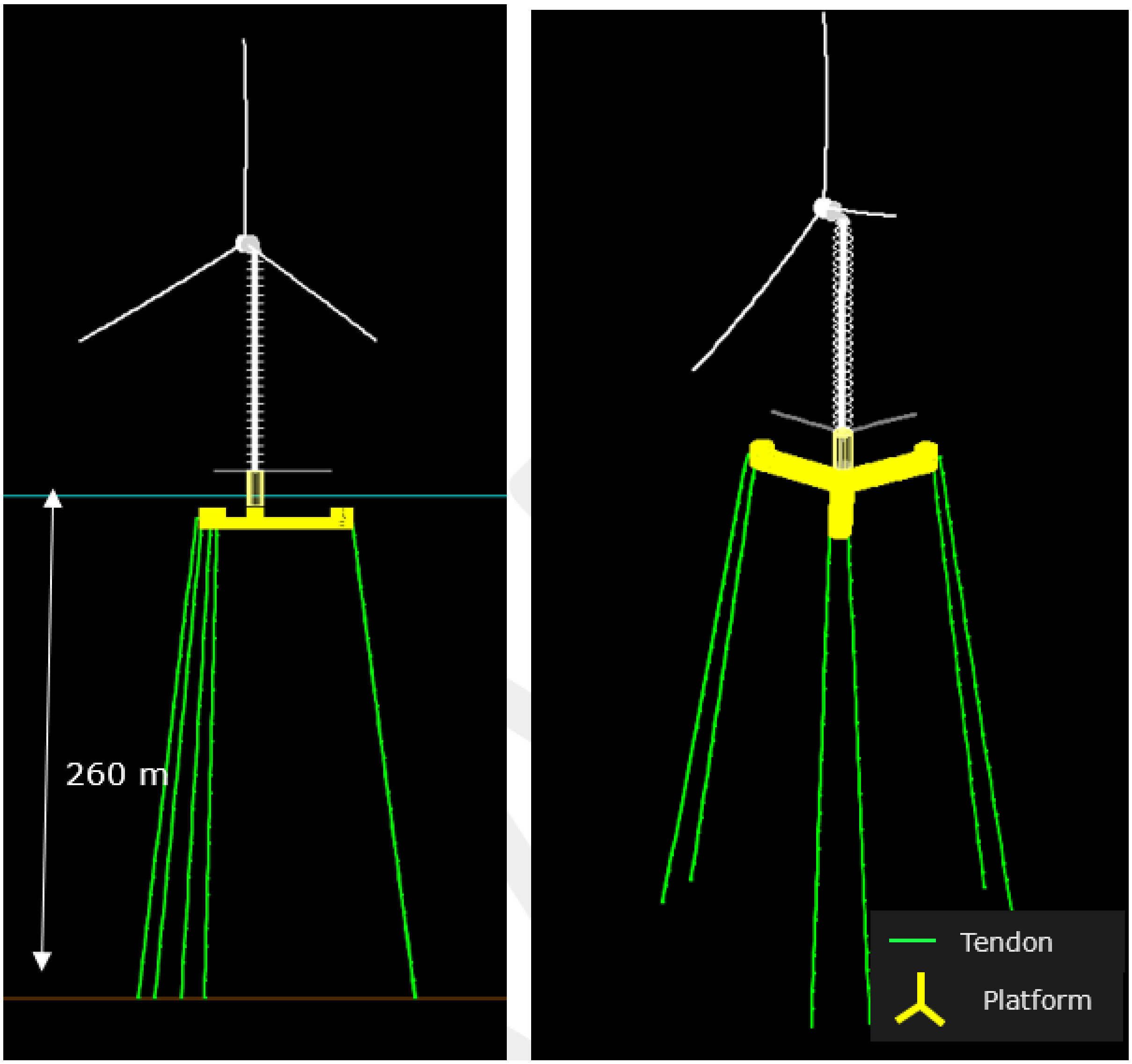
Scenario 4 is an 18 MW TLP with a TLP mooring in 260 m water. A TLP has minimal water plane area, but its buoyancy modules are below the waterline; thus, a TLP looks like a fixed wind monopile from the surface because the platform is submerged.

As shown in Figure 11, the TLP design can be like the semi-sub design, but the buoyancy columns are shorter in the TLP and are below the water surface. In this setup (Figure 11) the TLP is relatively high in the water column[8].

[8] In rough seas, the TLP would need to be deeper in the water column to ensure that in high waves, the columns do not pierce the water surface.

There are different designs of tendons and configurations, some with vertical tendons, however, angled tendons (0 to 10 degrees) are typically used. The overall the space claim of TLPs is lower than the catenary and taut mooring, as shown in Figure 13. The tendons presented are in three

FIGURE 11: PROFILE (LEFT), ISOMETRIC (RIGHT) (SCENARIO 4)



Note: This is a conceptual, schematic representation that does not reflect site-specific conditions.

FIGURE 12: PLAN VIEW OF TLP MOORING 18 MW WTG (SCENARIO 4)

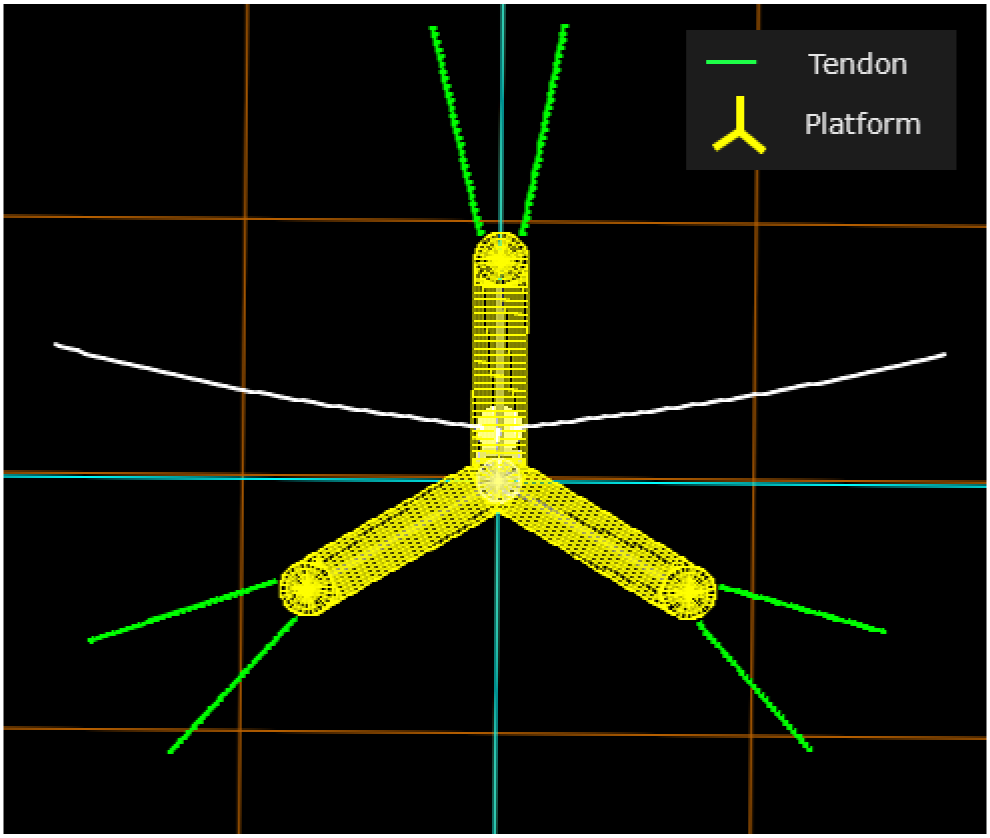
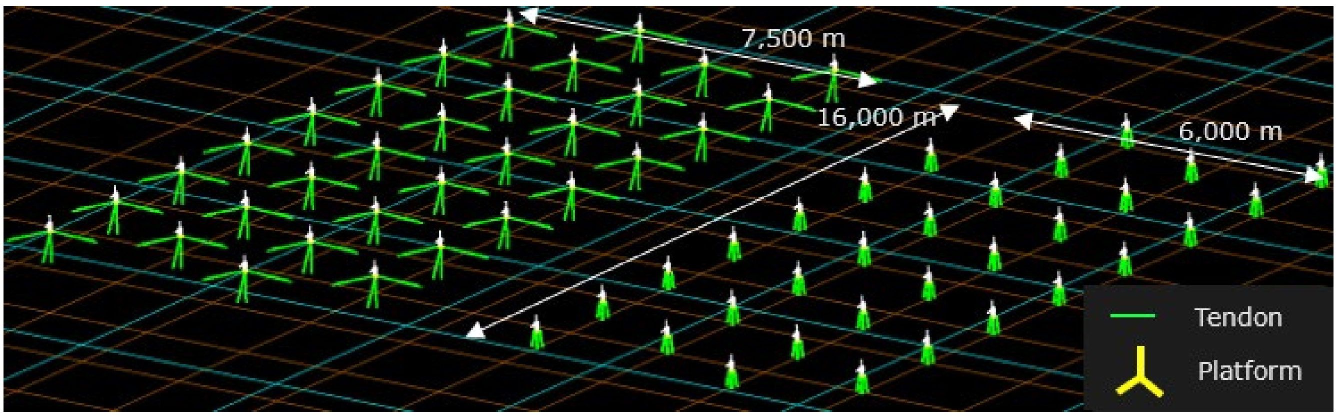


FIGURE 13: TAUT MOORING VS TLP MOORING FOR 576 MW WINDFARM (18 MW WTG, SCENARIO 4))

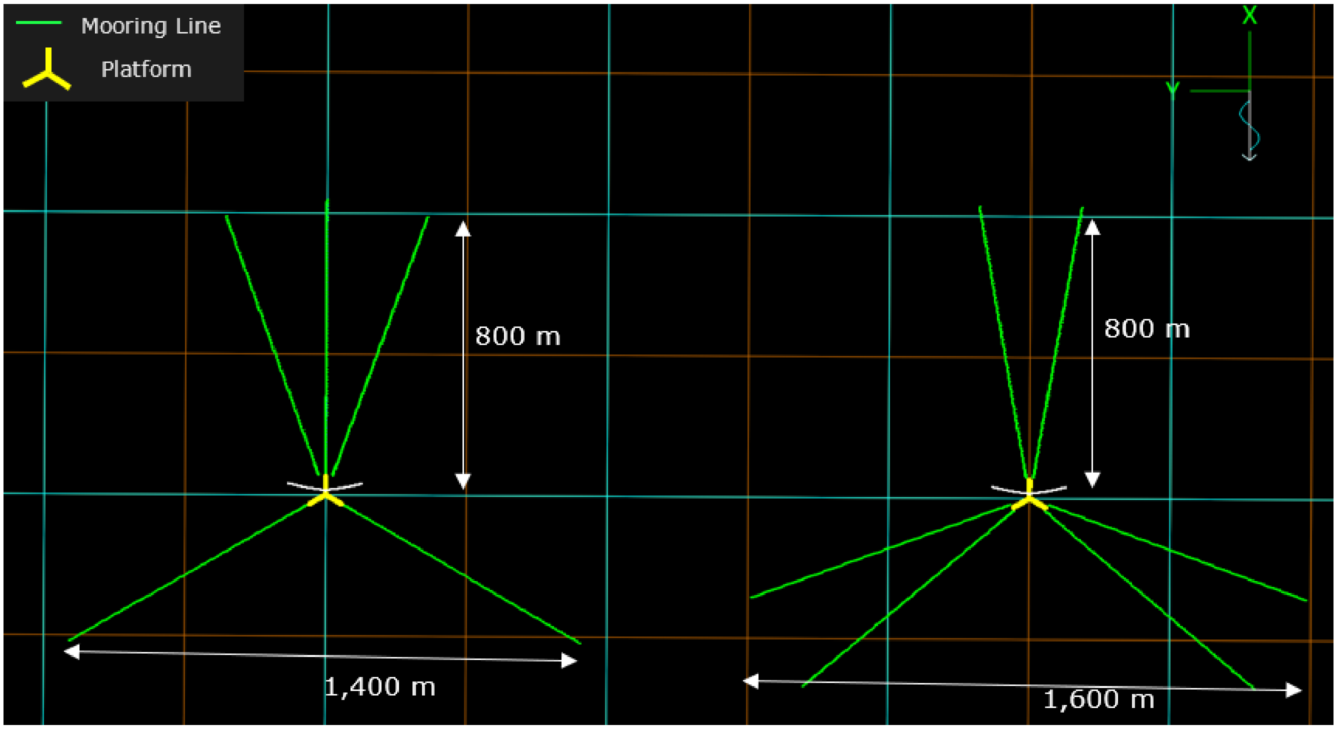


Note: The above figure shows a simplified, static layout based on a uniform water depth of 260 m and does not include geotechnical or seafloor conditions.

E4.5 ASYMMETRIC MOORING

In the sections above, the mooring designs have been symmetrical assuming potential load from any direction. In real world projects there are dominant wave (and wind) directions, so the mooring can be designed to align to the prevailing wind and wave direction for optimal performance. Typically, this means more, longer, or large components in the mooring line in the prevailing wind/wave direction to account for these stronger forces. Figure 14 demonstrates an example of asymmetric mooring design using a catenary mooring and its comparison to Scenario 3 (18 MW taut mooring). In terms of space claim, even though there are more mooring lines on the windward side of the platform, the overall space claim is similar. Therefore, ERM does not consider asymmetric mooring design in the scenarios discussed in the previous sections.

FIGURE 14: AXI-SYMMETRIC MOORING LEFT, AND SYMMETRIC MOORING RIGHT



Note: This is a conceptual, schematic representation that does not reflect site-specific conditions.

ERM HAS OVER 140 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina
Australia
Belgium
Brazil
Canada
China
Colombia
Denmark
France
Germany
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
Netherlands
New Zealand
Panama
Peru
Poland
Portugal
Romania
Singapore
South Africa
South Korea
Spain
Switzerland
Taiwan
Thailand
UAE
UK
US
Vietnam

ERM's Boston Office

One Beacon Street
5th Floor
Boston, MA 02108

T +1 617 646 7800
F +1 617 830 8975

www.erm.com

ERM

APPENDIX F PHASE 3 STAKEHOLDER ENGAGEMENT: PRELIMINARY RECOMMENDATIONS (FISHING INDUSTRY)

Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind

Appendix F: Phase 3 Stakeholder Engagement: Preliminary Recommendations (Fishing Industry)

PREPARED FOR
State of Maine Governor's Energy Office

DATE
14 January 2025

REFERENCE
0724797

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym	Description
AIS	Automatic Identification System
BOEM	Bureau of Ocean Energy Management
ERM	ERM Consulting & Engineering, Inc.
FOW	floating offshore wind
FWG	Maine Offshore Wind Roadmap Fisheries Working Group
GMRI	Gulf of Maine Research Institute
NiD	nature-inclusive design
TLP	tension-leg platform

EXECUTIVE SUMMARY

Over the course of 2023, the Maine Offshore Wind Research Consortium Advisory Board underwent a rigorous prioritization process to identify three research topics to fund in its inaugural round of projects. This project, Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind, was one of the projects included in the competitive Request for Proposals that was issued in November 2023 by the Governor's Energy Office on behalf of the Research Consortium.

ERM Consulting & Engineering, Inc. (ERM) and Gulf of Maine Research Institute (GMRI) were awarded the project to pursue the research and stakeholder engagement to advance understandings of floating offshore wind (FOW) and fishery coexistence. The project kicked off in February 2024.

This report shares the GMRI's findings from Phase 3 of 3 of stakeholder engagement with fishing industry stakeholders exploring the feasibility of fisheries' coexistence with FOW technology, *Preliminary Recommendations (Fishing Industry).* GMRI engaged 18 fishing industry stakeholders, presenting them with a set of preliminary recommendations for fisheries' coexistence with FOW and a preliminary technical compatibility assessment of several fishing gear types with FOW mooring types; GMRI then solicited stakeholder feedback on ERM's preliminary recommendations and assessment. Respondents' feedback on the preliminary recommendations was mixed, providing insights on ways to improve and alter recommendations to ensure they practically align with the perspectives of fisheries stakeholders. Respondents also provided mixed responses on the preliminary technical compatibility assessment and underscored the need for assessments to incorporate more comprehensive factors, including but not limited to, fishermen's perceived risks and environmental considerations.

F1. INTRODUCTION

Because floating offshore wind (FOW) is a nascent industry, little is known about the potential interoperability between commercial-scale FOW projects and fisheries within the Gulf of Maine. FOW in the Gulf of Maine presents a wide range of technical and logistical challenges for offshore wind and fishing industries. Fishermen are concerned about FOW's potential impacts on their operations, including restricted fishing access, risks with navigating, and increased industry competition within limited areas of the ocean. The characteristics of FOW technology, including subsurface mooring lines and inter-array cables, may result in new challenges for fishing activity. It is crucial for proponents of FOW projects to engage constructively with the Gulf of Maine fishing industry around the feasibility of and strategies for potential coexistence between fishing practices and FOW.

As such, ERM Consulting & Engineering, Inc. (ERM) and the Gulf of Maine Research Institute (GMRI) are working with fisheries stakeholders to explore approaches to fisheries' coexistence with FOW (the Project). GMRI is leading the stakeholder engagement for this Project, working with fishermen and fishing organizations to build an understanding of their concerns and anticipated challenges of operating within a FOW array, as well as potential opportunities to promote coexistence between FOW and fishing. Stakeholder engagement includes detailed discussions on gear and fishery-specific coexistence-challenges and feedback on the Project's findings, which informed preliminary recommendations. Ongoing engagement by regulatory agencies, non-governmental organizations, and developers with the fishing industry is key to ensuring the recommendations are relevant to the Gulf of Maine fishing industry.

F2. ENGAGEMENT METHODS

F2.1 OVERVIEW OF METHODS

To engage stakeholders effectively and constructively, GMRI employed a three-phase engagement approach for the Project:

- Phase 1: engagement to test existing understandings and identify further research questions among fisheries' stakeholders;
- Phase 2: engagement to understand interactions between the FOW technology scenarios specific to the various gear types used in the Gulf of Maine; and
- Phase 3: engagement to test preliminary recommendations with fishing stakeholders to consider their feedback, reactions, and opportunities for further research.

A subset of the Maine Offshore Wind Research Consortium Advisory Board approved this engagement approach, and the questions used in Phases 1 and 2. For Phase 3 engagement, GMRI sought feedback on the Project's preliminary technical compatibility assessment and the initial recommendations. The subset of the Maine Offshore Wind Research Consortium Advisory Board also approved and elaborated on an initial set of associations and fishermen to participate in each phase of the Project. To expand the participant base, GMRI employed a 'snowball' sampling method, a common approach in qualitative research where current participants suggest future participants from their networks.[1] This method was chosen due to the highly specialized nature of the fishing community, where relationships and trust play a critical role in participation. Snowball sampling allowed the team to leverage existing connections to ensure broad, yet relevant stakeholder engagement.

F2.2 PHASE 3 ENGAGEMENT DESCRIPTION

Phase 3 engagement (18 November to 12 December 2024) was conducted using a semi-structured format either through phone conversation, an online survey sent via email (see Attachment F-A), in-person conversation (see Attachment F-B), or focus group (see Attachment F-C). Respondents were asked to review the preliminary compatibility assessment and preliminary recommendations for fisheries' coexistence with FOW. Each preliminary recommendation was followed by one to three questions to gauge reactions and feedback.

For engagement via phone conversation, GMRI described the preliminary recommendations and asked stakeholders the questions over the phone or organized a time to meet in person. In some cases, phone engagement required the team to be conscious of stakeholders' time, which limited the amount of detail the team was able to relay and receive in such conversations. As such, input from phone conversations on the preliminary technical compatibility matrix (Figure 1) is limited due to the inability of respondents to see the matrix (six individuals provided feedback over the phone). Respondents who were engaged by phone spent between 30- and 60-minutes providing feedback on the preliminary recommendations.

[1] Lopez, V., & Whitehead, D. (2013). Sampling data and data collection in qualitative research. *Nursing & midwifery research: Methods and appraisal for evidence-based practice*, *123*, 140.

For engagement via email, participants were asked to respond to an online survey in which they viewed the preliminary technical compatibility assessment and gave feedback on preliminary recommendations. Respondents who took the online survey spent approximately 20 to 45 minutes completing it. This same feedback format was used for engagement conducted one-on-one in-person and in the in-person focus group.

The focus group was held with five Maine-based fishermen in Portland, Maine. The session totaled 2.5 hours, during which GMRI provided a presentation of the preliminary technical compatibility matrix (Figure 1) and preliminary recommendations (Attachment F-C). GMRI then asked the same questions listed in the online survey and received feedback from the group. GMRI worked with the focus group to create an amended preliminary compatibility matrix based on suggestions from focus group participants (Figure 2). Using feedback from the focus group, the compatibility results and considerations were altered.

To avoid stakeholder fatigue while ensuring comprehensive input, GMRI limited attempts to contact stakeholders to a maximum of three attempts per stakeholder. Three organizations that participated in Phase 1 and Phase 2 declined to participate in Phase 3, citing other priorities and not having enough time. In total, GMRI contacted 14 fishermen and 12 organizations, of which 12 fishermen and 6 organizations responded, totaling 18 participants (see Table 1).

TABLE 1: SUMMARY OF STAKEHOLDER OUTREACH AND PARTICIPANTS

Stakeholders	Contacted	Engaged
Fishermen	14	12
Organizations[2]	12	6
Totals	26	18

F2.3 STAKEHOLDER DEMOGRAPHICS

Respondents from Phase 3 engagement include organizations and individuals from Midcoast and Southern Maine; coastal New Hampshire; North Shore, South Shore, Greater Boston, and Cape Cod, Massachusetts. For some respondents, these regions represent their homeport and not necessarily where they land their catch. For instance, a fisherman may be based in South Shore, Massachusetts, but land most of their catch in Portland, Maine, or vice-versa. All respondents either fish, represent a fishing industry, or are otherwise directly connected to fishing activity in the Gulf of Maine.

Respondents use diverse gear types or represent a fishing industry that employs multiple gear types. Mobile gear includes both bottom and midwater trawls and targets groundfish, scallops, squid, and herring. Mobile gear fisheries are generally characterized by their ability to cover large areas and capture significant quantities of target species. Fixed gear includes gillnets and lobster

[2] Engagement included reaching out to individual fishermen and leaders of fishing associations/organizations. Organization leaders often represent groups of fishermen by geographic area, fishery, or gear type. Organization leaders were asked the same questions as individuals and were not asked to specify whether their answers were their own perspectives or represented input from their membership/organizational base. Therefore, use caution if interpreting input from organizations as a broader group of fishermen.

pots/traps. Fixed gear is typically more selective as they are set in determined locations. Line gear includes longlines and jigging gear and can be set in place, drift, or move slowly.

F2.4 ANALYSIS METHODS

GMRI employed a thematic analysis approach to process the qualitative data collected during Phase 3. This method involved identifying, analyzing, and reporting patterns within the data, allowing the team to organize and summarize the data sets in detail.[3] The thematic analysis approach is widely used in social science research and was chosen for its effectiveness in accurately interpreting qualitative data in this context and preserving the anonymity of respondents.

[3] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. ; Clarke, V., & Braun, V. (2017). Thematic analysis. *The journal of positive psychology*, *12*(3), 297-298.

F3. STAKEHOLDER FEEDBACK: PRELIMINARY COMPATIBILITY ASSESSMENT

GMRI gathered feedback from respondents on the preliminary technical compatibility assessment, which evaluated four FOW mooring technologies and eight fishing gear types (Figure 1). Technical compatibility between the mooring technologies and fishing gear types is categorized in the following three ways:

- Not expected to be technically compatible (X/red);
- May be technically compatible in certain areas of the array in certain circumstances (~/amber); and
- Expected to be technically compatible throughout most of the array (√/green).

In some cases, technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines; these instances are marked in the preliminary technical compatibility assessment table with an asterisk.

Respondents were informed that the technical compatibility is based solely on the Project's desktop and engineering assessment and does not include levels of perceived risk from fishermen. Respondents were asked to review the preliminary technical compatibility assessment results and offer reactions, feedback, and/or questions. In cases where the team engaged respondents via phone conversation, input on the preliminary technical compatibility assessment is limited because fishermen were not able to see Figure 1. For responses received via online survey or in-person conversation, respondents provided greater detail. This section summarizes feedback from respondents, arranged thematically, on the preliminary technical compatibility assessment.

FIGURE 1: PRELIMINARY TECHNICAL COMPATIBILITY ASSESSMENT

Preliminary technical compatibility assessment based on currently available technology[1]:

Mooring Type	Bottom Trawls	Midwater/ Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Catenary	X	~	~*	~*	X	~	~*	✔
Semi-Taut	X	~	~*	~*	X	~	~*	✔
Taut	X	X	~*	~*	X	~	~*	✔
TLP	~*	~	✔*	✔*	X	~	~	✔

X	Not expected to be technically compatible
~	May be technically compatible in certain areas of the array in certain circumstances[2]
✔	Expected to be technically compatible throughout most of the array

* = Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines

[1] FOW technology and fishing gear are continuing to evolve

[2] For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array

F3.1 SUMMARIZED FEEDBACK ON THE PRELIMINARY TECHNICAL COMPATIBILITY ASSESSMENT

Respondents provided feedback on specific points of the preliminary technical compatibility assessment; these are listed by available technology type below.

Bottom Trawls

Six respondents commented on bottom trawls; they broadly agreed with the preliminary technical compatibility assessment for this gear type with all mooring types. Some respondents noted that the tension-leg platform (TLP) mooring design may be technically compatible with the bottom trawl, but that it depends on spacing between the TLPs and layout considerations. Respondents also acknowledged that different fishermen may have different perceived risks of fishing with bottom trawls in a FOW array.

Midwater/Pelagic Trawls

Four respondents commented on midwater/pelagic trawls. Respondents had differing responses on midwater and pelagic trawls, with some noting strict incompatibility of this gear type with mooring types and others agreeing with the potential for compatibility. Some respondents were confused as to why this gear type is classified as "amber" ("May be technically compatible in certain areas of the array in certain circumstances") for all mooring types except for the taut design as they understand that the mooring radius of a taut design is not tremendously different from those of semi-taut or catenary designs. Respondents asked for more information on the turbine spacing and layout assumptions that were used to develop the preliminary technical compatibility assessment.

Bottom Gillnets

No comments specifically referenced bottom gillnets.

Pots and Traps

Four respondents commented on pots and traps. While most respondents acknowledged that fixed gear types such as pots and traps have greater technical compatibility potential with FOW, two respondents were concerned that fishermen's perceived risk was not considered in the preliminary technical compatibility assessment. For instance, one respondent noted that, "a lobsterman who wants to stay alive would not want to sit anywhere near a turbine."

Dredges

Three respondents commented on dredges. Respondents largely agreed with the preliminary technical compatibility assessment for dredges, but several were confused by dredges being listed as technically incompatible with all gear types, while bottom trawl gear was listed as technically compatible in certain areas with the TLP design, as respondents generally perceive these two gear types as having similar technical compatibility, especially with the same considerations for cable burial.

Pole and Line

Two respondents commented on the pole and line gear type. One respondent shared their perspective that gear types similar to pole and line (e.g., hook and line) are potentially more compatible with mooring types than as classified in the preliminary technical compatibility matrix. Though the study focused on commercial fishermen, one respondent noted that the subsurface FOW platform and mooring infrastructure may attract species of fish that could be desirable for recreational hook and line fishermen, who may be able to operate in more discrete areas; the ability to fish around these mooring types would then depend on the perceived risk of individual fishermen – some of whom may be more comfortable fishing these areas than others.

Purse Seine

One respondent commented on this gear type, noting concern that while purse seines may be technically compatible with certain mooring configurations, to reduce the potential for gear entanglement, fishermen using this gear type may be limited in the size/amount of gear they deploy within a FOW array. Additional considerations from respondents regarding this gear type are shared in Section F3.4.

Harpoon

One respondent commented on this gear type, indicating that the harpoon should be listed as incompatible with all mooring types, as it is used to target tuna or swordfish; when these species are harpooned, they do not die instantaneously, but rather run, so fishermen have to chase their catch until they can retrieve it, which increases the potential risk of gear entanglement with any mooring type or turbine foundation.

F3.2 THE NEED FOR A COMPREHENSIVE COMPATIBILITY ASSESSMENT

Respondents throughout Phase 3 noted the need for a more comprehensive compatibility assessment. Respondents acknowledged that this preliminary technical compatibility assessment offers robust engineering insights on a key aspect of fisheries' coexistence with FOW, but engineering is one of many determinants of successful fisheries' coexistence. According to respondents, several other factors ought to be considered when determining compatibility, including those listed below.

Fishermen's perceived risk: Several respondents noted that the perceived risk of fishing around FOW mooring types and arrays is the most important compatibility factor. As one respondent explained, if a fisherman does not feel comfortable in the presence of a certain mooring type, they will avoid fishing around a FOW turbine, regardless of whether their gear type is technically compatible. Perceived risk guides fishermen's behavior, which dictates their fishing decisions. Respondents also acknowledged that perceived risk may vary from one individual to another, or one industry to another. As such, respondents recognized that incorporating perceived risk into a compatibility assessment is challenging, but that it must be considered when evaluating the prospects of fisheries' coexistence with FOW.

Weather and oceanographic conditions: Three respondents pointed out that wave, wind, tidal, and other oceanographic and atmospheric conditions also influence gear compatibility. These factors can reduce visibility, impact vessel handling, and alter the location of subsurface FOW infrastructure or fishing gear. One respondent asked whether "the engineers [took] into account the weather offshore?" Another noted that the desktop preliminary technical compatibility assessment produces different results than a study conducted on the water; an assessment "on the water is a significantly different scenario," and it's important to incorporate weather and oceanographic factors into compatibility assessments.

Vessel insurance: Numerous respondents throughout all phases of this Project mentioned the importance of accounting for whether vessels would be insured to fish within FOW arrays. This is key to determining compatibility because if vessels are not eligible for insurance to fish or navigate within FOW arrays, fishermen are unlikely to fish in these areas, as they may not be covered for potential issues such as gear entanglement or vessel collisions. Similarly, if they are insured, but premiums increase due to increased risk, fishing within FOW may be economically undesirable or cost prohibitive.

F3.3 THE NEED FOR SITE-SPECIFIC EXPECTATIONS

Respondents emphasized the importance of approaching compatibility assessments from a site-specific lens. With the lease areas and offshore wind developers determined for the Gulf of Maine region, respondents noted that having specific information directly from the developer's engineers on what spacing (i.e., clustered or spread out), layouts (e.g., turbines arranged in parallel lines), exclusion zones (e.g., 1 mile radius from the platforms), and technology types (i.e., platform, mooring, anchoring, and cabling designs) will be used is critical to understand gear compatibility. Several respondents acknowledged that this information is largely unknown at this time and may be determined through developers' site assessment activities and the preparation of construction and operations plans; respondents emphasized that this information, however, is critical to incorporate into compatibility assessments as it becomes available.

Additionally, some respondents noted that the discretion in the preliminary technical compatibility assessment, which notes that for some considerations, "technical compatibility depends on the cable being buried" is an unrealistic expectation. Some feel that developers are unlikely to bury inter-array cables because of cost. Greater clarification on what to expect in a FOW array would be a helpful next step in determining comprehensive compatibility.

F3.4 THE NEED TO CONSIDER ENVIRONMENTAL AND SPECIES FACTORS

Two respondents alluded to the need to incorporate environmental considerations, particularly marine species distributions, into a compatibility assessment. For instance, one respondent discussed how they felt that FOW arrays, which may introduce new sources of noise and light, would prevent certain species of fish (e.g., herring) from concentrating within FOW arrays. This is important for fishermen who use midwater trawls or purse seines, as they rely on these large concentrations of fish (such as herring) to make their fishing operations efficient. Without large concentrations of fish to pursue, fishermen using these gear types may be less inclined to fish within FOW arrays, as it is not economically viable to do so. On the other hand, another respondent pointed out the opposite, describing how FOW arrays may serve as artificial reefs, attracting certain species of fish. Regardless, respondents felt it was generally important to account for environmental considerations when evaluating the broader compatibility of gear types in FOW arrays.

F3.5 FOCUS GROUP INPUT

Recognizing the importance of incorporating fishermen's perceived risk into a compatibility assessment, GMRI worked with the five fishermen in the focus group to solicit feedback on the preliminary technical compatibility matrix and create a new compatibility assessment (Figure 2). Figure 2 was developed from the perspectives of five fishermen representing both mobile and fixed gear types; it is not a comprehensive assessment of compatibility. Perceived risk is variable and any further determinations of compatibility must incorporate extensive stakeholder engagement with fishermen. Figure 2 does, however, offer initial insights into how perceived risk may influence gear compatibility together with engineering insights and other factors.

FIGURE 2: FISHERIES FOCUS GROUP-DEVISED COMPATIBILITY ASSESSMENT

<table>
<tr><th>Mooring Type</th><th>Bottom Trawls</th><th>Midwater/ Pelagic Trawls</th><th>Bottom Gillnets</th><th>Pots & Traps</th><th>Dredges</th><th>Pole & Line (jigging)</th><th>Purse Seine</th><th>Harpoon (tuna)</th></tr>
<tr><td>Catenary</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">1 mile minimum between mooring anchors*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">More than 1 mile between mooring anchors with recognition that species may "run" when harpooned*</td></tr>
<tr><td>Semi-Taut</td></tr>
<tr><td>Taut</td></tr>
<tr><td>TLP</td></tr>
</table>

X	Not expected to be technically compatible
~	May be technically compatible in certain areas of the array in certain circumstances[2]
✔	Expected to be technically compatible throughout most of the array

* = Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines

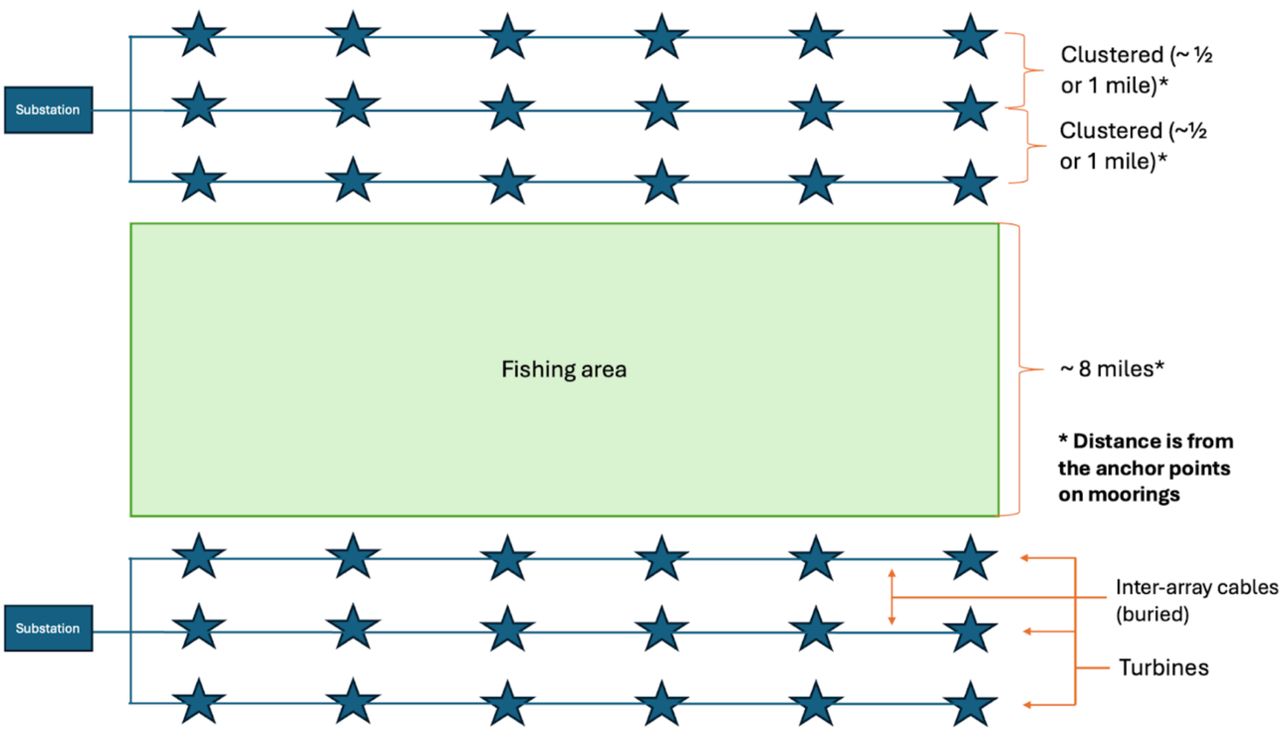
[1] FOW technology and fishing gear are continuing to evolve

[2] For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array

As shown in Figure 2, fishermen in the focus group felt it was paramount to incorporate specific spacing and layout considerations when assessing potential compatibility with gear types. All gear types were broadly noted as potentially compatible in certain areas of an array in certain circumstances. For all gear types, FOW cables (both inter-array and export cables) would need to be buried, and an exclusion zone would need to be determined around the turbines for the gear to be compatible with FOW. An exclusion zone would also need to indicate where mooring lines and cables occupy space in the water column.

For bottom trawls, midwater/pelagic trawls, bottom gillnets, pots and traps, and purse seines, a minimum four-mile separation between the anchor points of the FOW mooring lines would be necessary for potential compatibility. Alternatively, as shown in Figure 3 below, turbines could be clustered as closely as possible in parallel lines and a common fishing area with no turbines or subsurface infrastructure (i.e., mooring, cable, and anchoring lines) could be incorporated into the wind array. This fishing area would need to be a minimum of 8 miles wide to enable multiple fishermen employing different gear types to operate in these areas simultaneously; for instance, fishermen using bottom trawls, which require more space as the trawl is not necessarily following directly behind the vessel (i.e., can be up to 0.25 miles to either side of the vessel) could operate in the designated fishing area, while other gears like pole and line could operate in the clustered areas. However, the compatibility of multiple fishermen operating concurrently within an array depends on site-specific conditions and effort patterns. For the pole and line gear type, the group acknowledged its ability to operate more discreetly. As such, they noted that a minimum one mile spacing between the mooring anchors would be necessary for compatibility. Lastly, the group was concerned with the harpoon gear type compatibility assessment, noting that some species tend to "run" when targeted with this gear type. As such, more than one mile spacing would be necessary for compatibility with this gear type.

FIGURE 3: POTENTIAL LAYOUT SCENARIO DEVISED BY FISHERIES FOCUS GROUP (NOT TO SCALE)



In addition to the compatibility considerations above, fishermen in the focus group stressed that the sample layout (Figure 3) and amended compatibility assessment (Figure 2) depend on which fisheries are active in the lease areas, which ones will want to fish in these areas, and how they might want to fish. Individuals noted that fishing effort patterns are determined by site-specific conditions including seabed bottom type and species distribution. They were concerned that a layout like the one shown in Figure 3 may lead to over-concentrated fishing efforts. Participants described the need to work on layout designs as part of micro-siting within lease areas. For further detail on the focus group's insight on layout patterns, see Section F4.1.

F4. STAKEHOLDER FEEDBACK: INITIAL RECOMMENDATIONS

This section presents the preliminary recommendations for fisheries' coexistence with FOW (Attachment F-A) and summarizes feedback from respondents to these specific recommendations; recommendations are italicized, and respondent reactions are presented below the recommendations. Reactions from respondents are organized thematically and correspond to individual recommendations listed below. The feedback was then integrated into the updated recommendations, presented in Section 4. To underscore the importance of the preliminary recommendations to the fishing industry, notes are also included where recommendations align with the Fisheries Working Group (FWG) recommendations[4] submitted to the Maine Offshore Wind Roadmap Advisory Committee.

F4.1 ENGINEERING RECOMMENDATIONS

F4.1.1 SPACING FOR MOORING AND PLATFORM CONSIDERATIONS

Increasing platform spacing could allow sufficient clearance for trawling around subsea infrastructure (mooring and anchors) and enable individual platforms to be treated as separate obstacles (aligns with FWG Rec. 23). This spacing could allow more fishing activity, but it would reduce array density, requiring the wind array to cover more area to maintain power output.

Preference for greater spacing: Most respondents supported this recommendation, noting that greater spacing between the platforms is generally desirable, as it is more conducive to fishing operations. As one respondent noted, "greater spacing is definitely better […] for avoiding gear conflicts." Several respondents, however, were skeptical of the likelihood of greater spacing happening, noting they felt that developers are likely to pursue tighter spacing, which requires less cabling and is more cost-effective.

Preference for clustered spacing: Some respondents supported an alternative spacing approach in which the turbines are clustered as closely together as possible without losing wind value or creating wind wake issues; this approach would ideally reduce the footprint of FOW arrays and leave more area for fishing without the risk of gear entanglement from subsea FOW infrastructure. One respondent highlighted that in addition to the cost savings from reduced cable length, developers could also explore shared mooring anchors for multiple platforms.

Spacing preferences depend on site-specific conditions: For both approaches to spacing, respondents stressed the importance of recognizing that preference for layout will depend on where the arrays are located and if fishing is allowed in these areas. As one respondent remarked, clustering turbines in multiple locations may result in loss of access to several discrete areas instead of one large block. Choosing which is preferable depends on the location of the most productive fishing areas.

[4] Fisheries Working Group. (2022). Fisheries Working Group Recommendations Submitted to Maine Offshore Wind Roadmap Advisory Committee. https://www.maineoffshorewind.org/wp-content/uploads/2023/02/Fisheries-Working-Group-Final-Recommendations.pdf

Buffer zones: Respondents generally agreed that buffer zones around FOW turbines are helpful safety mechanisms, but their size would depend on the furthest perimeter of the mooring technology.

Focus Group

The focus group described two potential layout designs. The first is a clustered approach that includes a common fishing area 8 miles across with turbines spaced 1 mile apart on the perimeters (Figure 3). The other design had a minimum 4 mile spacing between the anchor points of the mooring lines; with this spacing, it is assumed that fishermen using mobile gear (e.g., a bottom trawl) may be able to navigate and turn their vessels around with gear in the water. Both options were conceived to ensure that fishermen would be safe and able to fish efficiently.

F4.1.2 LAYOUT CONSIDERATIONS

The layout of a wind array could be optimized for greater fishing potential (aligns with FWG Rec. 23). For example, aligning the rows of turbines with the predominant wind, wave and current direction can make trawling and fishing operations easier by allowing vessels to head into the weather.

Support for optimized layouts: Most respondents support layouts that are conducive to existing fishing activities but emphasized that this is tougher to accomplish than it may seem. Several respondents noted that most fishermen prioritize factors such as bottom type rather than weather and oceanographic conditions such as wind, wave, and current direction when analyzing how valuable an area is for fishing. The bottom type determines the species fishermen target and the areas where they feel confident fishing without getting snags. For example, one respondent noted that fishermen targeting groundfish would focus on bathymetry contours. Because fish species behave differently and fishing gear types work differently, a layout that works well for one type of fishing may not work well for another type of fishing. Determining a layout optimized for greater fishing potential requires a comprehensive understanding of active fishermen in each area, an assessment of predominant fishing patterns, consultation with fishermen, and significant work in micro-siting FOW infrastructure; these considerations would require data. According to two respondents, vessel monitoring system tracks and other data from the National Ocean and Atmospheric Administration's National Weather Service may help determine predominant fishing patterns and potential layouts.

Focus Group

Fishermen in the focus group echoed similar concerns and feedback to those listed above. The group emphasized the importance of prioritizing predominant fishing patterns instead of weather and oceanographic conditions when optimizing layouts. The group suggested that a layout aligning turbines from a Northeast to Southwest direction (60 degrees and 240 degrees, clockwise from North) was preferable to the lobster industry. This layout would be parallel to some fishermen's fishing activity and may allow them to set traps parallel and not across cables. Other fisheries would have different needs for layout patterns.

F4.1.3 TECHNOLOGY OPPORTUNITIES

For successful coexistence of fishing and FOW, any improvement in the knowledge, and understanding of the location of underwater equipment, whether fishing equipment (trawler nets, pots) or mooring and anchor lines or cables, can only improve the certainty and help reduce the risk of snagging (aligns with FWG Rec. 18). This could be achieved through transponders and beacons to get accurate real-time location information.

Support for improving an understanding of underwater equipment: All but one respondent supported this recommendation because leveraging technology such as transponders or beacons could help fishermen understand the location of fishing gear and subsea FOW infrastructure. As one respondent said, "knowing what is below the water is crucial for preventing snagging and other conflicts." Another respondent pointed out that research into these improvements is ongoing. They noted that researchers are exploring the potential to mark the location of lobster gear using Bluetooth technology. The one respondent who was concern about this recommendation stated that additional technology equipment would clutter existing radar systems.

Concern with cabling: One respondent who supported the improvements noted above was skeptical about the ability for technology to effectively interact with "the dynamic nature of gear," including cable and mooring systems, largely because gear moves unpredictably within the water column.

Funding: Several individuals noted that technology improvements would be an economic burden for the fishing industry if fishermen were required to upgrade their current systems. They noted that if this recommendation were implemented, it should be funded by the FOW developer.

Additional safety measures: One respondent noted that physical safety features should be incorporated on individual platforms (e.g., ladders, personal flotation devices, Emergency Position Indicating Radio Beacons, etc.); in the event of a person overboard situation, the platforms could serve as a rescue station.

Boulders: One respondent noted that in addition to expanding the knowledge of underwater equipment, boulders that may be relocated for anchoring should be mapped, as boulders are an entanglement concern for fishermen.

Focus Group

The focus group agreed with this recommendation and echoed several of the points above but also alluded to the importance of incorporating other safety measures around FOW arrays. For example, placing mooring balls on the outer perimeter of a FOW platform's watch circle may be helpful for vessels navigating the area, as the mooring balls could set gear directly above the anchor points of the mooring line's anchoring points to help vessels understand the location of underwater equipment.

F4.2 REGULATORY, DEVELOPMENT PROCESS, AND COMPENSATION RECOMMENDATIONS

F4.2.1 APPLY REGULATIONS TO ENSURE COEXISTENCE OPPORTUNITIES AND SOLUTIONS ARE IMPLEMENTED

Regulations may need to evolve to address FOW and coexistence with fisheries. These include:

1. Comprehensive environmental impact assessments, spanning the effects of surveys, construction, operation, and decommissioning activities on wildlife (aligns with FWG Rec. 3).
2. Regulations covering the creation of marine protected areas in surrounding seabed areas to preserve and increase fish populations.
3. Requirement for construction, maintenance, or decommissioning activities to be scheduled around key fishing seasons and fish life cycle stages (e.g., spawning periods) (aligns with FWG 12a).
4. Policies around access to fishing areas surrounding FOW farms, including potential spillover effects to other areas and navigational risks/limitations.

Note, some recommendations have been, may be, or are being implemented through existing laws and regulations. For instance, the terms and conditions of construction and operations plan approval for offshore wind projects can require benthic habitat and fisheries monitoring conditions.[5] Existing environmental impact assessment regulations and permitting have been implemented for existing fixed-bottom projects. Requirements will need adjustment as FOW projects progress through review. Lease stipulations and Bureau of Ocean Energy Management's (BOEM) Fisheries Mitigation Guidance document[6] also offer existing mechanisms to support coexistence.

Mixed responses: Respondents broadly acknowledged that regulations need to evolve to promote coexistence, and individuals shared mixed opinions on the sample regulations, noting that more need to be considered. Specific input from respondents on each sample regulation is summarized below.

1. Three respondents described how environmental assessments need to be more comprehensive by including assessments of all FOW infrastructure (i.e., offshore substations and the effect of dynamic cables and anchors within the water column and what effect those may have on migrating mammals and fish). One respondent noted that these are new areas requiring research as they, "do not exist in current wind developments."
2. While acknowledging that increasing fish populations is important, several individuals were opposed to creating marine protected areas surrounding FOW arrays. One described this recommendation as "incredibly dangerous to fishermen," describing how this would exclude fishermen from areas adjacent to FOW arrays, adding another potential burden of displacement from fishing areas. Another respondent reacted similarly, noting that this policy

[5] BOEM. (2024). Conditions of Construction and Operations Plan Approval Lease Number OCS-A 0534.

[6] BOEM. (2025). Guidelines for Providing Information for Mitigating Impacts to Commercial and For-Hire Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR Part 585 .

would create additional buffers around arrays, taking more fishable bottom away from fishermen. One respondent questioned whether there is evidence that regional protected areas would increase fish populations.

3. Overall, respondents viewed this recommendation positively and offered additional factors to consider. One respondent noted that this regulation should not be limited to routine maintenance and that emergency repairs should also be scheduled around key fishing seasons and fish life cycle stages. Another respondent noted that marine mammal activities should be considered when scheduling FOW activities. Another respondent who supported this recommendation commented that survey activities should be scheduled around fishing seasons and life cycle stages to avoid conflicts with survey vessels and fisheries.
4. Only one respondent commented on this regulation, noting support for it.

Other changes to consider: Several respondents offered other regulatory changes they felt may need to be implemented. Input from respondents is summarized in the bullets below.

- Individuals voiced the need to rethink how fishing is valued from a regulatory lens. The fishing industry contributes to the Gulf of Maine region and beyond, and many respondents feel their importance is undervalued in decision-making. One respondent noted the need to incorporate language into the regulatory scheme that gives the fishing industry greater influence in the decision-making process regarding offshore wind development. Specifically, one respondent mentioned that in Canada, honoring and acknowledging fisheries' ecological knowledge is required by Bill C-49.
- Given that FOW areas in the Gulf of Maine have the potential to be larger than fixed bottom developments (based on spatial footprints) in Southern New England, an accurate and transparent economic exposure analysis should be conducted for FOW in consultation with fishermen.
- An individual noted a need for a regulatory provision to address the possibility that the actual economic impacts on fishermen from FOW development exceed projected impacts. If mitigation levels set before development underestimate impacts, there needs to be a mechanism to ensure that impacts are mitigated fairly and accordingly.
- Incorporating flexibility into the regulatory framework around offshore wind is important. For instance, if one area is closed to fishing because of FOW development, perhaps another area elsewhere could be opened to compensate for that loss of fishing area.
- Regulatory provisions should exist to ensure that fishermen are protected from liability if their gear becomes entangled in FOW arrays.
- Comprehensive monitoring of the array areas before, during, and after construction and for the life of the array should be required.

Focus Group

The group stressed the importance of incorporating fishermen's perspectives into the decision-making- process. Several noted that the "cart has come before the horse" throughout the lease area identification process. They discussed how regulatory schemes must shift to ensure that fishermen have input on the development of the terms and conditions before the approval of a developer's construction and operations plan; this would ensure that fishermen's perspectives are incorporated into the decision-making process.

F4.2.2 ENGAGE FISHERMEN IN SURVEY OPERATIONS

1. Engage local fishing communities before and during survey operations to minimize conflicts during survey activities (aligns with FWG Rec. 1a);
2. Hire credentialed local fishermen to provide real-time guidance and support on survey vessels (aligns with FWG Rec. 1c); and
3. Use fishing vessels to conduct surveys, creating revenue for fishermen while also ensuring survey compatibility with fishing industry operations.

General support for engaging fishermen in survey operations: Respondents support these recommendations, with a few caveats.

- Hiring local fishermen for survey operations should not replace lost fishing opportunities. Instead, these opportunities should be long-term and offered to supplement existing, unaltered fishing operations.
- Compensation for these opportunities should be fair and competitive.
- Fishermen need to be properly credentialed and capable of participating in survey operations.
- Developers and regulators need to align their survey requirements and standards to ensure that fishermen know what is required from their vessels/crew. Different standards would add costs and complexity that would make it more difficult for fishermen to participate in survey activities.

With the above caveats in mind, respondents noted that this recommendation could benefit both the fishing industry and developers. One respondent discussed how survey vessels are often under time-bound contracts and may move from one area to another regardless of whether planned surveys are completed. By incorporating fishermen into survey operations, fishermen can expedite the surveys by lending their knowledge of the area and by leveraging community connections to solve potential problems. Another respondent noted that survey opportunities can benefit fishing industries where fishing can only occur during limited seasons. For example, the scallop industry already benefits from on-demand survey work that supplements their existing fishing operations. Another respondent noted that engaging local fishing communities early and often would help developers to anticipate and address potential survey conflicts.

Focus Group

The focus group supported the recommendations, highlighting how they could be one step closer to fishing industry-based surveys. They, however, cautioned against survey work replacing existing fishing operations; survey work is not a substitute for lost fishing because of FOW development.

F4.2.3 ESTABLISH CLEAR PROTOCOLS FOR COMPENSATION

4. Establish a standard gear loss compensation program before survey activities to mitigate the financial impact on fishermen whose equipment may be damaged during operations (aligns with FWG Rec. 1e).

5. Establish a regional compensation fund, like the Fishermen's Contingency Fund under the Outer Continental Shelf Lands Act, to address losses related to offshore wind development (aligns with FWG Rec. 25).[7]
6. Leverage cooperative developer funding to provide local benefits to fisheries and mitigate impacts on fishing productivity – research funding (e.g., impact monitoring surveys) and damage mitigation for impacted fisheries can apply to the coexistence of all fishing methods operating symbiotically with the wind array.

Recognizing the need for compensation: Most respondents feel that compensation programs are necessary, but only after efforts to minimize impacts to fisheries are fully exhausted. Respondents were aware of a regional third-party fund that has been established for 11 East Coast states. One respondent pointed out that the regional fund will aggregate compensation and mitigation funding from several offshore wind developers, hopefully creating efficiencies and consistency for fishermen seeking claims. Rather than creating new programs, it would make sense to explore how FOW compensation may be incorporated into the same program.

Need for broader compensation for impact: Some respondents noted that compensation programs need to have stipulations to account for broader impacts. One respondent was concerned that compensation may only be provided for the owners of fishing vessels, which could limit the ability of captains and crew to be compensated. Another respondent noted that programs should compensate for shoreside impacts, such as financial losses to industries supporting vessels and processing catch.

Compensation is not a substitute: Several respondents were concerned that compensation may be relied upon too heavily as a substitute for fishing. One respondent noted that they "don't want to be paid not to fish." Compensating fishermen not to fish "should be seen as a major policy failure, not a solution."

Difficult to administer: Two respondents highlighted that compensation programs are complicated to manage and require transparency to ensure the process is fair and efficient. An additional respondent was skeptical about whether there would be enough money in the programs to adequately compensate fishermen.

[7] This recommendation is currently being implemented. The Eleven East Coast states of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina (the States) have been advancing an initiative to establish a regional fund administrator for fisheries compensatory mitigation which would provide financial compensation for economic loss from offshore wind development off the Atlantic Coast. A third-party independent entity to design and develop this regional fund has been selected and the fund is currently under development.

Focus Group

Similar to other respondents, the focus group noted that compensation programs should be a last resort effort after minimizing impacts. Compensation programs should be administered by a third party for transparency.

F4.2.4 ESTABLISH ADAPTIVE MANAGEMENT FRAMEWORKS

Establish adaptive management frameworks that consider new fishing and monitoring data and adjust operations, where needed, to reduce impact (aligns with FWG Rec. 6).

General support: Except for a few survey respondents who were confused about this recommendation, respondents generally supported establishing adaptive management frameworks. Specifically, respondents recognized these frameworks as useful to adjust operations based on new data to reduce negative impacts on the fishing industry and other stakeholders.

Focus Group

The focus group did not share any specific reactions in response to this recommendation.

F4.2.5 MITIGATE IMPACTS ON FISHING

1. Develop clear guidelines and buffer zones to avoid interference.
2. Promote dialogue between developers and fishermen to update best practices and adjust mitigation measures as FOW projects evolve.
3. Establish communication protocols with the fishing industry to inform them about upcoming and ongoing survey activities (e.g., timeline and locations) through apps and text alerts.

Recognition of value in reliable in-person communication: Respondents broadly support these recommendations, emphasizing their previously stated views on preferred layout, spacing considerations, and preferences for developers to engage with the fishing industry early and often. In response to questions about best practices for promoting dialogue and establishing communication between the fishing industry and developers, respondents underscored the importance of sustained, in--person communication. Most respondents noted that in-person engagement is most effective. Many respondents emphasized the importance of engaging with fishermen around their existing schedules to avoid conflicts. One individual noted that the fisheries liaisons employed by offshore wind developers in Southern New England are capable communicators and are resources that should be leveraged to create best communication practices. Beyond in-person engagement, several respondents noted that communication via phone calls, text updates, radio (marine broadcasts), council meetings, and trade association meetings, among others, are also good communication methods.

Focus Group

The focus group also supported this recommendation. They emphasized the need for on-site fisheries liaisons within the major fishing ports in the Gulf of Maine. These liaisons would ideally be accessible in-person when the fishermen are available in port. The group noted that National Ocean and Atmospheric Administration Fisheries has the contact information for permit holders in the Gulf of Maine, which would be a good point of initial contact for communication with fishermen.

The group noted that if FOW were developed, mitigating risks on fishing would require significant input from fishermen with FOW engineers to determine the most appropriate technologies.

F4.3 DATA AND INNOVATION RECOMMENDATIONS

F4.3.1 USE DATA-DRIVEN SITING TO REDUCE OCEAN USER CONFLICTS

Through a data-driven siting process – such as the Bureau of Ocean Energy Management wind energy area siting and deconfliction process in the Gulf of Maine – fisheries-related data and stakeholder feedback is incorporated to avoid specific user conflicts (e.g., specific fishing grounds or navigational routes) (aligns with FWG Rec. 6).

Support for data-driven siting: Respondents generally agreed that data-driven siting is vital for minimizing conflicts between FOW and fisheries. One respondent noted, "any and all data is important," and another echoed that opinion, "data-driven processes are super important." From the perspective of some respondents, siting is a vital step in mitigation and leveraging data to inform that process is just as important.

Incorporate stakeholder feedback: One respondent cautioned that data-driven approaches are important but emphasized that over-reliance on data without input from stakeholders, including fishermen, may be a misstep. Particularly with FOW (a nascent industry relying on new technology), data must be combined with stakeholder insights to make comprehensive siting decisions.

Data selection: Respondents pointed to data that shows fishing footprints, such as vessel trip reports, landings data, and all other data used by BOEM in the wind energy area siting process, among others, as the most important datasets to consider for FOW development. Data should be used in all phases of development.

Focus Group

The focus group noted similar reactions to those listed above.

F4.3.2 INCORPORATE PREVENTATIVE MEASURES CONSIDERING COLLISION AND SNAGGING RISKS

FOW-specific guidance for engaging with fisheries during project design is essential to avoid areas where high snag-risk activities are important to local fisheries (aligns with FWG Rec. 18). Technological innovations, such as alarm or monitoring systems to detect snagging, improved navigational tools, and new gear technologies, should be explored to mitigate these risks.

Support for preventative measures: Many respondents support technological innovations to reduce collision and snagging risks, with some highlighting how technology could potentially improve safety for vessels that may fish or navigate within an array. Respondents highlighted that in addition to the listed technological innovations, decision-makers should explore 1) improvements to radar technology to clearly and accurately detect the location of FOW turbines, 2) providing standardized charts of FOW arrays, 3) marking turbines and subsea infrastructure on Automatic Identification System (AIS), and 4) innovating gear to promote compatibility without losses to catch efficiency.

Need for uniformity with new measures: Two respondents highlighted the need to ensure that any new improvements with technology, navigational charts, alarm systems, mooring markers, etc., should be standardized and consistent across different lease areas. Predictability is key to ensuring that these mechanisms work effectively.

Added costs: Some respondents are concerned that new technologies would be costly and noted that any recommended new technologies be funded by the developer.

Focus Group

The group had similar reactions to those listed above, emphasizing that new technologies to detect subsea FOW infrastructure would be helpful but must come at the cost of the developer. Improvements to vessel radar systems should ensure that systems can accurately function within FOW arrays without potential disruption.

F4.3.3 CONSIDER NATURE-INCLUSIVE DESIGN PRINCIPLES

Nature-inclusive design (NiD)[8] *can positively influence surrounding ecosystems (e.g., FOW platforms can act as artificial reefs), and has been shown to increase species populations in wind arrays and surrounding waters.*

Mixed opinions: Individuals who provided reactions to this recommendation were skeptical and noted the topic was tough to comment on. Other respondents mentioned that though FOW platforms acting as artificial reefs may benefit fish species, they ultimately conflict with fishermen. Two respondents commented that if FOW arrays are treated as areas closed to fishing, and the arrays act as artificial reefs, they may attract species of fish from fishable areas, possibly reducing the ability of fishermen to catch these fish. They were concerned that if fish concentrate around FOW turbines, vessels may not be able to survey these populations due to access concerns, which may ultimately reduce the fishing quotas for these species.

Decommissioning: One respondent discussed how implementing NiD principles may create "difficult conversations" when FOW arrays are ultimately decommissioned. In theory, according to the respondent, an environmental impact assessment of decommissioning activities could discover that it is more harmful to remove an artificial reef than to keep it.

Focus Group

[8] The Ministry of Agriculture, Nature and Food Quality. (2020). *Nature-Inclusive Design: A catalogue for offshore wind infrastructure*.

The focus group was concerned that implementing NiD principles may create artificial reefs that concentrate fish populations in unfishable areas. NiD measures may change the ecosystem by creating predator indexes that may not have existed in these areas previously.

F4.3.4 SHARE DATA

1. Conduct comprehensive baseline biological and oceanographic monitoring in coordination with the fishing industry before, during, and after FOW construction (aligns with FWG Rec. 6).
2. Use an AIS to track location and provide a record of activities for any conflict resolution.
3. Map fishing activities, habitats, and predict future trends through continuous monitoring (aligns with FWG Rec. 3a).
4. Share the raw monitoring data in an open-source format with common standards and metadata; establish clear data access policies (aligns with FWG Rec. 3k).

Sharing data is important: Most respondents agreed with this recommendation, many noting the importance of ensuring that data from any study (e.g., biological, oceanographic, geological, etc.) is publicly available in easily digestible formats. As one respondent said, if developers are gathering data and holding onto it for themselves, then it is of little use to the public. One respondent noted that data collection for biological and oceanographic monitoring around FOW arrays should be conducted by independent researchers to maintain objectivity. One respondent acknowledged that not all fisheries have comprehensive data because AIS is only required for some vessels.

Focus Group

The group similarly emphasized the importance of data transparency and the need for comprehensive baseline biological and oceanographic monitoring with the fishing industry before, during, and after FOW construction.

F5. CONCLUSION

The findings from this Phase 3 engagement highlight the importance of continuous and meaningful collaboration between the FOW industry and Gulf of Maine fishing stakeholders. Through an iterative engagement process, GMRI has gathered critical insights on perceived risks, technical challenges, and opportunities to align FOW development with the needs of the fishing community. Stakeholder feedback highlights the challenges to achieving coexistence, emphasizing the importance of comprehensive compatibility assessments, site-specific considerations, and adaptive management frameworks.

Integrating fishermen's perspectives into micro-siting processes and prioritizing transparent communication will be key to addressing evolving challenges. The preliminary recommendations, feedback on those recommendations, and revised compatibility assessment provide a foundation for enhancing coexistence strategies. Sustained engagement and innovative approaches will be essential to fostering mutual understanding and ensuring that FOW development aligns with the environmental, economic, and social priorities of the Gulf of Maine region.

ERM

ATTACHMENT F-A GOOGLE FORM SURVEY

Seeking Feedback on Recommendations for Best Practices on Fisheries' Coexistence with Floating Offshore Wind

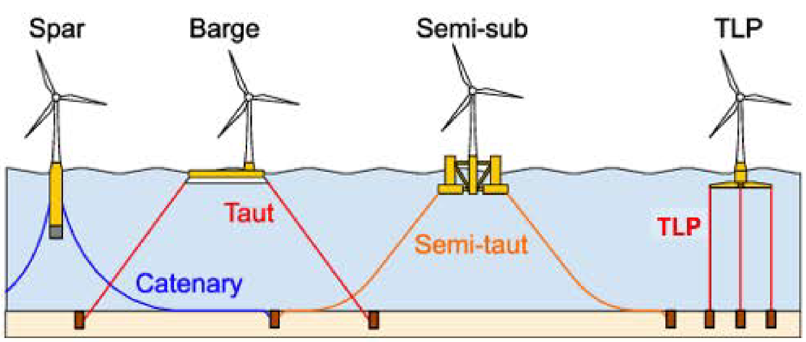
As part of a Maine Governor's Office-funded project exploring fisheries' coexistence with floating offshore wind (FOW), Environmental Resources Management (ERM) analyzed the components and design of FOW systems to assess their compatibility with existing fisheries in the Gulf of Maine, particularly within the Gulf of Maine lease areas. The ERM team then summarized fishing methods that may be suitable for coexistence with FOW and suggested initial solutions and recommendations to support coexistence. **This form intends to gather input and gauge reflections on these initial recommendations for best practices for fisheries' coexistence with floating offshore wind technologies.** Your responses will be kept anonymous and feedback will be incorporated into the project's final report.

We recognize that some questions may not be applicable to all audiences, so please feel free to leave responses blank if you feel they do not apply to you. Thank you so much for your time.

1. Name/Affiliation

____

For context, this simplified figure illustrates the FOW platform and mooring technologies evaluated by ERM.



Compatibility Assessment of Fishing Gear Types with Floating Offshore Wind (FOW) Technologies

The table below is a summary of fishing gear types used in the Gulf of Maine lease areas and the preliminary technical compatibility of using those gear types within different floating offshore wind (FOW) technologies. Note that this technical compatibility is based on a desktop assessment of currently available technology and does not include different levels of perceived risk from fishermen, which must also be considered in an overall assessment of compatibility. Further, all coexistence scenarios assume that inter-array cables are buried and protected.

TABLE 5-1: TECHNICAL COMPATABILITY SUMMARY OF FISHING GEAR TYPES AND FOW TECHNOLOGIES

Mooring Type	Bottom Trawls	Midwater / Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Catenary	X	~	~*	~*	X	~	~*	✓
Semi-Taut	X	~	~*	~*	X	~	~*	✓
Taut	X	X	~*	~*	X	~	~*	✓
TLP	~*	~	~*	~*	X	~	~	✓

Note: Fishing methods have been rated using the following key:

✓ = Expected to be technically compatible throughout the most of the farm	~ = May be technically compatible in certain areas of the farm in certain circumstances[1].	X = Not expected to be technically compatible

*Technical compatibility depends on the cable being buried and an established exclusion zone around the WTGs. Required standards would need to be developed for the site by regulators, in addition to existing standards such as DNV-ST-0119, and approved from an engineering perspective.

[1]For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the FOW array.

2. *What reactions/feedback do you have after reviewing the technical assessment above? If there are areas where you envision conflict between certain fishing gear types and mooring technologies, please note them below.*

Engineering Recommendations

Spacing for Mooring and Platform Considerations:

Increasing spacing between individual turbines could allow sufficient clearance for trawling around subsea infrastructure (mooring and anchors) and enable individual platforms to be treated as separate obstacles. This spacing could allow more fishing activity, but it would reduce array density, requiring the wind array to cover more area to maintain power output.

3. *What is your reaction to this recommendation? Do you have any feedback?*

4. *Are there specific spacing factors to be considered between the platforms (above surface)? What buffer zone would be necessary around the platform structures?*

5. *Are there specific spacing factors to be considered between the mooring types and anchors (below surface)? What buffer zone would be necessary around anchors and mooring lines?*

Layout Considerations:

The layout of the wind array could be optimized for greater fishing potential. For example, aligning the rows of turbines with the predominant wind, wave and current direction can make trawling and fishing operations easier by allowing vessels to head into the weather.

6. *What is your reaction to this recommendation? Do you have any feedback?*

7. *What layout pattern would ease fishing concerns?*

8. *What data exists to support an understanding of fishing activities (i.e. VMS/AIS data, weather patterns, current direction, etc.)? Which data are most important to consider?*

Technology Opportunities:
Invest in and deploy existing or new technology, like transponders and beacons, to get accurate, real time location information of underwater equipment, whether that's fishing gear, mooring and anchor lines, or cables. Greater certainty on the location of underwater gear will reduce the risk of snagging and facilitate greater coexistence between fishing and FOW.

9. *What is your reaction to this recommendation? Do you have any feedback?*

10. *What other engineering recommendations do you feel would be helpful to enable fishing operations within floating offshore wind arrays?*

Regulatory, Development Process, and Compensation Recommendations

Apply regulations to ensure coexistence opportunities and solutions are implemented, where feasible:
Regulations may need to evolve to address FOW and coexistence with fisheries. These include:

1. Comprehensive environmental impact assessments (EIA) regulations, spanning the effects of surveys, construction, operation, and decommissioning activities on wildlife.
2. Regulations covering the creation of marine protected areas (MPA) in surrounding seabed areas, to preserve and increase fish populations.
3. Requirement for construction, maintenance, or decommissioning activities to be scheduled around key fishing seasons and fish life cycle stages (e.g., spawning periods).
4. Policies around access to fishing areas surrounding FOW farms, including potential spillover effects to other areas and navigational risks/limitations.

11. *What is your reaction to these recommendations? If you have specific feedback regarding one or several recommendations, please indicate the corresponding number in your response.*

12. *What other regulatory changes need to be in effect for coexistence?*

Engage Fishermen in Survey Operations:

- Engage local fishing communities before and during survey operations to minimize conflicts during survey activities.
- Hire local fishermen to provide real-time guidance and support on survey vessels.
- Use fishing vessels to conduct surveys, creating revenue for fishermen while also ensuring survey compatibility with fishing industry operations.

13. *What is your reaction to this recommendation? Do you have any feedback?*

Establish Clear Protocols for Compensation:

- Establish a standard gear loss compensation program prior to survey activities to mitigate the financial impact on fishermen whose equipment may be damaged during operations.
- Establish a regional compensation fund, like the Fishermen's Contingency Fund under the Outer Continental Shelf Lands Act (OCSLA) to address losses related to offshore wind development.
- Leverage cooperative developer funding to provide local benefits to fisheries and mitigate impacts on fishing productivity – research funding (e.g., impact monitoring surveys) and damage-mitigation for impacted fisheries can apply to the coexistence of all fishing methods operating symbiotically with the wind array.

14. *What is your reaction to this recommendation? Do you have any feedback?*

Establish Adaptive Management Frameworks:
Establish adaptive management frameworks that consider new fishing and monitoring data and adjust operations, where needed, to reduce impact.

15. *What is your reaction to this recommendation? Do you have any feedback?*

Mitigate Impacts on Fishing:

- Develop clear guidelines and buffer zones to avoid interference.
- Promote dialogue between developers and fishermen to update best practices and adjust mitigation measures as FOW projects evolve.
- Establish communication protocols with the fishing industry to inform them about upcoming and ongoing survey activities (e.g., timeline and locations) through apps and text alerts.

16. *What is your reaction to this recommendation? Do you have any feedback?*

17. *Have you seen or experienced constructive communication practices with the fishing industry in OSW or another offshore industry?*

18. *What should be considered when developing communication protocols? How should fishermen be engaged to have transparent dialogue? What mechanisms do you suggest work best for communicating with fisheries? (i.e. port visits, email, text, phone calls, etc.)*

Data and Innovation Recommendations

Use data-driven siting to reduce ocean user conflicts:

Through a data-driven siting process – such as the BOEM wind energy area siting and deconfliction process in the Gulf of Maine – fisheries related data and stakeholder feedback is incorporated to avoid specific user conflicts (e.g., specific fishing grounds or navigational routes).

19. *What is your reaction to this recommendation? Do you have any feedback?*

20. *During what phases of planning, leasing, construction and operation do you see fisheries data being most important? What datasets should be considered?*

Incorporate preventative measures considering collision and snagging risks, where feasible:

FOW-specific guidance for engaging with fisheries during project design is essential to avoid areas where high snag-risk activities are important to local fisheries. Technological innovations, such as alarm or monitoring systems to detect snagging, improved navigational tools, and new gear technologies should be explored to mitigate these risks.

21. *What is your reaction to this recommendation? Do you have any feedback?*

22. *What improvements to fishing gear are needed to implement this recommendation?*

23. *What improvements to navigation tools are needed to implement this recommendation?*

Consider implementing nature-inclusive design (NiD) principles in offshore wind arrays:

Nature-inclusive design principles (e.g. incorporating hard substrates for reef restoration) can positively influence surrounding ecosystems (e.g. FOW platforms can act as artificial reefs) which has been shown to increase the species' populations in wind arrays and surrounding waters.

24. *What is your reaction to this recommendation? Do you have any feedback?*

Share Data:

- Conduct comprehensive baseline biological and oceanographic monitoring in coordination with the fishing industry before, during, and after FOW construction.
- Use an Automatic Identification System (AIS) to track location and provide a record of activities for any conflict resolution.
- Map fishing activities, habitats, and predict future trends through continuous monitoring.
- Share the raw monitoring data in an open-source format with common standards and metadata; establish clear data access policies.

25. *What is your reaction to this recommendation? Do you have any feedback?*

26. If you have suggestions for other recommendations for best practices on fisheries' coexistence with FOW, please feel free to share them below.

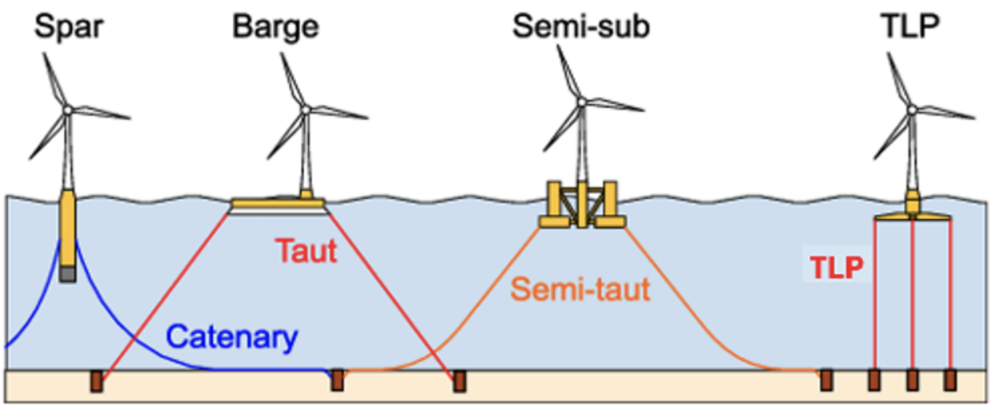
ERM

ATTACHMENT F-B ENGAGEMENT QUESTIONS

As part of a Maine Governor's Office-funded project exploring fisheries' coexistence with floating offshore wind (FOW), ERM analyzed the components and design of FOW systems to assess their compatibility with existing fisheries in the Gulf of Maine, particularly within the Gulf of Maine lease areas. The ERM team then summarized fishing methods that may be suitable for coexistence with FOW and suggested solutions and recommendations to support coexistence. **This engagement intends to gather input and gauge reflections on ERM's initial recommendations for best practices for fisheries' coexistence with floating offshore wind technologies.** Your feedback will remain anonymous and be incorporated into this project's final report.

We understand that not every question may be applicable to all audiences, so please feel free to leave questions unanswered if they do not apply to you. Thank you for your time.

Simplified figure of mooring types evaluated by ERM:



Preliminary technical compatibility assessment based on currently available technology[1]:

Mooring Type	Bottom Trawls	Midwater/ Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Catenary	X	~	~*	~*	X	~	~*	✔
Semi-Tau t	X	~	~*	~*	X	~	~*	✔
Taut	X	X	~*	~*	X	~	~*	✔
TLP	~*	~	✔*	✔*	X	~	~	✔

X	Not expected to be technically compatible
~	May be technically compatible in certain areas of the array in certain circumstances[2]
✔	Expected to be technically compatible throughout most of the array

* = Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines

[1] FOW technology and fishing gear are continuing to evolve

[2] For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array

The table above is a summary of fishing gear types used in the Gulf of Maine lease areas and the technical compatibility of using those gear types within different floating offshore wind (FOW) technologies. Note that this technical compatibility is based on a desktop assessment and does not include different levels of perceived risk from fishermen, which must also be considered in an overall assessment of compatibility. All coexistence scenarios assume that cables are buried and protected.

- What reactions/feedback do you have after reviewing the technical assessment above?
- If there are areas where you envision conflict between certain fishing gear types and mooring types, please note them below.
- The table notes that an "established exclusion zone" around the platforms would be necessary for some gear types to operate around floating turbines. Is there a set-back you feel would be necessary to safely operate around these types of platforms?

Recommendations For Best Practices to Enable Fisheries' Coexistence with Floating Offshore Wind (FOW)

Engineering Recommendations

Spacing for Mooring and Platform Considerations: Increasing platform spacing could allow sufficient clearance for trawling around subsea infrastructure (mooring and anchors) and enable individual platforms to be treated as separate obstacles. This spacing could allow more fishing activity, but it would reduce array density, requiring the wind array to cover more area to maintain power output.

- What is your reaction/feedback to these recommendations?
- Are there specific spacing factors to be considered between the platforms (above surface)? What buffer zone would be necessary around the platform structures?
- Are there specific spacing factors to be considered between the mooring types and anchors (below surface)? What buffer zone would be necessary around anchors and mooring lines?

Layout Considerations: The layout of the wind farm could be optimized for greater fishing potential. For example, aligning the rows of turbines with the predominant wind, wave and current direction can make trawling and fishing operations easier by allowing vessels to head into the weather.

- What is your reaction/feedback to these recommendations?
- What layout pattern would ease fishing concerns?
- What data exists to support an understanding of fishing activities (i.e. VMS/AIS data, weather patterns, current direction, etc)?

Technology Opportunities: For successful coexistence of fishing and FOW, any improvement in the knowledge, and understanding of the location of underwater equipment, whether fishing equipment (trawler nets, pots) or mooring and anchor lines or cables, can only improve the certainty and help reduce the risk of snagging. This could be achieved through transponders and beacons to get accurate real time location information.

- What is your reaction/feedback to these recommendations?
- What other engineering recommendations do you feel would be helpful to enable fishing operations within floating offshore wind farms?

Regulatory, Development Process, and Compensation Recommendations

Apply regulations to ensure coexistence opportunities and solutions are implemented, where feasible: Regulations may need to evolve to address FOW and coexistence with fisheries. These include:

- Comprehensive environmental impact assessments (EIA) regulations, spanning the effects of surveys, construction, operation, and decommissioning activities on wildlife.
- Regulations covering the creation of marine protected areas (MPA) in surrounding seabed areas, to preserve and increase fish populations.
- Requirement for construction, maintenance, or decommissioning activities to be scheduled around key fishing seasons and fish life cycle stages (e.g., spawning periods).
- Policies around access to fishing areas surrounding FOW farms, including potential spillover effects to other areas and navigational risks/limitations.

- What is your reaction/feedback to these recommendations?
- What other regulatory changes need to be in effect for coexistence?

Engage Fishermen in Survey Operations:

- Engage local fishing communities before and during survey operations to minimize conflicts during survey activities.
- Hire credentialed local fishermen to provide real-time guidance and support on survey vessels.
- Use fishing vessels to conduct surveys, creating revenue for fishermen while also ensuring survey compatibility with fishing industry operations.

- What is your reaction/feedback to these recommendations?

Establish Clear Protocols for Compensation:

- Establish a standard gear loss compensation program prior to survey activities to mitigate the financial impact on fishermen whose equipment may be damaged during operations.

- Establish a regional compensation fund, like the Fishermen's Contingency Fund under the Outer Continental Shelf Lands Act (OCSLA) to address losses related to offshore wind development.
- Leverage cooperative developer funding to provide local benefits to fisheries and mitigate impacts on fishing productivity – research funding (e.g., impact monitoring surveys) and damage-mitigation for impacted fisheries can apply to the coexistence of all fishing methods operating symbiotically with the wind array.

- What is your reaction/feedback to these recommendations?

Establish Adaptive Management Frameworks:

- Establish adaptive management frameworks that consider new fishing and monitoring data and adjust operations, where needed, to reduce impact.

- What is your reaction/feedback to these recommendations?

Mitigate Impacts on Fishing:

- Develop clear guidelines and buffer zones to avoid interference.
- Promote dialogue between developers and fishermen to update best practices and adjust mitigation measures as FOW projects evolve.
- Establish communication protocols with the fishing industry to inform them about upcoming and ongoing survey activities (e.g., timeline and locations) through apps and text alerts.

- What is your reaction/feedback to these recommendations?
- What should be considered when developing communication protocols? How should fishermen be engaged to have transparent dialogue? What mechanisms do you suggest work best for communicating with fisheries?

Data and Innovation Recommendations

Use data-driven siting to reduce ocean user conflicts: Through a data-driven siting process – such as the BOEM wind energy area siting and deconfliction process in the Gulf of Maine – fisheries related data and stakeholder feedback is incorporated to avoid specific user conflicts (e.g., specific fishing grounds or navigational routes).

- What is your reaction/feedback to these recommendations?
- During what phases of planning, leasing, construction and operation do you see fisheries data being most important?
- What datasets should be considered?

Incorporate preventative measures considering collision and snagging risks, where feasible: FOW-specific guidance for engaging with fisheries during project design is essential to avoid areas where high snag-risk activities are important to local fisheries. Technological innovations, such as alarm or monitoring systems to detect snagging, improved navigational tools, and new gear technologies should be explored to mitigate these risks.

- What is your reaction/feedback to these recommendations?
- What improvements to your fishing gear would need to be made to make this recommendation true?
- What improvements to your navigation tools would need to be made to make this recommendation true?

Consider implementing nature-inclusive design (NiD) principles in offshore wind farms: NiD can positively influence surrounding ecosystems (e.g., FOW platforms can act as artificial reefs) which has been shown to increase the species' populations in wind arrays and surrounding waters.

- What is your reaction/feedback to these recommendations?

Share Data:
- Conduct comprehensive baseline biological and oceanographic monitoring in coordination with the fishing industry before, during, and after FOW construction.
- Use an Automatic Identification System (AIS) to track location and provide a record of activities for any conflict resolution.
- Map fishing activities, habitats, and predict future trends through continuous monitoring.
- Share the raw monitoring data in an open-source format with common standards and metadata; establish clear data access policies.

- What is your reaction/feedback to these recommendations?

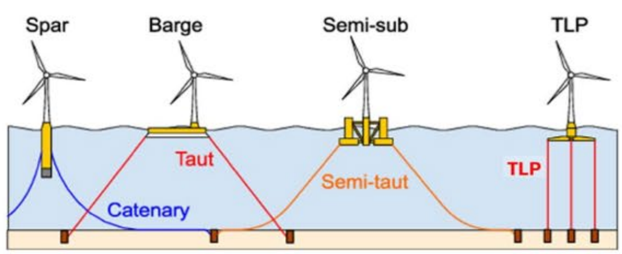
If you have suggestions for other recommendations for best practices on fisheries' coexistence with FOW, please feel free to share them.

ATTACHMENT F-C FOCUS GROUP PRESENTATION

Phase 3: Evaluating ERM's Initial Recommendations & Compatibility Matrix

FOW Technology Evaluated

The **mooring system** influences the **cabling** and **takes up the most space** ▯ assessing compatibility of fishing activities and the mooring system is critical.



ERM's Technical Compatibility Assessment

Preliminary technical compatibility assessment based on currently available technology[1]:

Mooring Type	Bottom Trawls	Midwater/ Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Catenary	X	~	~*	~*	X	~	~*	✓
Semi-Taut	X	~	~*	~*	X	~	~*	✓
Taut	X	X	~*	~*	X	~	~*	✓
TLP	~*	~	✓*	✓*	X	~	~	✓

X	Not expected to be technically compatible
~	May be technically compatible in certain areas of the array in certain circumstances[2]
✓	Expected to be technically compatible throughout most of the array

* = Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines

[1] FOW technology and fishing gear are continuing to evolve

[2] For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array

Fishermen's Perspectives on Compatibility

Preliminary technical compatibility assessment based on currently available technology[1]:

Mooring Type	Bottom Trawls	Midwater/ Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Catenary								
Semi-Taut								
Taut								
TLP								

X	Not expected to be technically compatible
~	May be technically compatible in certain areas of the array in certain circumstances[2]
✓	Expected to be technically compatible throughout most of the array

* = Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines

[1] FOW technology and fishing gear are continuing to evolve

[2] For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array

Fishermen's Perspectives on Compatibility

Preliminary technical compatibility assessment based on currently available technology[1]:

<table>
<tr><th>Mooring Type</th><th>Bottom Trawls</th><th>Midwater/ Pelagic Trawls</th><th>Bottom Gillnets</th><th>Pots & Traps</th><th>Dredges</th><th>Pole & Line (jigging)</th><th>Purse Seine</th><th>Harpoon (tuna)</th></tr>
<tr><td>Catenary</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">1 mile minimum between mooring anchors*</td><td rowspan="4">4 miles minimum between mooring anchors OR cluster turbines as closely as possible and include a common fishing area ~8 miles wide*</td><td rowspan="4">More than 1 mile between mooring anchors with recognition that species may "run" when harpooned*</td></tr>
<tr><td>Semi-Taut</td></tr>
<tr><td>Taut</td></tr>
<tr><td>TLP</td></tr>
</table>

X	Not expected to be technically compatible
~	May be technically compatible in certain areas of the array in certain circumstances[2]
✓	Expected to be technically compatible throughout most of the array

* = Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines

[1] FOW technology and fishing gear are continuing to evolve

[2] For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array

Engineering Recommendations

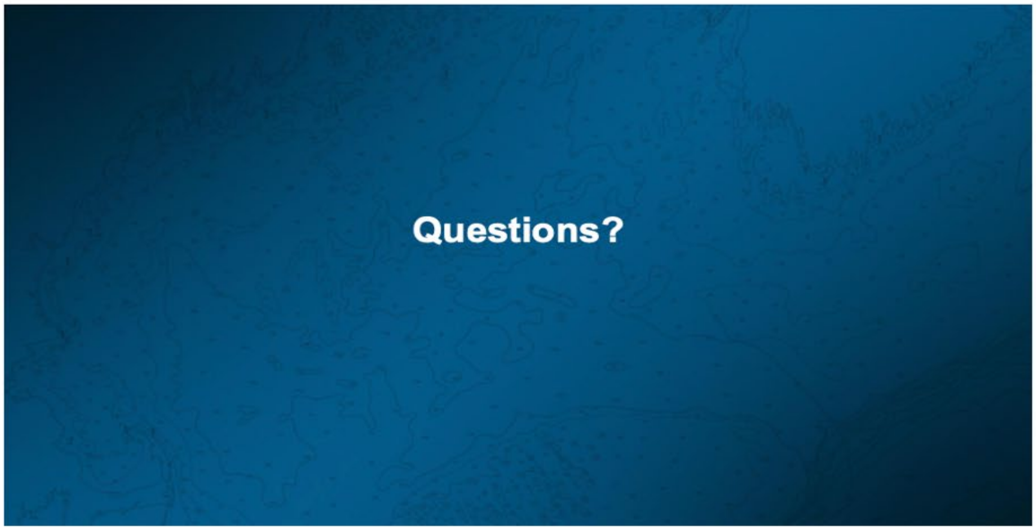
- Spacing for Mooring and Platform Considerations
  - Increasing platform spacing = more clearance for trawling around moorings and anchors
  - More spacing could allow more fishing activity, but the wind array then covers more area to maintain power output
- Layout Considerations
  - Aligning the rows of turbines with the predominant wind, wave and current direction can make trawling and fishing operations easier by allowing vessels to head into the weather.
- Technology Opportunities
  - Improvement in the knowledge, and understanding of the location of underwater equipment, whether fishing equipment (trawler nets, pots) or mooring and anchor lines or cables, can help reduce the risk of snagging.
  - This could be achieved through transponders and beacons to get accurate real time location information.

Regulatory, Development Process, and Compensation Recommendations

- Pass regulations to promote shared use opportunities; Regulations may need to evolve, including:
  - Comprehensive environmental impact assessments (EIA) & marine protected areas regulations
- Engage fishermen in survey operations
  - Hire credentialed local fishermen to provide real-time guidance and support on survey vessels.
  - Use fishing vessels to conduct surveys
- Establish clear protocols for compensation
  - Establish a standard gear loss compensation program prior to survey activities
  - Establish a regional compensation fund to address losses related to offshore wind development.
  - Leverage cooperative developer funding to provide local benefits to fisheries
- Mitigate impacts on fishing
  - Develop clear guidelines and buffer zones to avoid interference.
  - Promote dialogue between developers and fishermen to update best practices and adjust mitigation measures projects evolve.

Data and Innovation Recommendations

- Use data-driven siting to reduce ocean user conflicts
  - Through a data-driven siting process (i.e. BOEM WEA siting process) fisheries related data and stakeholder feedback is incorporated to avoid specific user conflicts (e.g., specific fishing grounds or navigational routes).
- Incorporate preventative measures considering collision and snagging risks
  - Technological innovations, such as alarm or monitoring systems to detect snagging, improved navigational tools, and new gear technologies should be explored to mitigate these risks.
- Consider implementing nature-inclusive design principles in wind arrays
  - (e.g., FOW platforms can act as artificial reefs) which has been shown to increase the species' populations in wind arrays and surrounding waters.
- Share data
  - Use AIS to track location and provide a record of activities for any conflict resolution.
  - Map fishing activities, habitats, and predict future trends through continuous monitoring.
  - Share the raw monitoring data in an open-source format with common standards and metadata; establish clear data access policies.


Questions?

ERM HAS OVER 140 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina
Australia
Belgium
Brazil
Canada
China
Colombia
Denmark
France
Germany
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
Netherlands
New Zealand
Panama
Peru
Poland
Portugal
Romania
Singapore
South Africa
South Korea
Spain
Switzerland
Taiwan
Thailand
UAE
UK
US
Vietnam

ERM's Boston Office

One Beacon Street
5th Floor
Boston, MA 02108

T +1 617 646 7800
F +1 617 830 8975

www.erm.com

ERM

APPENDIX G PHASE 3 STAKEHOLDER ENGAGEMENT: PRELIMINARY RECOMMENDATIONS (ADVISORY BOARD)

ERM

Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind

Appendix G: Phase 3 Stakeholder Engagement (Advisory Board)

PREPARED FOR
State of Maine's Governor's Energy Office

DATE
16 January 2025

REFERENCE
0724797

CONTENTS

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym	Description
Advisory Board	Maine Offshore Wind Research Consortium Advisory Board
BOEM	Bureau of Ocean Energy Management
ERM	ERM Consulting & Engineering, Inc.
FOW	floating offshore wind
FWG	Maine Offshore Wind Roadmap Fisheries Working Group
GMRI	Gulf of Maine Research Institute
MPA	marine protected areas
NiD	nature-inclusive design

EXECUTIVE SUMMARY

Over the course of 2023, the Maine Offshore Wind Research Consortium Advisory Board (Advisory Board) underwent a rigorous prioritization process to identify three research topics to fund in its inaugural round of projects. This project, Exploring Approaches to Fisheries' Coexistence with Floating Offshore Wind, was one of the projects included in the competitive Request for Proposals that was issued in November 2023 by the Governor's Energy Office on behalf of the Research Consortium.

ERM Consulting & Engineering, Inc. (ERM) and Gulf of Maine Research Institute (GMRI) were awarded the project to pursue the research and stakeholder engagement to advance understanding of floating offshore wind and fishery coexistence. The project kicked off in February 2024.

This report shares findings from Phase 3 of 3 of the GMRI stakeholder engagement exploring the feasibility of fisheries' coexistence with floating offshore wind (FOW) technology. During Phase 3, GMRI engaged both fishing stakeholders (Appendix F) and members of the Advisory Board. This report presents the approach and findings of GMRI's engagement with nine Advisory Board members, gathering input on questions relating to the preliminary recommendations for fisheries' coexistence with FOW. GMRI presented Advisory Board members with a set of preliminary recommendations for fisheries' coexistence with FOW and the preliminary technical compatibility assessment of several fishing gear types with FOW mooring types. GMRI then asked questions to elicit feedback on ERM's preliminary recommendations and assessment. Respondents provided mixed feedback on the preliminary technical compatibility assessment and underscored the need for assessments to incorporate more comprehensive factors including, but not limited to, fishermen's perceived risks and environmental considerations. Respondents also provided mixed responses to the preliminary recommendations, providing insights on ways to improve and alter recommendations to ensure they practically align with the perspectives of fishing stakeholders.

G1. INTRODUCTION

Because floating offshore wind (FOW) is a nascent industry, little is known about the potential interoperability between commercial-scale FOW projects and fisheries within the Gulf of Maine. FOW in the Gulf of Maine presents a wide range of technical and logistical challenges for offshore wind and fishing industries. Fishermen are concerned about FOW's potential impacts on their operations, including restricted fishing access, risks with navigating, and increased industry competition within limited areas of the ocean. The characteristics of FOW technology, including subsurface mooring lines and inter-array cables, may result in new challenges for fishing activity. It is crucial for proponents of FOW projects to engage constructively with the Gulf of Maine fishing industry around the feasibility of and strategies for potential coexistence between traditional fishing practices and FOW.

As such, ERM Consulting & Engineering, Inc. (ERM) and the Gulf of Maine Research Institute (GMRI; collectively the Project team) are working with fishing industry stakeholders to explore approaches to fisheries' coexistence with FOW. GMRI is leading the stakeholder engagement for this Project, working with fishermen and fishing organizations to build an understanding of their concerns, opportunities, and anticipated challenges of operating within a FOW array. Stakeholder engagement includes detailed discussions on gear and fishery-specific co-use challenges and feedback on the Project's findings, which informed preliminary recommendations. Ongoing engagement by regulatory agencies, non-governmental organizations, and developers with the fishing industry is key to ensuring the findings are relevant to the Gulf of Maine fishing industry.

G2. ENGAGEMENT METHODS

G2.1 OVERVIEW OF METHODS

To engage stakeholders effectively and constructively, GMRI employed a three-phase engagement approach for the Project:

- Phase 1: engagement to test existing understandings and identify further research questions among fisheries' stakeholders (Appendix B);
- Phase 2: engagement to understand interactions between the FOW technology scenarios specific to the various gear types used in the Gulf of Maine (Appendix D); and
- Phase 3: engagement to test preliminary recommendations with fishing stakeholders (Appendix F) and the Maine Offshore Wind Research Consortium Advisory Board (Advisory Board) (this present appendix) to consider their feedback, reactions, and opportunities for further research.

A subset of the Advisory Board approved this engagement approach, and the questions used in Phases 1 and 2. For Phase 3 engagement, GMRI sought feedback on the Project's preliminary technical compatibility assessment and the initial recommendations. The subset of the Advisory Board also approved and elaborated on an initial set of associations and fishermen to participate in each phase of the Project. To expand the participant base, GMRI employed a 'snowball' sampling method, a common approach in qualitative research where current participants suggest future participants from their networks.[1] This method was chosen due to the highly specialized nature of the fishing community, where relationships and trust play a critical role in participation. Snowball sampling allowed the team to leverage existing connections to ensure broad, yet relevant stakeholder engagement.

G2.2 PHASE 3 ENGAGEMENT DESCRIPTION

GMRI engaged Advisory Board members during Phase 3 (November 18 to December 12, 2024) using a semi-structured format through an online survey (see Attachment G-A) sent via email. The Project team provided a presentation to Advisory Board members on November 22, 2024 with details on both the preliminary assessment evaluating the compatibility of different fishing gear types with FOW mooring designs, and the preliminary recommendations for fisheries' coexistence with FOW. Following the presentation, the Project team answered twenty minutes of questions from the Advisory Board. GMRI then offered Advisory Board members an online survey to complete and provide input.

In the survey, respondents were asked to review the preliminary technical compatibility matrix (Figure 1) and preliminary recommendations for fisheries' coexistence with FOW. Each recommendation was followed by one to three questions developed by GMRI to gauge reactions and feedback. Respondents who took the survey spent approximately 20 to 45 minutes on it.

[1] Lopez, V., & Whitehead, D. (2013). Sampling data and data collection in qualitative research. *Nursing & midwifery research: Methods and appraisal for evidence-based practice*, *123*, 140.

To avoid stakeholder fatigue while ensuring comprehensive input, GMRI limited attempts to contact stakeholders to a maximum of three attempts per stakeholder. In total, GMRI contacted 27 Advisory Board members, 9 of which provided feedback via the online survey.

TABLE 1: SUMMARY OF STAKEHOLDER OUTREACH AND PARTICIPANTS

Stakeholders	Contacted	Gave Input
Advisory Board members	27	9

G2.3 BACKGROUND ON RESPONDENTS

Respondents for this report on Phase 3 engagement are all Advisory Board members. The Advisory Board has representation from commercial and recreational fisheries, marine wildlife and habitats expertise, commercial offshore wind development expertise, Tribal communities, and state agencies. Maine-based environmental non-governmental organizations, community representatives, and scientists from public and private research institutions are also represented on the Advisory Board.

Given fisheries representation on the Advisory Board, input received through this engagement effort is similar to the input provided by fishing industry stakeholders (Appendix F). Additionally, at the request of a respondent, input provided by Advisory Board members who are Tribal representatives is noted separately from members without Tribal affiliations. Tribal feedback was received from the Pleasant Point Passamaquoddy Reservation and the Indian Township Passamaquoddy Reservation.

G2.4 ANALYSIS METHODS

GMRI employed a thematic analysis approach to process the qualitative data collected during Phase 3. This method involved identifying, analyzing, and reporting patterns within the data, allowing the team to organize and summarize the data sets in detail.[2] The thematic analysis approach is widely used in social science research and was chosen for its effectiveness in accurately interpreting qualitative data in this context and preserving the anonymity of respondents.

[2] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. ; Clarke, V., & Braun, V. (2017). Thematic analysis. *The journal of positive psychology*, *12*(3), 297-298.

G3. STAKEHOLDER FEEDBACK: PRELIMINARY COMPATIBILITY ASSESSMENT

GMRI gathered feedback from respondents on the preliminary technical compatibility assessment, which evaluated four FOW mooring technologies and eight fishing gear types (Figure 1). Technical compatibility between the mooring technologies and fishing gear types is categorized in the following three ways:

- Not expected to be technically compatible (X/red);
- May be technically compatible in certain areas of the array in certain circumstances (~/amber); and
- Expected to be technically compatible throughout most of the array (√/green).

In some cases, technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines; these instances are marked in the preliminary technical compatibility assessment table with an asterisk.

Respondents were informed that the technical compatibility is based solely on the Project's desktop and engineering assessment and does not include levels of perceived risk from fishermen. Respondents were asked to review the preliminary technical compatibility assessment results and offer reactions, feedback, and/or questions This section summarizes feedback from respondents, arranged thematically, on the preliminary technical compatibility assessment.

FIGURE 1: PRELIMINARY TECHNICAL COMPATIBILITY ASSESSMENT

Preliminary technical compatibility assessment based on currently available technology[1]:

Mooring Type	Bottom Trawls	Midwater/ Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Catenary	X	~	~*	~*	X	~	~*	✔
Semi-Taut	X	~	~*	~*	X	~	~*	✔
Taut	X	X	~*	~*	X	~	~*	✔
TLP	~*	~	✔*	✔*	X	~	~	✔

X	Not expected to be technically compatible
~	May be technically compatible in certain areas of the array in certain circumstances[2]
✔	Expected to be technically compatible throughout most of the array

* = Technical compatibility depends on the cable being buried and an established exclusion zone around the wind turbines

[1] FOW technology and fishing gear are continuing to evolve

[2] For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the array

G3.1 SUMMARIZED FEEDBACK ON TABLE

Respondents provided feedback on the preliminary technical compatibility assessment; these are listed by available technology type below.

Bottom Trawls

Advisory Board Members: Three respondents commented on bottom trawls, one of whom agreed with the preliminary technical compatibility assessment for this gear type. This individual noted that bottom trawls may be more compatible with the mooring types with potential gear modifications, while the other two respondents noted that bottom trawls are incompatible with all mooring types.

Tribal Advisory Board Members: While respondents did not specifically reference all gear types in their comments, one individual noted that wind arrays will obstruct fishing activity regardless of gear type. They noted that except for surface harpoon fishing and hand jigging fishing for which, absent extensive technology development and changes to fishing methodologies, one would need a significant exclusion zone around FOW arrays, potentially causing significant displacement of Tribal cultural interests.

Midwater/Pelagic Trawls

Advisory Board Members: Three respondents commented on midwater and pelagic trawls. One respondent agreed with the preliminary technical compatibility assessment. One noted that this gear type is not compatible with any mooring types as it requires significant space to be deployed. The final respondent noted being "surprised" to see this gear type classified as "amber" (i.e., "May be technically compatible in certain areas of the array in certain circumstances") for the catenary, semi-taut, and tension-leg platform mooring types; they also noted it would be helpful to clarify the depth range assumed for where this gear type operates.

Tribal Advisory Board Members: See comment in "Bottom Trawls" section above.

Bottom Gillnets

Advisory Board Members: Two respondents commented on bottom gillnets. One individual agreed that in certain contexts, bottom gillnets, being a fixed gear type, may be technically compatible with FOW. Compatibility, however, depends on the amount and size of gear being used in FOW arrays. Larger bottom gillnets are less likely to be compatible in these areas, according to the respondent. The other respondent simply noted they agreed with the preliminary technical compatibility assessment.

Tribal Advisory Board Members: See comment in "Bottom Trawls" section above.

Pots and Traps

Advisory Board Members: Three respondents commented on pots and traps, each agreeing with the preliminary technical compatibility assessment. One respondent noted that pots and traps typically have a smaller spatial footprint, making them easier to deploy in a wind array. Another respondent, however, cautioned that lobster trawls, particularly in the offshore industry, have larger footprints that could potentially become entangled with the listed mooring types. As is noted in the table, pots and traps may therefore need additional exclusion zones to ensure compatibility.

Tribal Advisory Board Members: See comment in "Bottom Trawls" section above.

Dredges

Advisory Board Members: Two respondents commented on dredges, both agreeing with the preliminary assessment.

Tribal Advisory Board Members: See comment in "Bottom Trawls" section above.

Pole and Line

Advisory Board Members: No comments specifically referenced this gear type.

Tribal Advisory Board Members: See comment in "Bottom Trawls" section above.

Purse Seine

Advisory Board Members: One respondent commented on purse seines, agreeing with the preliminary technical compatibility assessment, but stressing that compatibility depends on the size and amount of gear being used in a space; smaller gear may be more compatible than larger gear.

Tribal Advisory Board Members: See comment in "Bottom Trawls" section above.

Harpoon

Advisory Board Members: Three respondents commented on harpoons. All three indicated the harpoon should be listed as technically incompatible with all mooring types, as it is widely used to target tuna or swordfish; when these species are harpooned, the fish do not die instantaneously but rather run when struck. They continued by explaining that in these cases, fishermen are forced to chase their catch (for 1 to 12 hours, according to one respondent) until they can retrieve it, which increases the potential risk of gear entanglement with any mooring type or turbine foundation. One respondent also noted feeling confused as to why the harpoon gear type is listed as the representative fishing method for highly migratory species as they feel it is a small component of the Gulf of Maine commercial bluefin tuna fishery. According to the respondent, more vessels are permitted to fish for these species under the "general" category, which involves fishing with rod and reel. They noted that rod and reel would be equally technically incompatible with any of the mooring types because, as noted earlier, these species "run" when they are targeted.

Tribal Advisory Board Members: See comment in "Bottom Trawls" section above.

G3.2 THE NEED FOR A COMPREHENSIVE COMPATIBILITY ASSESSMENT

Like many of the points raised by fishing industry stakeholders (Appendix F), several Advisory Board members, both in response to the Project team's presentation at the Maine Offshore Wind Research Consortium Advisory Board Meeting and in the online survey, noted the need for a more comprehensive compatibility assessment. Respondents acknowledged that this preliminary technical compatibility assessment offers robust engineering insights on a key aspect of fisheries' coexistence with FOW, but engineering is one of many determinants of successful fisheries' coexistence. According to respondents, several other factors ought to be considered when determining compatibility, including fishermen's perceived risk, weather and oceanographic conditions, and vessel insurance. For greater detail on these factors, see Appendix F.

G3.3 THE NEED FOR SITE-SPECIFIC EXPECTATIONS

As fishing industry stakeholders noted in the Appendix F, Advisory Board members generally noted that more site-specific information relevant to the Gulf of Maine environment is necessary to establish a comprehensive compatibility assessment. While acknowledging the difficulty of integrating factors that are currently unknown, some Advisory Board members stressed that there is not enough information for them to develop opinions on whether certain gear types will be compatible with FOW arrays in the Gulf of Maine. Areas that require more specific information, as raised by respondents, include:

- The width of spacing between FOW turbines;
- The layout configuration for FOW turbines;
- The layout configuration for FOW transmission cables;
- The exact size of exclusion zones around FOW turbines; and
- US Coast Guard Safety requirements around potential exclusion areas.

G3.4 INPUT FROM TRIBAL ADVISORY BOARD MEMBERS

Respondents noted that any FOW development in the Gulf of Maine will obstruct existing fishing activity. One respondent noted that there is a need to develop new technology-driven fishing techniques to operate within wind arrays. They also outlined a need to significantly increase data collection and to model the areas in and around the wind arrays. This, according to the same respondent, will improve the ability to assess the impacts – negative and positive – and implement more sophisticated approaches to fishing and dynamic management of the area.

G4. STAKEHOLDER FEEDBACK: INITIAL RECOMMENDATIONS

This section presents the preliminary recommendations for fisheries' coexistence with FOW (Attachment G-A) and summarizes feedback from respondents to these specific recommendations; recommendations are italicized, and respondent reactions are presented below the recommendations. Reactions from respondents are organized thematically and correspond to individual recommendations listed below. The feedback was then integrated into the updated recommendations, presented in Section 4. To underscore the importance of the preliminary recommendations to the fishing industry, notes are also included where recommendations align with the Fisheries Working Group (FWG) recommendations[3] submitted to the Maine Offshore Wind Roadmap Advisory Committee.

G4.1 ENGINEERING RECOMMENDATIONS

G4.1.1 SPACING FOR MOORING AND PLATFORM CONSIDERATIONS

Increasing platform spacing could allow sufficient clearance for trawling around subsea infrastructure (mooring and anchors) and enable individual platforms to be treated as separate obstacles (aligns with FWG Rec. 23). This spacing could allow more fishing activity, but it would reduce array density, requiring the wind array to cover more area to maintain power output.

Advisory Board Members

Mixed preferences on spacing: Respondents shared varied opinions on the best approach for spacing FOW infrastructure within arrays. Some support concentrating/clustering turbines to reduce the spatial footprint of an array. Others support spacing turbines farther apart to ensure that fishing activities could be possible within an array. According to a couple of respondents, preferences on spacing ought to be determined by fishing industry stakeholders' risk tolerance and the extent of the potential exclusion of fishing in these areas. As one respondent noted, for instance, there may be fishermen who do not wish to risk fishing near an array at all. Increasing spacing between turbines may increase the impacts to the fishermen who are not seeking to fish in these areas. As another respondent pointed out, if most types of fishing gears are incompatible with FOW (either due to technical, regulatory, insurance, or other reasons), then concentration may be ideal to reduce the area of exclusion from fishing activity.

The need for consultation and coordination with stakeholders: Respondents noted that FOW platform spacing decisions should be informed by robust consultation and coordination with fishermen who are active in the lease areas. According to one respondent, given that different fishing gear types may or may not be compatible within FOW arrays, fishermen and developers (ideally the developer's engineering team) could work together to ensure that spacing is conducive to the interests of the parties involved.

[3] Fisheries Working Group. (2022). Fisheries Working Group Recommendations Submitted to Maine Offshore Wind Roadmap Advisory Committee. https://www.maineoffshorewind.org/wp-content/uploads/2023/02/Fisheries-Working-Group-Final-Recommendations.pdf

Increased spacing may not be possible: One respondent noted that this recommendation was unrealistic, particularly in the sense that it suggests increasing spacing in the lease areas is practically possible. They noted that the lease areas are geographically fixed and that unless a spacing requirement was built into the lease area bidding process, developers are unlikely to increase spacing as this may reduce the power output from an array. Thus, increasing platform spacing may not be realistic.

Tribal Advisory Board Members

Spacing determinations will require an iterative process: One respondent noted that, as the recommendations suggest, it may be optimal from a cost/impact perspective to put the individual turbines as close together as possible. They continued, noting that an iterative process may be required to determine the spacing for fishing, steaming or whale passage, and fish migration; spacing determinations will depend on wind array engineering design, modeling, and new capabilities and technologies. They noted that it is premature to discuss spacing until individuals better assess the area, the potential development impacts, and the options available and under development for fishing in the wind arrays.

Safety risks: One respondent noted that spacing between platforms and buffer zones will pose potential safety risks by reducing maneuverability between fishing vessels, platforms, and protected whales. They noted that the size of any buffer zones from the platforms will be driven by technology development and modeling, and could be dynamic based on the habitat, ocean weather, and fishing method. They also noted that absent technology development, the spacing could be more than 1 mile around the outside of any obstructions for current fishing methods in these water depths. There must, therefore, according to the same respondent, be investments in developing new technologies and techniques for fishing in wind arrays. They also noted that this is because they do not want to lose fishing grounds and because the fishing could be better in the wind arrays as wind arrays could create artificial and potentially beneficial habitat.

Greater spacing may create greater impacts: One respondent discussed how, relative to a tighter spacing approach, increasing spacing within the lease area would potentially lend itself to relatively greater environmental disruptions due to a relatively larger spatial footprint being taken up by the array. This, according to the respondent, would also increase costs as inter array cables would then be longer and require more cable burial.

G4.1.2 LAYOUT CONSIDERATIONS

The layout of a wind array could be optimized for greater fishing potential (aligns with FWG Rec. 23). For example, aligning the rows of turbines with the predominant wind, wave and current direction can make trawling and fishing operations easier by allowing vessels to head into the weather.

Advisory Board Members

Layout should be determined by other factors: While most respondents noted that optimizing layouts is a positive idea, several noted that wind, wave and current direction are not factors that should be considered in making layout determinations. Instead, the topography of the seabed/bottom types or predominant fishing patterns should be evaluated to ensure that a layout is conducive to existing fishing activity. Additionally, one respondent pointed out that there is too much variability in wind direction to make this recommendation feasible, noting that it changes day to day and between tides.

Challenging to implement: Several respondents highlighted that this recommendation needs to acknowledge the impacts that layout optimization may have on a wind array's power yield, as well as potential resultant hydrodynamic and ecological impacts. As one respondent noted, this recommendation would potentially be "counterintuitive to power production optimization," making it challenging to implement.

The need for consultation and coordination: Just as with potential spacing changes, respondents noted that layout decisions should be driven in consultation with fishermen that are active in the FOW lease areas.

Fishing in transit lanes: One respondent suggested exploring the idea of allowing fishing within the designated transit lanes in the lease areas at defined intervals. Given that certain gear types may be able to operate in discrete areas, this may enable some fishermen to operate in these areas.

Tribal Advisory Board Members

Preference for optimized layouts: One respondent outlined that any layout that has the potential to optimize fishing opportunities should be considered and implemented if it demonstrates positive outcome.

The need for data and innovation before making layout determinations: Another respondent noted that there is a need to explore new technology-driven methods of fishing and protecting marine mammals. Also, it is premature to determine the optimal layout ahead of modeling and development of those methods. According to the respondent, their source of data is traditional knowledge, which leads them to the conclusions above about the need to develop and implement new technology. The respondent noted that the ocean environment around and under the wind arrays and along the cable runs is not currently modelled well enough to support decision making. They mentioned that a complete hydrodynamic, high-resolution ocean model is required, supported by extensive data to develop and validate the model. This data should include temperature, salinity, currents, wind, wave height and direction, tide height, and incoming solar radiation, taken at many locations. They noted that the data will best be collected by fishermen through sensors on fishing boats and gear operating within the research lease areas.

G4.1.3 TECHNOLOGY OPPORTUNITIES

For successful coexistence of fishing and FOW, any improvement in the knowledge, and understanding of the location of underwater equipment, whether fishing equipment (trawler nets, pots) or mooring and anchor lines or cables, can only improve the certainty and help reduce the risk of snagging (aligns with FWG Rec. 18). This could be achieved through transponders and beacons to get accurate real-time location information.

Advisory Board Members

Support for improving an understanding of underwater equipment: Most respondents noted that improving understanding of fishing equipment and subsea FOW infrastructure is crucial to prevent potential gear entanglement. As one respondent outlined, accurate markings of anchoring lines, mooring structures, and cables on electronic charting software used by the commercial fishing industry are very important, and the marking practices developers use for FOW infrastructure should closely align with the existing marking practices used by the fishing industry.

The need to understand the limitations and costs of the proposed technology: One respondent outlined that if technology (e.g., transponders and beacons) were to play a significant role in decision-making, research must be conducted to understand the limits of the technology. Another respondent also noted that it is important to understand the costs of technology like transponders and beacons, noting that their implementation would be reasonable if it is cheap, easy to use, and reliable.

Regulatory and technological challenges: One respondent was concerned that new technology would have to comply with National Oceanic and Atmospheric Administration and US Coast Guard regulations around transmitters, which may limit the practical implementation of this technology.

Liability and legal considerations: One respondent cautioned that while real-time data for underwater equipment could reduce entanglement risks, clear liability frameworks must be in place in the case that data may be inaccurate or delayed/lagged.

Technology innovation is ongoing: One respondent noted that there are efforts currently underway at the New England Fisheries Management Council by on demand fishing gear working groups to develop underwater communication requirements for ropeless/on demand gear. They suggested that any underwater technology providing real-time communication with vessels at the surface will also likely need to comply with these requirements.

<u>Tribal Advisory Board Members</u>

Technology improvements should come at the cost of the developer: One respondent noted that while this recommendation is a good idea, fishermen should not be responsible for investing in new technologies for their gear. Rather, they noted it should be the responsibility of the developers to provide such technology, either for free or at a significantly reduced cost.

Support for technology improvements: Another respondent agreed with this recommendation and noted there needs to be focused and high-priority engineering development to create a detection modalities system for fishing under the wind arrays using state-of-the-art technology. This and/or related technology, according to the respondent, should also be deployed to monitor for whales and other marine mammals, and to accurately attribute any incidental takes of these animals to underwater equipment, vessel-strikes, or fishing.

G4.2 REGULATORY, DEVELOPMENT PROCESS, AND COMPENSATION RECOMMENDATIONS

G4.2.1 APPLY REGULATIONS TO ENSURE COEXISTENCE OPPORTUNITIES AND SOLUTIONS ARE IMPLEMENTED, WHERE FEASIBLE

Regulations may need to evolve to address FOW and coexistence with fisheries. These include:

1. *Comprehensive environmental impact assessments, spanning the effects of surveys, construction, operation, and decommissioning activities on wildlife (aligns with FWG Rec. 3).*
2. *Regulations covering the creation of marine protected areas (MPA) in surrounding seabed areas to preserve and increase fish populations.*
3. *Requirement for construction, maintenance, or decommissioning activities to be scheduled around key fishing seasons and fish life cycle stages (e.g., spawning periods) (aligns with FWG 12a).*
4. *Policies around access to fishing areas surrounding FOW farms, including potential spillover effects to other areas and navigational risks/limitations.*

Note, some recommendations have been, may be, or are being implemented through existing laws and regulations. For instance, the terms and conditions of construction and operations plan approval for offshore wind projects can require benthic habitat and fisheries monitoring conditions.[4] Existing environmental impact assessment regulations and permitting have been implemented for existing fixed-bottom projects. Requirements will need adjustment as FOW projects progress through review. Lease stipulations and Bureau of Ocean Energy Management's (BOEM) Fisheries Mitigation Guidance document[5] also offer existing mechanisms to support coexistence.

Advisory Board Members

Mixed responses: Like how fishing industry stakeholders reacted to this recommendation in Appendix F, respondents broadly acknowledge that regulations need to evolve to promote coexistence. Individuals shared mixed opinions on the sample regulations and noted that more regulations need to be considered. Specific input from respondents on each sample regulation, respectively, is summarized below:

1. Respondents underscored the importance of comprehensive monitoring of FOW arrays before, during, after construction, and for the existence of arrays.
2. Several respondents were confused or opposed to the recommendation of creating MPAs surrounding FOW arrays. As one respondent noted, the FOW arrays may effectively remove areas that may be fishable with many conventional fishing methods. Introducing MPAs would remove more, they noted, potentially crowding fishermen into fewer, smaller areas. Another respondent noted, however, that there are potential benefits of FOW arrays acting as areas to increase fish populations, and that should be considered for further research.

---

[4] BOEM. (2024). Conditions of Construction and Operations Plan Approval Lease Number OCS-A 0534.
[5] BOEM. (2025). Guidelines for Providing Information for Mitigating Impacts to Commercial and For-Hire Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR Part 585.

3. Respondents indicated this recommendation would have considerable timeline and cost implications for FOW development, which would need additional consideration.
4. No comments were shared on this recommendation.

Other changes to consider: Some respondents offered other changes they felt may need to be implemented. These, according to respondents, include:

- FOW developers and operators should be financially liable for any loss of gear, fish or fishing opportunity experienced by fishermen.
- There should be clear legislation developed around liability to help manage the operating risk to developers and fishermen (e.g. risk of gear entanglement).
- Robust marine mammal protections should be applied to offshore wind construction, maintenance, and crew transfer activities.

Tribal Advisory Board Members

Responses:

1. Both respondents agreed that a comprehensive environmental impact assessment for all stages of development is needed to avoid and mitigate the impacts of wind array development.
2. One respondent opposed the creation of MPAs, noting that it would impact Tribal fishermen even more.
3. One respondent agreed with this recommendation, noting that planning development activity around key fishing seasons and fish life-cycle stages would be similar to activity in freshwater systems where lake levels are monitored to avoid interference with critical nesting areas for certain species.
4. No comments were shared on this recommendation.

Ensure adequate training for individuals active in FOW arrays: One respondent noted that operations within a wind array will be constrained to fishermen and fishing boats that should be trained and equipped to operate under a new technology-driven system of fishing.

G4.2.2 ENGAGE FISHERMEN IN SURVEY OPERATIONS:

1. *Engage local fishing communities before and during survey operations to minimize conflicts during survey activities (aligns with FWG Rec. 1a);*
2. *Hire credentialed local fishermen to provide real-time guidance and support on survey vessels (aligns with FWG Rec. 1c); and*
3. *Use fishing vessels to conduct surveys, creating revenue for fishermen while also ensuring survey compatibility with fishing industry operations.*

Advisory Board Members

General support: Most respondents supported this recommendation, some of whom noted it sounds "sensible" or "worth exploring," but others did not provide additional explanations. One respondent, who opted not to comment directly on the recommendation, suggested that the fishing industry would be better equipped to answer this question. To see input from fishing industry stakeholders on this recommendation, see Appendix F.

Tribal Advisory Board Members

General support: One respondent supported the employment of local fishermen wherever possible. Another noted that their Tribe should play a leading role in environmental impact studies and hiring local fisherman to collect critical environmental data. They noted that as part of the requirements to continue fishing in and around the study area, fishermen should be compensated to collect data on an ongoing basis.

G4.2.3 ESTABLISH CLEAR PROTOCOLS FOR COMPENSATION:

1. *Establish a standard gear loss compensation program before survey activities to mitigate the financial impact on fishermen whose equipment may be damaged during operations (aligns with FWG Rec. 1e).*
2. *Establish a regional compensation fund, like the Fishermen's Contingency Fund under the Outer Continental Shelf Lands Act , to address losses related to offshore wind development (aligns with FWG Rec. 25).*
3. *Leverage cooperative developer funding to provide local benefits to fisheries and mitigate impacts on fishing productivity – research funding (e.g., impact monitoring surveys) and damage mitigation for impacted fisheries can apply to the coexistence of all fishing methods operating symbiotically with the wind array.*

Advisory Board Members

General support: Respondents broadly agreed that compensation protocols should be put in place and stressed that compensation is a last-resort option after all mitigation measures have been exhausted.

The need for a co-creation process for mitigation funds: One respondent noted that there should be an element of co-creation and co-ownership of mitigation funds. They discussed how BOEM and offshore wind developers should continue developing standards and best practices for engaging with stakeholders and continue to evolve mitigation programs to better serve communities and the needs they identify.

Financial concerns: One respondent was skeptical that there will be enough money for these programs to operate effectively.

Tribal Advisory Board Members

Mixed responses: One respondent noted that these suggestions are the bare minimum. Another respondent noted that they agreed that funds like these are well-intentioned and will likely help some fishermen, but they are more interested in finding long-term solutions that will allow fishermen to continue to make their life at sea, coexisting with FOW array development. They also noted that it is important to keep in mind that FOW arrays may also provide benefits that offset some of their negative impacts. At this point, they discussed, they do not know how this will balance out for the fisheries, and it is only through the collection and analysis of data that individuals will determine both the negative impacts and potential benefits. This, according to the same respondent, requires a "system-of-systems" engineering approach that will enable development of a system that supports coexistence and takes advantage of any benefits provided by the presence of FOW arrays. The respondent envisions a region around and under a FOW array that operates more like an exclusion zone where only fishermen meeting specific requirements for technologically advanced gear, training (compensated), data collection, and heightened monitoring are allowed to participate.

G4.2.4 ESTABLISH ADAPTIVE MANAGEMENT FRAMEWORKS

Establish adaptive management frameworks that consider new fishing and monitoring data and adjust operations, where needed, to reduce impact (aligns with FWG Rec. 6).

Advisory Board Members

General Support: Respondents broadly agreed that adaptive management frameworks are necessary to reduce impacts. One respondent noted that a framework like this should include a risk-based assessment of fishing activity to ensure its effectiveness. Another respondent noted that government agencies such as National Oceanic and Atmospheric Administration National Marine Fisheries Service should be included in creating adaptive management frameworks.

The need for consultation and cooperation: Some respondents noted that adaptive management frameworks would require better structures of cooperation and mutual trust between FOW developers, regulatory agencies, and the fishing community to maximize their effectiveness.

Tribal Advisory Board Members

Adaptive management frameworks need to be comprehensive: One respondent noted that the recommendation is a simplistic statement of what needs to, can be, and should be accomplished. They noted the need for a comprehensive approach to 1) evaluate the area, 2) fish under the FOW array, 3) monitor impacts, and 4) survey for marine mammals and threats under the FOW array. They also noted that the development and implementation of this approach needs to begin now rather than in response to problems as the process moves along.

G4.2.5 MITIGATE IMPACTS ON FISHING

1. *Develop clear guidelines and buffer zones to avoid interference.*
2. *Promote dialogue between developers and fishermen to update best practices and adjust mitigation measures as FOW projects evolve.*
3. *Establish communication protocols with the fishing industry to inform them about upcoming and ongoing survey activities (e.g., timeline and locations) through apps and text alerts.*

Advisory Board Members

Recognition of value in reliable in-person communication: Advisory Board members echoed the same points as fishing industry respondents, largely noting that these recommendations are helpful. They noted that in-person communication is paramount and that fishermen need ample opportunity to communicate with developers on schedules that suit their needs. For greater detail on these points, see Appendix F.

The need for coordinated communication among developers: One respondent noted that coordinated communication across lease sites is also important. They noted that developers with lease sites should be communicating among one another and jointly communicating with the fishing industry to minimize the burdens of engagement for fishing industry stakeholders.

Tribal Advisory Board Members

Communication is important: One respondent noted that communication will be very important, and that dialogue will be imperative throughout this process. Regarding point number one, another respondent noted that they do not see how one might develop meaningful guidelines and buffer zones at this time, prior to the collection of significantly more data, modeling, and development and implementation of technology. Responding to points number two and number three, the same respondent agrees there needs to be plenty of dialogue, but this will only be meaningful when developers, regulators, and fishermen have a more complete and thorough environmental assessment led by their Tribe and the fishing industry.

G4.3 DATA AND INNOVATION RECOMMENDATIONS

G4.3.1 USE DATA-DRIVEN SITING TO REDUCE OCEAN USER CONFLICTS

Through a data-driven siting process – such as the BOEM wind energy area siting and deconfliction process in the Gulf of Maine – fisheries-related data and stakeholder feedback is incorporated to avoid specific user conflicts (e.g., specific fishing grounds or navigational routes) (aligns with FWG Rec. 6).

Advisory Board Members

Respondents support data-driven siting, noting that stakeholder feedback should be directly incorporated in decision-making and that data should be leveraged throughout all phases of development. Each of these themes was also outlined by fishing industry stakeholders in Appendix F. Two new points raised by respondents include the following:

- One respondent noted challenges with inter-annual spatial variation in fishing activity, so fishing activity from the past is not a perfect predictor of future activity. According to them, there needs to be a consultation element to the siting process as well as a data-driven approach.
- Two respondents discussed challenges with a lack of data (or differences in data quality) from all vessels, which can limit the effectiveness of a data-driven siting approach. As such, data availability should be improved.

Tribal Advisory Board Members

The need for a comprehensive approach to research and monitoring: One respondent agreed that the process should be data-driven but does not know how one could possibly deconflict in the absence of the required data, modeling, and fishing technology innovations required for assessing potential user conflicts and developing a coexistence approach. They recommend a rigorous, large "system-of-systems" engineering approach to develop a system of data collection, modeling, fishing, and monitoring that not only allows for FOW array co-existence with fisheries, but is also used to assess the environmental impacts, reduce whale entanglement and vessel-strikes, help fisheries adapt to climate change, prevent and remove marine debris, and aid in detection and tracking of marine mammals and underwater security threats.

Data is important for all phases: One respondent noted that fisheries, habitat, and environmental data is critical prior to the planning phase as a control and during construction and operation. They noted the need to collect data to assess and model the fisheries yield, habitat, and environmental conditions prior to installation, during construction, and following installation. They also noted that it is important to monitor for marine mammals before, during, and after construction, and to consider collecting data (e.g., environmental, food, etc.) that can be used to indicate habitat for marine mammal presence and absence.

G4.3.2 INCORPORATE PREVENTATIVE MEASURES CONSIDERING COLLISION AND SNAGGING RISKS, WHERE FEASIBLE

FOW-specific guidance for engaging with fisheries during project design is essential to avoid areas where high snag-risk activities are important to local fisheries (aligns with FWG Rec. 18). Technological innovations, such as alarm or monitoring systems to detect snagging, improved navigational tools, and new gear technologies, should be explored to mitigate these risks.

Advisory Board Members

Apart from a few respondents who did not comment on this recommendation, respondents echoed many of the same points raised by fishing industry stakeholders; see Appendix F. The only different comment was from a respondent who noted that preventative measures are great in theory but may prove challenging in practice. They discussed how engineers may find it difficult to ensure the effectiveness of sensors on mooring lines. For instance, they noted, it is unclear if sensors within mooring lines will be sensitive enough to detect debris accumulation or a snagging event because of the size and load on the mooring lines. Further research and development are needed to ensure the effectiveness of this recommendation.

Tribal Advisory Board Members

Conditional support for preventative measures: One respondent noted that this is a good recommendation so long as fishermen are not expected or required to provide gear for themselves. Any improvements necessary should come at no cost to fishermen, they noted.

Additional suggestions: Another respondent agreed with the recommendation but believes that Maine's Offshore Wind Research Consortium does not have the resources to lead the development and implementation of this recommendation. They also noted that accurate subsea marking technologies that allow for reliable endline-free fixed-gear fishing, as well as additional modifications to fishing gear and methods that may be driven by depth, habitat, and the selected array, would be needed. In addition, as discussed above, they highlighted that sufficient fishing gear in the area needs to be outfitted with environmental and potentially acoustic sensors to collect the data necessary to provide ongoing modeling and monitoring of ocean conditions and marine mammals, which may facilitate dynamic management. They noted that data collection must be transmitted to a command-and-control center for ongoing management in as near real-time as possible and that fishermen operating within the leased area will need one display showing all information in an intuitive manner. They also noted that placing the platforms, mooring lines, and anchors on the integrated display, along with other subsea marked gear, will require significant development and the cooperation of the leading vendors of navigation equipment and software (e.g., Garmin, Furuno, and TIMEZERO).

G4.3.3 CONSIDER IMPLEMENTING NATURE-INCLUSIVE DESIGN PRINCIPLES IN OFFSHORE WIND FARMS

Nature-inclusive design (NiD)[6] *can positively influence surrounding ecosystems (e.g., FOW platforms can act as artificial reefs), which has been shown to increase the species' populations in wind arrays and surrounding waters.*

Advisory Board Members

Mixed responses: Some respondents support the implementation of NiD principles, noting that they are critical and can include bird mitigation technologies. One respondent noted that certain NiD principles can minimize impacts while others may enhance ecosystems, making them potentially helpful mechanisms. Other respondents were opposed to NiD principles. One noted that it is unknown whether NiD principles are effective, and we need to know more about them before implementing them. Several respondents noted that NiD principles may encourage species of fish to concentrate in areas that fish did not previously frequent. If fish concentrate within FOW arrays and cannot be fished due to certain constraints, then NiD principles may negatively affect fishermen, according to one respondent. On the other hand, another respondent noted that the concentration of fish within the array may have spillover benefits outside of FOW arrays. Several respondents noted that more research needs to be conducted to confirm the impacts and potential benefits of implementing NiD principles.

Tribal Advisory Board Members

Conditional support: One respondent noted that if FOW platforms have the potential to increase fish species, mechanisms must exist for these areas to be fished or there are no benefits to fishermen or fisheries' coexistence. Another respondent noted that they agreed with the NiD concept, however the net impacts specific to the proposed area need to be studied. This, according to the respondent, requires significantly greater data collection, modeling, and monitoring than is currently being performed or planned. They believe that a program should be started to first accurately model the environment, which requires validation to confirm, and then use the models to investigate the possibilities and monitor the impacts.

G4.3.4 SHARE DATA

1. *Conduct comprehensive baseline biological and oceanographic monitoring in coordination with the fishing industry before, during, and after FOW construction (aligns with FWG Rec. 6).*
2. *Use an Automatic Identification System to track location and provide a record of activities for any conflict resolution.*

[6] The Ministry of Agriculture, Nature and Food Quality. (2020). *Nature-Inclusive Design: A catalogue for offshore wind infrastructure*.

3. *Map fishing activities, habitats, and predict future trends through continuous monitoring (aligns with FWG Rec. 3a).*
4. *Share the raw monitoring data in an open-source format with common standards and metadata; establish clear data access policies (aligns with FWG Rec. 3k).*

Advisory Board Members

General support: Respondents broadly support this recommendation, with several noting that robust data collection and transparent data sharing will help facilitate coexistence. Some respondents cautioned that not all vessels are required to have Automatic Identification System and some folks may be opposed to having their data shared, making this recommendation tough to implement.

Tribal Advisory Board Members

General Support: Two respondents noted support for these recommendations. One respondent noted that as ancient stewards of the environment, partnered with highly qualified and experienced ocean scientists and engineers, they believe that their Tribe has the knowledge and capacity to lead the data collection, analysis, modeling, monitoring, and critically, the development of a technology-driven solution that allows for coexistence of fishing under and around the FOW arrays, as well as monitoring for marine mammals and surveillance for threats around the FOW arrays.

G5. CONCLUSION

The findings from Phase 3 engagement with Advisory Board members highlight the importance of continuous and meaningful collaboration between the FOW industry and Gulf of Maine fishing stakeholders. Through an iterative engagement process, GMRI has gathered critical insights on perceived risks, technical challenges, and opportunities to align FOW development with the needs of the fishing community. Stakeholder feedback has underscored the complexity of achieving coexistence, emphasizing the importance of conducting comprehensive research and monitoring within FOW areas, crafting comprehensive compatibility assessments with site-specific considerations, and exploring regulatory structures that promote coexistence strategies. Respondents also underscored how Tribes have the knowledge to play valuable roles in contributing to data collection and monitoring activities in FOW areas, helping support technology-driven coexistence strategies.

Moving forward, integrating stakeholders' perspectives into the FOW development process and prioritizing transparent communication will be key to addressing evolving challenges. Sustained engagement and innovative approaches will be essential to fostering mutual understanding and ensuring that FOW development aligns with the environmental, economic, and social priorities of the Gulf of Maine region.

ATTACHMENT G-A GOOGLE FORM SURVEY

THE SLIDES PRESENTED TO THE ADVISORY BOARD ARE PUBLICLY AVAILABLE ON GEO'S WEBSITE: 2024 11 22 AB MEETING SLIDES.PDF

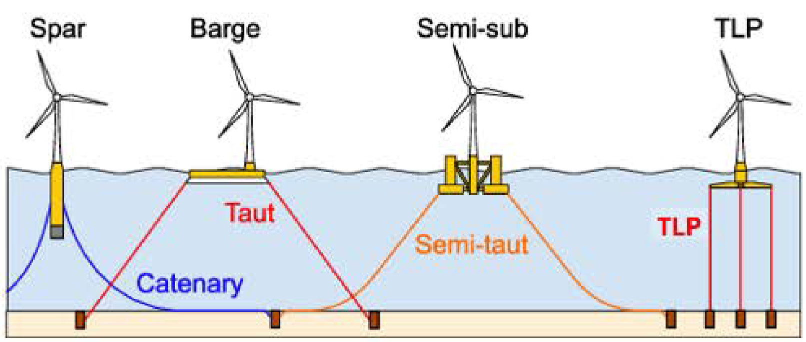
Seeking Feedback on Recommendations for Best Practices on Fisheries' Coexistence with Floating Offshore Wind

As part of a Maine Governor's Office-funded project exploring fisheries' coexistence with floating offshore wind (FOW), Environmental Resources Management (ERM) analyzed the components and design of FOW systems to assess their compatibility with existing fisheries in the Gulf of Maine, particularly within the Gulf of Maine lease areas. The ERM team then summarized fishing methods that may be suitable for coexistence with FOW and suggested initial solutions and recommendations to support coexistence. **This form intends to gather input and gauge reflections on these initial recommendations for best practices for fisheries' coexistence with floating offshore wind technologies.** Your responses will be kept anonymous and feedback will be incorporated into the project's final report.

We recognize that some questions may not be applicable to all audiences, so please feel free to leave responses blank if you feel they do not apply to you. Thank you so much for your time.

1. Name/Affiliation

For context, this simplified figure illustrates the FOW platform and mooring technologies evaluated by ERM.



Compatibility Assessment of Fishing Gear Types with Floating Offshore Wind (FOW) Technologies

The table below is a summary of fishing gear types used in the Gulf of Maine lease areas and the preliminary technical compatibility of using those gear types within different floating offshore wind (FOW) technologies. Note that this technical compatibility is based on a desktop assessment of currently available technology and does not include different levels of perceived risk from fishermen, which must also be considered in an overall assessment of compatibility. Further, all coexistence scenarios assume that inter-array cables are buried and protected.

TABLE 5-1: TECHNICAL COMPATABILITY SUMMARY OF FISHING GEAR TYPES AND FOW TECHNOLOGIES

Mooring Type	Bottom Trawls	Midwater / Pelagic Trawls	Bottom Gillnets	Pots & Traps	Dredges	Pole & Line	Purse Seine	Harpoon
Catenary	X	~	~*	~*	X	~	~*	✓
Semi-Taut	X	~	~*	~*	X	~	~*	✓
Taut	X	X	~*	~*	X	~	~*	✓
TLP	~*	~	~*	~*	X	~	~	✓

Note: Fishing methods have been rated using the following key:

✓ = Expected to be technically compatible throughout the most of the farm	~ = May be technically compatible in certain areas of the farm in certain circumstances[1].	X = Not expected to be technically compatible

*Technical compatibility depends on the cable being buried and an established exclusion zone around the WTGs. Required standards would need to be developed for the site by regulators, in addition to existing standards such as DNV-ST-0119, and approved from an engineering perspective.

[1]For all amber categories, additional engineering solutions would be needed for fishermen to feel comfortable fishing in the FOW array.

2. *What reactions/feedback do you have after reviewing the technical assessment above? If there are areas where you envision conflict between certain fishing gear types and mooring technologies, please note them below.*

Engineering Recommendations

Spacing for Mooring and Platform Considerations:

Increasing spacing between individual turbines could allow sufficient clearance for trawling around subsea infrastructure (mooring and anchors) and enable individual platforms to be treated as separate obstacles. This spacing could allow more fishing activity, but it would reduce array density, requiring the wind array to cover more area to maintain power output.

3. *What is your reaction to this recommendation? Do you have any feedback?*

4. *Are there specific spacing factors to be considered between the platforms (above surface)? What buffer zone would be necessary around the platform structures?*

5. *Are there specific spacing factors to be considered between the mooring types and anchors (below surface)? What buffer zone would be necessary around anchors and mooring lines?*

Layout Considerations:

The layout of the wind array could be optimized for greater fishing potential. For example, aligning the rows of turbines with the predominant wind, wave and current direction can make trawling and fishing operations easier by allowing vessels to head into the weather.

6. *What is your reaction to this recommendation? Do you have any feedback?*

7. *What layout pattern would ease fishing concerns?*

8. *What data exists to support an understanding of fishing activities (i.e. VMS/AIS data, weather patterns, current direction, etc.)? Which data are most important to consider?*

Technology Opportunities:

Invest in and deploy existing or new technology, like transponders and beacons, to get accurate, real time location information of underwater equipment, whether that's fishing gear, mooring and anchor lines, or cables. Greater certainty on the location of underwater gear will reduce the risk of snagging and facilitate greater coexistence between fishing and FOW.

9. *What is your reaction to this recommendation? Do you have any feedback?*

10. *What other engineering recommendations do you feel would be helpful to enable fishing operations within floating offshore wind arrays?*

Regulatory, Development Process, and Compensation Recommendations

Apply regulations to ensure coexistence opportunities and solutions are implemented, where feasible:

Regulations may need to evolve to address FOW and coexistence with fisheries. These include:

1. Comprehensive environmental impact assessments (EIA) regulations, spanning the effects of surveys, construction, operation, and decommissioning activities on wildlife.
2. Regulations covering the creation of marine protected areas (MPA) in surrounding seabed areas, to preserve and increase fish populations.
3. Requirement for construction, maintenance, or decommissioning activities to be scheduled around key fishing seasons and fish life cycle stages (e.g., spawning periods).
4. Policies around access to fishing areas surrounding FOW farms, including potential spillover effects to other areas and navigational risks/limitations.

11. *What is your reaction to these recommendations? If you have specific feedback regarding one or several recommendations, please indicate the corresponding number in your response.*

12. *What other regulatory changes need to be in effect for coexistence?*

Engage Fishermen in Survey Operations:

- Engage local fishing communities before and during survey operations to minimize conflicts during survey activities.
- Hire local fishermen to provide real-time guidance and support on survey vessels.
- Use fishing vessels to conduct surveys, creating revenue for fishermen while also ensuring survey compatibility with fishing industry operations.

13. *What is your reaction to this recommendation? Do you have any feedback?*

Establish Clear Protocols for Compensation:

- Establish a standard gear loss compensation program prior to survey activities to mitigate the financial impact on fishermen whose equipment may be damaged during operations.
- Establish a regional compensation fund, like the Fishermen's Contingency Fund under the Outer Continental Shelf Lands Act (OCSLA) to address losses related to offshore wind development.
- Leverage cooperative developer funding to provide local benefits to fisheries and mitigate impacts on fishing productivity – research funding (e.g., impact monitoring surveys) and damage-mitigation for impacted fisheries can apply to the coexistence of all fishing methods operating symbiotically with the wind array.

14. *What is your reaction to this recommendation? Do you have any feedback?*

Establish Adaptive Management Frameworks:

Establish adaptive management frameworks that consider new fishing and monitoring data and adjust operations, where needed, to reduce impact.

15. *What is your reaction to this recommendation? Do you have any feedback?*

Mitigate Impacts on Fishing:

- Develop clear guidelines and buffer zones to avoid interference.
- Promote dialogue between developers and fishermen to update best practices and adjust mitigation measures as FOW projects evolve.
- Establish communication protocols with the fishing industry to inform them about upcoming and ongoing survey activities (e.g., timeline and locations) through apps and text alerts.

16. *What is your reaction to this recommendation? Do you have any feedback?*

17. *Have you seen or experienced constructive communication practices with the fishing industry in OSW or another offshore industry?*

18. *What should be considered when developing communication protocols? How should fishermen be engaged to have transparent dialogue? What mechanisms do you suggest work best for communicating with fisheries? (i.e. port visits, email, text, phone calls, etc.)*

Data and Innovation Recommendations

Use data-driven siting to reduce ocean user conflicts:

Through a data-driven siting process – such as the BOEM wind energy area siting and deconfliction process in the Gulf of Maine – fisheries related data and stakeholder feedback is incorporated to avoid specific user conflicts (e.g., specific fishing grounds or navigational routes).

19. *What is your reaction to this recommendation? Do you have any feedback?*

20. *During what phases of planning, leasing, construction and operation do you see fisheries data being most important? What datasets should be considered?*

Incorporate preventative measures considering collision and snagging risks, where feasible:

FOW-specific guidance for engaging with fisheries during project design is essential to avoid areas where high snag-risk activities are important to local fisheries. Technological innovations, such as alarm or monitoring systems to detect snagging, improved navigational tools, and new gear technologies should be explored to mitigate these risks.

21. *What is your reaction to this recommendation? Do you have any feedback?*

22. *What improvements to fishing gear are needed to implement this recommendation?*

23. *What improvements to navigation tools are needed to implement this recommendation?*

Consider implementing nature-inclusive design (NiD) principles in offshore wind arrays:

Nature-inclusive design principles (e.g. incorporating hard substrates for reef restoration) can positively influence surrounding ecosystems (e.g. FOW platforms can act as artificial reefs) which has been shown to increase the species' populations in wind arrays and surrounding waters.

24. *What is your reaction to this recommendation? Do you have any feedback?*

Share Data:

- Conduct comprehensive baseline biological and oceanographic monitoring in coordination with the fishing industry before, during, and after FOW construction.
- Use an Automatic Identification System (AIS) to track location and provide a record of activities for any conflict resolution.
- Map fishing activities, habitats, and predict future trends through continuous monitoring.
- Share the raw monitoring data in an open-source format with common standards and metadata; establish clear data access policies.

25. *What is your reaction to this recommendation? Do you have any feedback?*

26. If you have suggestions for other recommendations for best practices on fisheries' coexistence with FOW, please feel free to share them below.

ERM HAS OVER 140 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina
Australia
Belgium
Brazil
Canada
China
Colombia
Denmark
France
Germany
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
Netherlands
New Zealand
Panama
Peru
Poland
Portugal
Romania
Singapore
South Africa
South Korea
Spain
Switzerland
Taiwan
Thailand
UAE
UK
US
Vietnam

ERM's Boston Office

One Beacon Street
5th Floor
Boston, MA 02108

T +1 617 646 7800

http://www.erm.com/