Offshore Wind and Fisheries: the Science Behind Coexistence

Climate change is a serious threat to the marine environment, fish, and fisheries.[1] Offshore wind farms provide an energy resource that will help reduce greenhouse gas emissions, helping to reduce the progress of climate change. Fisheries and offshore wind are compatible ocean uses that can sustainably *coexist*.[2,3,4]

This document summarizes scientific literature detailing how offshore wind projects can share space with fisheries' uses of windfarm areas, provide benefits to fisheries, create new opportunities for research, will mitigate limited noise impacts, and how subsea cables can cause minimal impacts to fish. Offshore wind also can increase local biodiversity because of new structures and refuge habitats.[5]

Adapting Wind Farm Design and Fisheries Management

Fisheries and offshore wind are compatible ocean uses that can sustainably coexist.[2,3,4] Windfarm design can account for fisheries' uses of windfarm areas.[6] Significant work has been done to reduce the size of ocean tracts for leasing in response to community, state, and fishermen's feedback to find ways to keep fishing and offshore windfarms compatible.[7] With turbine spacing and layouts coordinated with BOEM and the U.S. Coast Guard, leasing areas can continue to be used for many of their current uses, such as a variety of commercial and recreational fishing.[8] Fisheries' working groups are helping to inform compatible development. New approaches to fisheries' research and monitoring will ensure fisheries' management can adapt to the presence of windfarms.[9,10] Fisheries' managers can continue to work to maintain yields and food security through adjustment of current management measures such as fishery surveys conducted by the National Oceanic and Atmospheric Administration (NOAA) Fisheries Science Centers as windfarms are built. However, additional resources are needed by NOAA Fisheries to support calibration of existing data and updating fishery survey methodology. The industry fully supports increasing these resources.

As part of planning and authorizing offshore wind, developers and agencies engage stakeholders in decision-making, evaluation of risks, and development of mitigation and monitoring to avoid and minimize potential impacts.

Benefits of Offshore Wind to Fish and Fisheries

Offshore wind provides multiple benefits for the marine environment. Foraging opportunities can increase as biological productivity and fish biodiversity increase with the creation of new structures producing additional habitats.[11] Another benefit is the creation of small marine safety areas around turbines that can serve as refuges for organisms.[2,5,12] Structures in the water can create habitat for benthic organisms, including commercially important fish and invertebrates, which can have benefits to marine communities[13] and some fisheries.[2] Fisheries and windfarms have been successfully co-located in Europe. For example, up to 90% of Danish annual gillnet fleet landings of plaice 2010-2012 were from areas overlapping with windfarms.[14] Climate change has been predicted to potentially have dramatic effects on the marine environment.[15] These effects include the disruption of prey distributions, decreased biodiversity, and changes in habitat availability.[16,17,18] Climate variability results in fishing employment losses.[19] Offshore wind provides an energy resource that will help reduce greenhouse gas emissions responsible for climate change.

Benefits of Offshore Wind Energy

- Renewable energy resource to help combat climate change
- Reef effects and connectivity that can increase biodiversity and productivity
- Offshore wind turbines can act as small marine safety zones

Active Collaboration for Research and Monitoring

The offshore wind industry continues its strong engagement and collaboration with scientific and stakeholder communities to conduct research, address stressors on populations, share resources, and improve the ability to conserve and protect these important fish.[20 21] The research and monitoring currently being conducted by industry include long-term projects that will improve biological understanding and provide adaptive management opportunities. Fish will be monitored before and after construction to inform strategies for avoiding, minimizing, and offsetting potential impacts.

Limited Impacts to Fisheries During Construction & Operations

Just as fishing vessels are given right of way by other mariners while actively trawling, offshore wind vessels will have temporary safety zones during certain development and operation activities. There may be some shifts in community assemblages of marine species, as turbines create artificial reefs, provide substrate, and attract fish and other predators. Individual injury or mortality of fish may occur during offshore wind construction, though population-level impacts are ***unlikely.*** There is a considerable body of literature on marine structures, pile driving sound, wind farms in Europe, and other disturbances and their effects on fish, as well as a wide variety of mitigation measures that have been developed to avoid and minimize potential effects. Some examples of mitigation measures include seasonal construction windows and sound dampening technologies for pile driving.[22 23]

SOUND

Mitigation is used to reduce sound and the potential impacts of sound on fish and fisheries.[24] Although windfarm-related vessels and survey operations will make sound, it is ***insignificant*** compared to existing background sound, which is generated by human and natural phenomena.[24] The loudest period during wind farm construction and operations is pile driving, which is used to install foundations. The process of pile driving is relatively short in duration, though low-frequency components of this sound can propagate long distances in water, which is typically mitigated by use of barriers such as bubble curtains or cofferdams.[3 4] Studies have shown that offshore wind operational sound ***did not*** have any adverse effects on fish hearing, even relatively close to turbines, and displacement was limited to less than 4 meters from turbines and only at high wind speeds (>13 m/s).[25] Turbines ***do not*** cause consistent avoidance during operations or physiological damage to fish.[22] In Europe, which has been generating offshore wind for 29 years, the intensity of disturbance to fish is ***minimal*** and fish returned to pre-existing behaviors after offshore wind construction was complete.[26 27] BOEM has determined, for one project, that impacts from noise to fish, even with swim bladders, would be negligible to minor.[28] A study of flatfish at Block Island Wind Farm found no negative effects from construction and operations.[29]

LONG-TERM STRUCTURES

During the initial pile driving and construction phases of offshore wind development, there is the potential for impacts to fish. Once construction is complete, however, wind turbines can create artificial reef-like habitats which attract fish and can increase local biodiversity.[5 13 20] For example, BOEM expects ***moderate beneficial*** impacts from reef effects to result from Vineyard Wind.[19] Long-term structures can alter the local substrate and the benefits or impacts from this are dependent upon location.

ELECTRO-MAGNETIC FIELDS (EMF), VIBRATION, AND HEAT

Just like all transmission cables and household appliances, subsea cables used in offshore wind emit EMF, vibration, and heat. Effects of these are dependent on substrate type, burial depth, cable type, function of fish sensory organs (if present), and ambient temperature.[6 7 31] Cable burial and sheathing are used to minimize these emissions. EMF detection and effects on fish would be limited to very close to subsea cables during offshore wind operation, with ***little*** potential for interaction. BOEM found that fish and large invertebrates such as crabs and sea stars had no response, attraction or repulsion, to EMF from a 35kV alternating current in situ power transmission cable.[32 33 34] Offshore wind operation vibratory effects are extremely localized and are expected to have ***minimal*** impacts on fish.[35 36] With subsea cable guidelines, effects on fish can be minimized.[19 37]

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