NEFSA

OFFSHORE WIND
RESEARCH SUMMARY

AUG. 7TH | WWW.NEFISHERMEN.ORG

INTRODUCTION:

We fear **the public is misinformed** as to the scale and scope of offshore wind projects. Federal regulators at the Bureau of Ocean Energy Management (BOEM) have designated almost **10 million acres for wind farm** surveys and development. This is **a vast swath of our ocean**, and covers highly productive fishing grounds New England fishermen have worked for **hundreds of years**.

The turbines themselves rise from the ocean floor, or a floating platform chained to the bottom, and tower hundreds of feet in the air. At 853 feet, the GE Haliade-X turbine is **taller than the Washington Monument and Seattle's Space Needle**. Indeed, the turbine is almost **three times larger than the Statue of Liberty**. Public officials and foreign green energy companies mean to build thousands of these mammoth structures, sprawling sea-borne complexes larger than many cities.

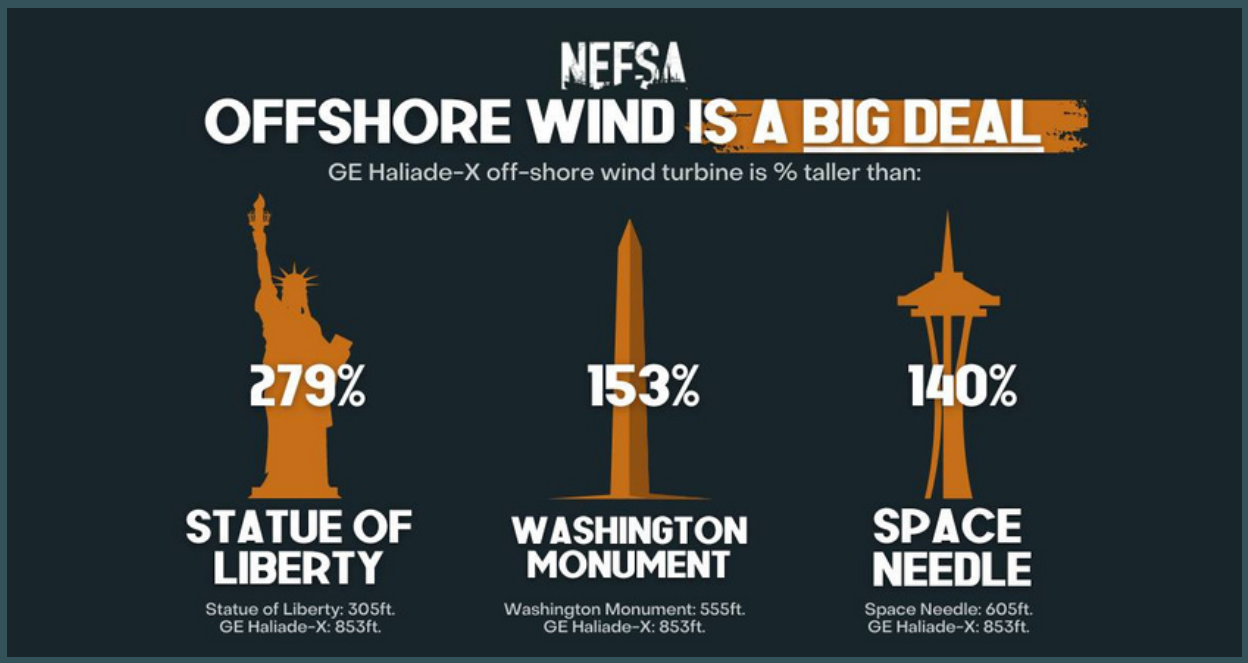
Industrialization on this scale will of necessity **change our ocean ecosystem**. Nobody can honestly contend otherwise. New legislation would ban development in a portion of the draft call area, Lobster Management Area One. **This is a good step and an encouraging development**. But as a study in this report shows, electromagnetic fields (EMFs) emanating from subsea cables appear to produce birth deformities in juvenile lobster. **Construction anywhere is a threat to lobster stocks everywhere**.

INTRODUCTION:

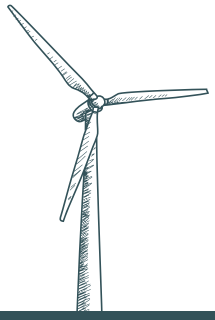
Remarkably, **public officials and corporate leaders are proceeding** with their lucrative, well-laid development plans i**n the absence of a definitive, scientific consensus** as to the effects of wind energy on the ocean and marine life. Even the federal government concedes this point. The National Oceanic and Atmospheric Administration (NOAA) is offering a grant to study the effects of wind farm construction on right whale acoustics, **an admission that government scientists do not understand how these platforms will affect a critically endangered marine mammal.**

As wild harvesters, we find this irresponsible and unjustifiable. As such, we are asking state and federal authorities to rescind the existing Gulf of Maine Call Area; conduct an environmental review for the Gulf of Maine before identifying any commercial wind energy areas; and **delay any further development until experts have monitored and studied** the Gulf of Maine research array the state of Maine is currently developing. NEFSA encourages readers to review this report with an open mind and to **sign our petition urging our political leaders to adopt a more prudent course** before industrializing our oceans.

INTRODUCTION:



WIND FARMS MIMIC CLIMATE CHANGE BY CAUSING SEA SURFACE TEMPERATURES TO RISE:



Wind farms increase sea surface temperatures and alter upper-ocean hydrodynamics in ways scientists do not yet understand. Mixing of the ocean surface layer is primarily shear-driven, meaning that “anomalies in the wind field can have severe consequences for the upper ocean dynamics," according to a 2022 study published in “Frontiers of Marine Science."

Over time, extracting wind energy at and just above the surface results in “extensive areas of reduced wind speed and decrease shear-driven forcing at the sea surface boundary." Wind speeds are reduced about 10 percent at the ten-meter height, according to this study. **This is the so-called “wind wake effect.”**

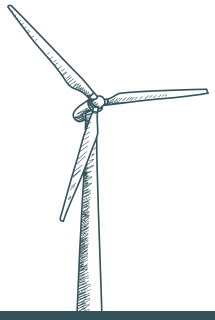
The study found that “coherent patterns of increasing **mean sea surface temperature are present in areas of wind farm development.**’ Further, the “large-scale surface heating of up to 0.1ºC imitates the effects of climate change, in which an increase of sea surface temperature is also to be expected as a result of the warming of the earth’s atmosphere.’ **The turbine-induced changes are one order of magnitude smaller than average perturbations due to climate change**. Importantly, as these authors write elsewhere, the cumulative effects of increasing offshore installations will amplify the consequences at scale.

These findings “**raise concerns about substantial changes to the hydrodynamics of the North Sea**. In particular, since the offshore development in the North Sea is growing continuously, questions about environmental consequences of offshore wind farming become crucial for prospective research.’

One such line for pursuit is the impact of regional atmospheric conditions, as “**surface heating along with the reduction in turbulent mixing influences the upward heat and momentum fluxes from the ocean into the atmosphere.’** Apart from temperature consideration, stunting the mixing process can “affect the distribution of nutrients between the water layers and thus primary production.’ The authors are Nils Christiansen, Ute Daewel, Bughsin Djath, and Corrina Schrum with the Hereon Institute of Coastal Systems in Germany.

Source: “Emergence of Large-Scale Hydrodynamic Structures Due to Atmospheric Offshore Wind Farm Wakes’ Frontiers in Marine Science vol. 9 (February 2022)

EMFS STUNT LOBSTER LARVAE AND COMPROMISE SWIMMING ABILITIES:



Cables running inland from offshore wind farms emit electromagnetic fields. One study found that chronic exposure to EMFs **resulted in defects and deformities among lobster larvae.**

Lobstermen in the UK collected 20 egg-producing female lobster and 25 adult female crabs with sperm plugs. Researchers kept the subjects in holding tanks at the St. Abbs Marine Station. All lobsters used for the experiment were above the minimum landing size and had comparable weight and carapace (shell) length.

Six "berried' or egg-carrying lobsters and six berried crabs were exposed to a constant, uniform EMF for the duration of incubation and larval release. The EMF strength was chosen based on modelled values expected around a single subsea power cable. A second control group was held without exposure to EMF.

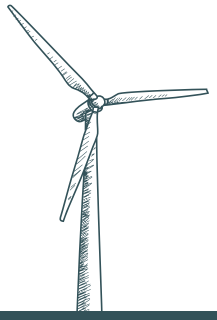
One hundred freshly hatched larvae were randomly selected from each female. With respect to lobster larvae, the researchers found that "**larvae exposed to EMF throughout their embryonic development had a significantly smaller total length (TL), carapace height (CH) and maximum eye diameter (ED)** and a significantly longer carapace length,' as compared to the control group.

Based on these results, the researchers warned that cable EMFs "could have a measurable impact on early development of two commercially important crustaceans.' Apart from findings respecting larval development, lobster larvae exposed to EMF also "**fail significantly more vertical swimming trials.**' Vertical swimming is important because the uppermost water layers have high food abundance and currents that carry larvae to suitable areas for settlement.

The study identified "gene expression, larval physiology, growth, dispersal, settlement, survival and feeding rate' as subjects **in need of further study in order to fully understand the effects of marine renewables on the ocean environment.**

Source: "The Effects of Anthropogenic Electromagnetic Fields (EMF) on the Early Development of Two Commercially Important Crustaceans' Journal of Marine Science and Engineering (April 2022)

WIND WAKES UNDERMINE PRIMARY PRODUCTION, THE BUILDING BLOCK OF MARINE LIFE:



The wind wake effect that creates spikes in surface temperatures also has consequences for marine food systems.

As previously discussed in this report, the "wind wake effect' interferes with ocean hydrodynamics. **Wind wakes also effect marine "primary production.'** Primary production refers to the creation of new organic matter that serves as the base of the food web for most marine consumers.

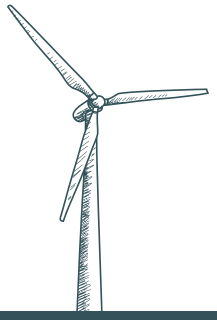
Researchers using numerical modeling found that the **wind wake effect provokes localized changes of up to 10 percent in primary production.** "Our results provide evidence that the ongoing offshore wind farm developments can have a substantial impact on the structuring of coastal marine ecosystems on basin scales,' the study warns.

Disturbingly, many North Sea offshore installations are planned for highly productive areas (i.e. these waters have particularly high primary production). For example, "most obvious' to researchers was a decrease in "net primary production' (netPP) in the center of large wind farm clusters in the inner German Bight and at Dogger Bank in the North Sea. It is not clear if developers in the Atlantic have controlled for this factor in their plans.

The authors are Christiansen, Djath, Schrum, and Naveed Akhtar with the Hereon Institute of Coastal Systems in Germany.

Source: "Offshore wind farms are projected to impact primary production and bottom water deoxygenation in the North Sea' Communications Earth & Environment vol. 3 (Nov. 2022)

WIND TURBINES GENERATE GIANT SEDIMENT PLUMES THAT THREATEN MARINE LIFE:



Wind turbines whip up sea sediment and generate highly turbid wakes that are 30-150 meters wide and several kilometers in length. Researchers Quinten Vanhellemont and Kevin Ruddick of the Royal Belgian Institute of Natural Sciences used the Landsat 8 satellite to observe suspended particulate matter (SPM) and sediment plumes in and around windfarms in the North Sea.

Windfarm generated SPM is an urgent subject of study for several reasons. First, SPM "dominates the attenuation of light' in turbid waters, according to the researchers. **Thus it has a "a major impact on primary production by phytoplankton," which are the base of marine food chains.** Turbid SPM wakes could further disrupt food chains because of effects on "visual predation.'

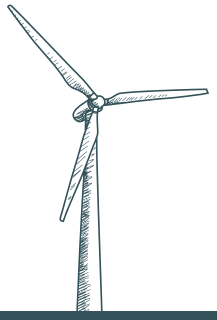
These problems are especially acute because **windfarms are generally built in shallower waters which function as "fish nurseries,'** meaning the SPM wakes could have population-scale consequences for certain species. Apart from potential consequences to ocean food webs, rapidly increasing suspended sediments underwater could "**significantly impact sediment transport and downstream sedimentation,'** according to the report.

Vanhellemont and Ruddick used Lansat 8 to study five windfarms in the Thames estuary. Satellite sensors revealed similar patterns of SPM emanating from particular turbines. Sometimes turbid wakes exceed ten kilometers, as at the Thanet farm in the North Sea in April 2013.

The researchers also expressed confidence that the **SPM wakes they observed are generated by turbines**, rather than some other cause. "A striking observation is that sediment plumes are associated with the wakes of individual turbine monopiles of offshore wind farms,' the study reads. "It is clear that the brown color of these wakes is caused by an in-water wake phenomenon (SPM) and not an atmospheric wake or air–sea interface phenomenon.'

Source: "Atlantic cod (Gadus morhua) larvae are attracted by low-frequency noise simulating that of operating offshore wind farms' Communications Biology (2023)

WIND TURBINES ARE AN ATTRACTIVE NUISANCE FOR FISH:



Wind turbines generate operational noise in a low frequency range (less than 700 Hz) with most energy concentrated between 2 and 200 Hz. This frequency range "overlaps with that used by fish for communication, mating, spawning, and spatial movement,' according to the study. Importantly, the study notes that there are "**major gaps in our knowledge** of the responses of marine animals to the sound and vibration caused by operating turbines.'

In this study, cod larvae were exposed to continuous low-frequency sound while they were drifting in transparent behavioral chambers in a Norwegian fjord. Half of the sample larvae (N=45) were exposed to continuous low frequency sound integrated with the natural soundscape of the fjord. The other half of the cod larva (N=44) were tested in the same conditions but without exposure to continuous low frequency sound.

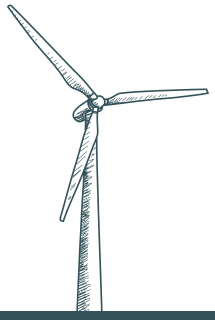
The authors found that **exposure to continuous low frequency** sound **affected the orientation of the cod larvae.** The sample larvae exposed to continuous sound swam toward the sound. The authors added that the sound appeared to override their natural orientation. However, exposure to the sound did not affect swimming performance.

These findings present conflicting possibilities. On the one hand, the authors acknowledge the attraction to low frequency sound could be evolutionarily advantageous. On the other hand, the installation of thousands of turbines on the Norwegian coast – and by implication the Atlantic coast – could have a massive attractive effect that will **fundamentally alter the distribution of cod**, with unknown consequences for the ocean ecosystem. The authors concluded more research is of crucial importance to identify possible mitigation measures.

Importantly for wild harvesters, and as the researchers elsewhere acknowledged, **if cod cluster around wind farms that huge portions of the biomass will be unavailable to fishermen**, who cannot operate safely near turbines.

Source: "Atlantic cod (Gadus morhua) larvae are attracted by low-frequency noise simulating that of operating offshore wind farms' Communications Biology (2023)

WIND TURBINES COULD DECIMATE HADDOCK STOCK:



A recent study found that subsea HVDC cables ferrying energy from offshore wind farms reduce the swimming activity of haddock larvae and warned of potentially devastating consequences to Atlantic haddock stocks.

HVDC cables are expected to become the most used type of subsea cables connecting renewable energy devices owing to cost and relatively low loss over distances, according to the study. **HVDC cables produce magnetic fields (B-fields) whose consequences for marine life are not fully understood**.

The study concluded that B-field intensity **reduced swimming activity for 60 percent of haddock larvae in their sample**. Reduced swimming activity "might alter the spatial distribution of haddock larvae, which could result in them drifting to different areas, potentially areas with less food and more predation,' according to the study. **The authors further warned of "population-scale implications for haddock in the wild."**

This study focused specifically on swimming activity. The authors broached the possibility that B-fields could also **negatively affect the drifting trajectory of haddock larvae by interfering with their magnetic orientation abilities**, but cautioned more research is needed.

Haddock account for a significant portion of U.S. commercial fish landings **and are an important component of the marine food chain**. Howard Browman, Ph.D, principal research scientist at the Institute of Marine Research -- Austevoll Research Station, designed the study, interpreted the data, and wrote the paper.

Source: "Magnetic fields produced by subsea high-voltage direct current cables reduce swimming activity of haddock larvae' PNAS Nexus vol. 1 issue 4 (Sept. 2022)

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