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# The Relationship Between Offshore Wind Farms and Marine Wildlife in Rhode Island

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# I. Introduction

With the looming threat of climate change increasing due to fossil fuel emissions, renewable forms of energy, such as wind energy, are providing environmentally sound solutions. In response to these threats, the companies Eversource and Orsted partnered up to create the Revolution Wind Project, which is set to include 100 wind turbines in an offshore wind farm located 15 nautical miles southeast of Rhode Island's Point Judith. This wind farm is estimated to be fully operational in 2025, with a capacity of 704 megawatts of clean energy, capable of powering nearly 250,000 homes. While the Revolution Wind Project is in a prime area for wind energy generation, it is also at the forefront of a global controversy regarding the impact of offshore windfarm construction and its impact on marine wildlife.

Many Rhode Island and Massachusetts citizens are concerned that the construction of the Revolution wind turbines will displace, injure, or even kill marine life such as whales, sea birds, and benthos, decreasing the biodiversity of marine ecosystems. More specifically, many claim that the installation of offshore wind farms will interfere with the migration paths of the endangered North Atlantic right whale, and the osprey, a raptor protected under the Migratory Bird Treaty Act, through physical obstruction, light pollution, and noise pollution. Additionally, benthic communities are of equal concern when it comes to wind farm construction. The term "benthic" or "benthos" refers to organisms that live on the sea floor, like barnacles, mussels, crustaceans, corals, sea stars and sea urchins. Benthic communities are thought to be crushed or smothered during the anchoring of the base of offshore wind turbines. However, current research refutes these claims on the negative impacts of offshore wind farms, stating that their construction benefits benthic communities, has little to no impact on the health of whales, and only temporarily impacts migrating bird species. New and innovative technology has found ways to decrease the negative impact of windfarms to birds, whales, and benthic organisms, as

scientists are finding ways to make the turbines safer and less disruptive to these animals and their environment.

False scientific claims from biased, unreliable news sources also continue to spread false information on the impacts of offshore wind farms in Rhode Island, creating discrepancies in data and sparking debates over the safety of the Revolution Wind Project and similar wind turbine installations worldwide. Thus, the following paper presents a comprehensive analysis of the positive and negative impacts of offshore wind farms on birds, whales, and benthos, in relation to environmental justice.

## *Wind Farms, Wildlife & Environmental Justice*

The focus of this project is to determine how offshore wind farms affect the biodiversity of marine ecosystems by accumulating local and current data on the positives and negatives of offshore wind farm construction concerning whales, birds, and benthic communities. The purpose of this project is to educate the public on The Revolution Wind Project, and how the wind farm will benefit or harm marine species so that citizens of Rhode Island and Massachusetts can make more informed decisions in their support for, or against wind farms. Moreover, this project will focus on a variety of marine species, including Right whales, ospreys, and mussels. The Revolution Wind Project and its impact on marine ecosystems is a pressing issue of environmental justice, as its controversy requires the implementation and enforcement of environmental laws, regulations, and policies, while also involving all citizens in the decision processes regardless of race, ethnicity, or income.

# II. Positive Impacts of Offshore Wind Farms

## *A. Birds*

Older studies state that wind turbines are responsible for roughly 140,000 to 679,000 bird deaths annually, but because these studies are close to ten years old the numbers are likely higher now (Audubon, 2023). However, these numbers are very insignificant when compared to other causes of bird deaths, such as flying into buildings or being caught by domestic cats, which studies estimate kill between 988 million and 4 billion birds every year (Audubon, 2023). These same studies also show that between 12 and 64 million birds are killed every year by flying into the power lines that connect wind power and other forms of power to facilities using electricity. A 2012 study showed that wind energy kills 0.269 birds per gigawatt-hour, whereas fossil fuel energy sources kill roughly 5.18 birds per gigawatt-hour of electricity usage (FWS, 2012). These fossil fuel sources also greatly contribute to climate change, air pollution, and other issues that negatively impact human and animal health, including that of birds. Wind energy provides cleaner energy than fossil fuels, and it also does not kill birds at a significantly greater rate than these other forms of energy commonly used now.

Another common concern for wind turbines with birds is that they cannot see the wind turbines, so they run into the turbines and die. However, scientists are finding ways to combat this, by doing more research to determine if the locations where the wind farms are being constructed are common bird habitats, and they either don't build them there or they will build fewer. Additionally, some construction plans have one turbine painted black, increasing visibility, and reducing bird fatality by over 70% (NWCC, 2010). Some scientists have even investigated using artificial intelligence to detect when birds are nearing a turbine and slowing the motions down so that they are not as likely to run into the turbines (NWCC, 2010). While there are many dangers posed to birds by more wind farms, there are also many efforts in place

to reduce the risk for birds, and the clean energy produced by the wind farms decreased the risk birds face of dying from air pollution and climate change.

The way in which birds are impacted by wind turbines is dependent on the species of birds. For example, one study looked at the difference between bird species when it comes to the impact of wind turbines. This 2010 study found that most of the birds killed by wind turbines are songbirds, especially during their migration season in the spring and fall (NWCC, 2010). When songbirds are migrating, they typically fly at altitudes much higher than the wind turbines are located, however weather often causes them to have to fly at lower altitudes, which is when they run into the turbines and die. These deaths account for nearly three quarters of all bird casualties at US wind facilities. Raptors are another species of birds that were investigated, and it was found that as raptor population increases in areas, raptor fatalities also increase. It appears that when species forage for prey close to the turbines, they have increased fatality rates, but there are some species, like the common raven, that are able to avoid collisions all together (NWCC, 2010).

Historically, turbines are made of lattice support towers, which provide perfect perching spots for raptors and other bird species, putting them at a higher risk for death as they are more likely to inhabit the areas surrounding these turbines. However, now turbines are being crafted as monopole tubular support towers, which are much larger than the lattice ones (NWCC, 2010). The larger turbines move at a slower rate and fewer turbines are needed per tower to produce the same amount of energy, all of which contribute to decreased fatality rates of raptors and other bird species (NWCC, 2010).

### *B. Whales*

Before any construction of offshore wind farms can even begin, surveys of the area and the sea floor need to be conducted for about ten years (The Oceanography Society). During this time period agencies, such as NOAA and the Bureau of Ocean Energy Management (BOEM), ensure the safety and protection of all marine animals in the survey area (National Resources Defense Council). Before any of the construction begins, developers need to map out the seabed that they want to build on using a High Resolution Geophysical (HRG) survey (National Resources Defense Council). Compared to conducting the surveys using seismic air guns, HRG surveys are much lower in energy and use a suite of active sound sources to produce sounds that are reflected off subsea structures in order to obtain images of the seafloor (BOEM). The noise that is created from seismic air guns can cause stress on the animals, leading to negative health effects, since it causes them to swim away from their preferred feeding and breading areas (National Resources Defense Council). Since HRG surveys would be at a much lower level and have a shorter duration than the seismic air guns, there has been less severe impacts found on marine mammals (NOAA Fisheries).

Offshore windfarms are becoming the most modern way of producing clean, renewable energy, rather than using nonrenewable resources such as coal, natural gas, and oil, which all add extremely high amounts of carbon dioxide into the atmosphere every day. Climate change has been extremely prominent in recent years, and offshore wind farms can be a solution. Rising water temperature, due to severe climate change, has been a proven factor for the increase in humpback whale deaths, by NOAA. Humpback whales eat small fish called menhaden, which are now being found closer to shore than in the past, due to increasing water temperatures (NBC Chicago). Due to this, the humpback whales are swimming closer to shore than they should, in order to follow the food that they are hunting for (NBC Chicago). As humpback whales swim

closer to shore, they can come in contact with passing ships, and they have a higher chance of becoming entangled in fishing gear that is either being used on the ships or has not been discarded properly by humans (The New York Times). Also, they can come into more direct contact with humans participating in recreational activities such as whale watching boats, personal fishing boats, surfers, and jet skis, which can all cause strikes (NOAA Fisheries, Humpback Whales). Offshore wind farms would help combat the problem of climate change since it produces clean energy, which would hopefully not draw humpback whales as close to shore to follow their prey.

### *C. Benthic Communities*

When it comes to the impact of offshore wind farms on benthos in New England waters, it has been determined that the anchors of wind turbines often benefit benthos. While offshore wind components cover portions of the seafloor, they also introduce new types of habitats that can benefit some benthic organisms that favor hard bottom areas. Wind turbine foundations, anchors, and scour protection all create new hard substrate and potential habitat. Benthic communities have been found to rapidly establish on hard substrate, such as turbine foundations and rocky scour protection, after installation (Hutchinson et al., 2020). The new substrate also introduces shelter and nursery grounds that increase habitat complexity and attract some species that are considered prey for some foraging animals (Horwath et al., 2021).

This determination was made based on data accumulated after the Block Island Wind Farm (BIWF) was completed off the coast of Rhode Island in 2016 (SEER U.S., 2022). Construction of the Block Island Sound Wind Farm resulted in a biomass hotspot for benthic species, and the benthic predators such as snails, sea stars, and crabs present on and under the anchoring structures of the turbines benefitted from the new prey communities (Hutchinson et

al., 2020). Moreover, based on the presence of many juvenile crabs, the BIWF potentially serves as a nursery ground, where juvenile species are protected by the artificial structures (Hutchinson et al., 2020). Additionally, the abundant mussel population around the BIWF structure increased filtration rates of local phytoplankton (SEER U.S., 2022).

More specifically, vertical foundation structures that support colonizing communities can impart changes to the surrounding seabed and benthic community. For example, blue mussels, which attached to the turbine foundations at Block Island Wind Farm in Rhode Island, fall off as well as disperse their larvae onto the surrounding seabed, leaving dense mussel aggregations extending beyond the foundation footprint, and increasing (Horwath et al., 2021).

Clearly, the installation of the Block Island Sound Wind Farm caused the benthic biodiversity and species abundance of marine life to increase significantly, a phenomenon that is applicable to the similar sea floor ecosystem surrounding the Revolution Wind Project. For example, over time, there was also a notable increase in black sea bass (*Centropristis striata*) around the structures, estimated to exceed 100 individuals per turbine after three years (Horwath et al., 2021). Scientific divers at the site also reported the frequent presence of Atlantic striped bass (*Morone saxatilis*) schooling at the base of the turbines, bluefish (*Pomatomus saltatrix*) observed in midwater around the turbines, scup (*Stenotomus chrysops*) at the base of the structures, and occasional schools of dogfish (*Squalus acanthias*) (Horwath et al., 2021). In addition, rock gunnels (*Pholis gunnellus*) made use of the mussel habitat, and a monkfish (*Lophius americanus*) was resident at one of the turbines (Horwath et al., 2021). Thus, the artificial reef effect of wind turbine anchors, including the Revolution wind turbine anchors, is now relatively well characterized as benefiting fish and shellfish by providing refuge and creating forage, and as attracting abundant and diverse communities.

# III. Negative Impacts of Offshore Wind Farms

## *A. Birds*

Offshore wind farms have proven to have some negative impacts on avian communities. No matter where they are placed, birds can collide with the turbine itself, power lines connecting to it, or its large blades which cause death in most cases. According to the Audubon Society, collisions with offshore wind farms cause approximately 140,000 to 679,000 bird deaths yearly. The construction of these offshore wind farm facilities can degrade the habitat that is necessary for many birds. Many seabirds forage for their food source of fish in areas where offshore wind farms have been or will be constructed. Because the construction and operation of offshore wind farms can displace fish populations, it becomes detrimental for seabird populations that rely on a constant supply of fish for their survival.

According to NOAA, over time seabird populations have been heavily disturbed by a variety of man-made sources including habitat destruction and human disturbance. Research from around the world has proven that many species of seabirds are subject to displacement due to the placement of offshore wind farms. A 2016 study from the North Sea demonstrates that five different species of seabirds had been displaced by offshore wind farms with a 75 to 92 percent lower abundance of species inside the area of the wind farm (Welcker and Nehls 2016). Also, according to the Audubon Society, some seabird species like gulls and terns can deviate more than a mile from their natural flight path to avoid large structures like offshore wind turbines.

Habitat loss is also another major issue when it comes to the negative impacts of offshore wind farms. As offshore wind farms are constructed, they take away vital resources for many seabird populations. When a wind turbine is established, it may cause these populations of

seabirds to start a search for a new area of habitat that has been untouched or undisturbed by human activity. These changes in habitat from wind turbine operation can disrupt breeding patterns and nesting behaviors (Exo et al. 2003) which in turn will cause fewer chicks to survive until adulthood. This can have serious impacts on the overall populations of seabird populations as well.

### *B. Whales*

A lot of misinformation is being spread and assumed about the impacts offshore wind farms have on the whale species, which is changing people's opinions and making the topic very controversial. While it is assumed that the increase in whale deaths along the East Coast of the United States is due to the construction and operation of offshore windfarms, it is actually not the case (NOAA Fisheries). NOAA and BOEM have conducted many tests and biopsies on deceased whales and have found absolutely no direct correlation between increase offshore wind farm activities and the death of the whales (NOAA Fisheries, Humpback Whales).

Another area of concern that arises is the frequency of vibrations that come from the wind turbines do affect the whale's vocalization. The Right whale has a vocalization that is roughly within the range of 50Hz to 2kHz (Stamiezkin). The range of the frequency coming from the wind turbines that can range from 20 to 1000 Hz (Stamiezkin). This number also includes not only the continuous rotations but also talked about the piledriving, drilling and the dredging that's involved with the installation of the turbine. The vibrations from the operating rotating blades is called Aerodynamic vibrations, which is when the sound from the rotating blades goes from the structure into the water where the whales are. As the turbine mechanics wear as they age, this increases the sound in the water. While the pool of studies on these whales is small, one study showed that the Atlantic Right whale reacts to sounds around 500 Hz to 4500 Hz. So, it

would be predicted that the whales could hear the noise made from the operation could be heard from far away even in a naturally loud habitat.

### *C. Benthic Communities*

Similarly to whales, the effect of offshore wind farm installation on benthic communities is minimal to none. In general, the installation of wind turbine anchors only causes temporary disturbance to the sea floor. Installation of wind turbine components can suspend sediment into the surrounding water column during construction, increasing turbidity and smothering or burying benthic organisms, clogging filtration systems for filtering animals, and decreasing visibility (SEER U.S., 2022). Noise from construction may also cause temporary disturbances. Building offshore windfarms will invariably take up space on the ocean floor that may otherwise be used as habitat by benthic organisms. Consequently, offshore wind components remove a small amount of existing habitat on the seafloor, which results in a loss of the hard bottom habitat (Hutchinson et al., 2020). Mobile organisms can potentially move to new locations to avoid effects, but stationary organisms may be crushed or smothered directly at the installation site depending on activities (SEER U.S., 2022). In addition, the seabed immediately surrounding the foundation may be subject to erosion (or scour) in soft bottom locations depending on the strength of the ocean current and the type of sediment (Hutchinson et al., 2020).

Pollution and the introduction of non-native species during the wind farm construction process are other variables that can harm ecosystem functioning and lead to a trophic cascade of benthic communities. Invasive species are defined as those that are not native to a specific area and that tend to spread, resulting in damage to the environment, economy, or human health (Molnar et al., 2008). From a New England perspective, offshore wind foundations in a large expanse of soft-bottom substrate can provide steppingstones for invasive species to expand

further (Molnar et al., 2008). Invasive species can spread between foundations and nearby hard-bottom areas that might otherwise be too far to reach, like groups of islands or previously uncolonized sections of coastline (Molnar et al, 2008). However, there is no scientific data or evidence supporting the claim that wind turbine installation spreads marine invasive species, and this idea is solely speculative in relation to Rhode Island waters.

Overall, loss of habitat from an offshore wind farm only occurs in small areas within the wind farm boundary, typically causing a direct habitat loss of less than 1% of the windfarm area, which is insignificant (Hutchinson et al., 2020). Also, post-construction monitoring campaigns of early soft bottom offshore wind farms in Europe found that within a few years of disturbance there were no significant differences in seabed topography near offshore turbines when compared to control sites outside the wind farm, suggesting that the 1% of habitat loss quickly rebounds (Hutchinson et al., 2020). Similarly, after construction of the Block Island Wind Farm, bathymetric surveys found that much of the soft bottom areas that were disturbed from construction and trenching activities had physically recovered within three years (Hutchinson et al., 2020). These observations show that physical disturbances during installation are typically followed by natural recovery of the benthic habitat as sediment moves back into disturbed areas, and organisms such as crabs, mussels, sea stars, and juvenile fish quickly and safely recolonize the area. The negative impact of offshore wind farm installation on benthic communities is minimal, and the construction of the Revolution Wind Project in Rhode Island will likely benefit the benthic biodiversity of the surrounding New England coast.

## IV. Conclusion

Wind Farms have sparked a very intense debate especially in Newport where there have been increasingly polarized views. Wind farms are an important and necessary step to move toward a greener future. A future where we can focus on mainly depending on renewable energy instead of energy sources that only have been seen to impact us negatively and have a short life span. While wind energy is among some of the cleanest air energy, the effect that it has on the avian and marine wildlife is still present. After addressing the data, however, it was shown that the negatives that were found are a lot less impactful than the positives. With increasing access to advanced technology and development of technology through what is already built, it's safe to say that wind turbines will become less and less harmful to the environmental landscape. When balancing the benefits with the negatives of renewable energy such as wind turbines we hopefully can look towards a more sustainable future.

# References

"Do Wind Turbines Kill Birds?" *MIT Climate Portal*, 12 Dec. 2023, climate.mit.edu/ask-mit/do-wind-turbines-kill-birds#:~:text=%E2%80%9CFossil%20fuels%20contribute%20to%20climate,such%20environmental%20and%20health%20impacts.%E2%80%9D.

Exo, K. M., Huppop, O., & Garthe, S. (2003). Birds and offshore wind farms: a hot topic in marine ecology. *Bulletin-Wader Study Group*, *100*, 50-53.

Fisheries, NOAA. "Frequent Questions-Offshore Wind and Whales." *NOAA*, 17 Aug. 2023, www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/frequent-questions-offshore-wind-and-whales#:~:text=mortality%20of%20whales.-,There%20are%20no%20known%20links%20between%20recent%20large%20whale%20mortalities,produce%20may%20disturb%20marine%20mammals.

Fisheries, NOAA. "2016–2023 Humpback Whale Unusual Mortality Event along the Atlantic Coast." *NOAA*, 4 Dec. 2023, www.fisheries.noaa.gov/national/marine-life-distress/2016-2023-humpback-whale-unusual-mortality-event-along-atlantic-coast.

Haney, J. C. (2024, January 25). *What offshore wind energy can teach us about seabirds*. Audubon. https://www.audubon.org/news/what-offshore-wind-energy-can-teach-us-about-seabirds#:~:text=Research%20from%20around%20the%20world,way%20to%20avoid%20the%20structures.

Horwath, S., Hassrick, J., Grismala, R., Miller, E., Krebs, J., & Manhard, R. (2021). Comparison of Environmental Effects from Different Offshore Wind Turbine Foundations. Retrieved from https://www.boem.gov/sites/default/files/documents/environment/Comparison-Environmental-Effects-Different-OWT-Foundations-2021.pdf

"Humpback Whale Deaths Are Rising. See What Marine Experts Say Is to Blame." *NBC Chicago*, NBC Chicago, 23 Feb. 2023, www.nbcchicago.com/news/national-international/climate-change-could-be-culprit-in-deaths-of-humpback-whales/3079922/#:~:text=Humpback%20whales%20are%20dying%20in,National%20Oceanic%20and%20Atmospheric%20Administration.

Hutchinson, Z. L., Bartley, M. L., Degraer, S., English, P., Khan, A., Livermore, J., … King, J. W. (2020). Offshore Wind Energy and Benthic Habitat Changes: Lessons from Block Island Wind Farm. Retrieved from https://doi.org/10.5670/oceanog.2020.406

"Introduction." *Acoustic Impacts of Offshore Wind Energy on Fishery Resources: An Evolving Source and Varied Effects Across a Wind Farm's Lifetime | Oceanography*,

tos.org/oceanography/article/acoustic-impacts-of-offshore-wind-energy-on-fishery-resources-an-evolving-source-and-varied-effects-across-a-wind-farms-lifetime.

Kershaw, Dr. Francine. "Protecting Our Marine Wildlife during Offshore Wind Surveys." *Be a Force for the Future*, 4 Mar. 2022, www.nrdc.org/bio/francine-kershaw/protecting-our-marine-wildlife-during-offshore-wind-surveys.

Molnar, J. L., Gamboa, R. L., Revenga, C., & Spalding, M. D. (2008). Assessing the Global Threat of Invasive Species to Marine Biodiversity. *Frontiers in Ecology and the Environment*, *6*(9), 485–492. http://www.jstor.org/stable/20440991

"Offshore Renewable Activities." *Offshore Renewable Activities | Bureau of Ocean Energy Management*, www.boem.gov/renewable-energy/offshore-renewable-activities.

SEER U.S. Offshore Wind Synthesis of Environmental Effects Research. (2022). Benthic disturbance from offshore wind foundations, ... Retrieved from https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Benthic-Disturbance.pdf

Slivka, Kelly. "Close to Shore, Humpbacks Are Far from Safe." *The New York Times*, The New York Times, 20 Aug. 2012, www.nytimes.com/2012/08/21/science/earth/close-to-cape-cod-shore-humpback-whales-are-far-from-safe.html.

Society, N. A. (2023, September 25). *Wind Power and birds*. Audubon. https://www.audubon.org/news/wind-power-and-birds#:~:text=Placing%20wind%20projects%20where%20birds,outdoor%20cats%20and%20building%20collisions.

US Department of Commerce, N. O. and A. A. (2010, November 17). *What threats do seabirds face?*. NOAA's National Ocean Service. https://oceanservice.noaa.gov/facts/seabird-threats.html#:~:text=Seabirds%20are%20impacted%20by%20a,%2C%20disturbances%2C%20and%20habitat%20destruction.

Welcker, J., & Nehls, G. (2016). Displacement of seabirds by an offshore wind farm in the North Sea. *Marine Ecology Progress Series*, *554*, 173-182.

*Wind energy: U.S. Fish & Wildlife Service*. FWS.gov. https://www.fws.gov/node/266177#:~:text=Turbine%20strings%20or%20arrays%20may,facilities%20on%20birds%20and%20bats.

"Wind Turbine Interactions with Birds, Bats, And ..." *National Wind Coordinating Collaborator*, 2010, www1.eere.energy.gov/wind/pdfs/birds_and_bats_fact_sheet.pdf.

Zuckoff, E. (2024, April 1). *The complicated truths about offshore wind and right whales*. GBH. https://www.wgbh.org/news/local/2024-04-01/the-complicated-truths-about-offshore-wind-and-right-whales