Mutual Benefits for Offshore Wind Energy in the Mid-Atlantic: Science and Policy Strategies to Mitigate Harm to Marine Species and Maximize Benefits for Renewable Energy

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Abstract

Wind energy is a renewable energy source and a viable alternative to dependence on fossil fuels, but it must be harnessed properly and efficiently. Some of the current challenges that wind energy faces include legal obstacles, aesthetic concerns, and uncertainty regarding the impacts of wind turbine installation on marine species. New Jersey is planning to make significant advancements in wind energy, including the Ocean Wind farm off the coast of Atlantic City extending across the New Jersey shore. This farm will be one of the first in the world to be powered by the most powerful turbines.

This paper addresses the nature and scope of risks to the Mid-Atlantic marine environment and examines science-based policy options to propose possible solutions to mitigate harm to marine species and promote marine biodiversity. It offers pathways to secure a goal of promoting offshore wind development in a way that enhances protection of the marine environment through improved management of data and protected areas. The paper includes results from interviews of experts involved in the Mid-Atlantic offshore wind regulatory landscape including representatives from state and regional regulatory bodies, the offshore wind industry, environmental groups, and marine scientists.

Experts Interviewed for this Project

Julia Beaty

Fishery Management Specialist, Mid-Atlantic Fishery Management Council

Doug Copeland

Development Manager, Atlantic Shores Offshore Wind

Tim Dillingham

Executive Director, American Littoral Society

Jim Ferris

Bureau Chief of New Technology, Clean Energy Division, New Jersey Board of Public Utilities (NJ BPU)

Suzanne Hornick

Founder, Ocean City, New Jersey Flooding Committee

Kris Ohleth

Executive Director, Special Initiative on Offshore Wind

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Introduction

"Nearly 15 billion metric tons of fossil fuels are consumed every year" with China, the United States, and India using more than the rest of the world combined (Cassidy, 2019). Furthermore, while China's 1.38 billion population consumes 4.7 billion metric tons of fossil fuels per year, the United States consumes twice that amount per person (Cassidy, 2019). The harm caused to the environment and the consequential propagation of climate change due to the increasing emissions of carbon dioxide (CO_2) is widely known, yet political inaction to address climate in the U.S. has persisted for three decades. Only recently has the U.S. government started to turn this tide of inaction by fully considering and beginning to implement alternative sources of energy, such as offshore wind energy. The Biden administration's plan for offshore wind was announced in Executive Order No. 14008 on January 27, 2021, shortly after President Biden took office. (President, 2021).

Offshore wind energy involves placing wind turbines in deep water regions of an ocean. Energy is created through the coastal winds that move the turbines. This energy is harnessed by the turbines and transported along underwater sea cables to a power grid on coastal land, yielding clean electricity for homes and businesses. The deployment of offshore wind (OW) in the U.S. is no longer a question of whether, when, or where it will happen – it is already happening. Currently, one OW farm exists in the waters of Block Island in Rhode Island, which provides clean electricity to a few thousand residents. However, the OW energy market is expected to grow annually by 18.6% until 2024 and by 8.2% by the end of the decade in the U.S. (Christopher, Davis, Flemma, & Johnson, 2020)

The Biden administration has established a national goal of 30 gigawatts (GW) of production by 2030 while protecting biodiversity and promoting ocean co-use (White House Briefing Room, 2021). In pursuit of this goal, seven East Coast states have already signed contracts committing to generate over 30 GW of offshore wind by 2030. One component of these plans is the $2.8 billion Vineyard Wind project (Bowling, et al., 2021), which will be an 800-megawatt farm that is projected to deliver clean energy to up to 400,000 Massachusetts homes in 2023 (Christopher, Davis, Flemma, & Johnson, 2020).

The Biden administration identified three steps in its Offshore Wind Strategic Plan (OWSP): 1) enforce wind energy projects to create better paying union jobs, 2) invest in American infrastructure to allow for OW energy and encourage domestic supply, and 3) support research, development, and data sharing. These steps not only reflect the advancements that OW is expected to secure, but also the amount of federal support the industry is receiving. This industry could support the American public with about 40,000 jobs by 2030 and $12 billion in capital investments, and power up to 10 million American homes per year while preventing CO_2

emissions of 78 million metric tons (Bowling, et al., 2021). From 2025 to 2035, the OW industry has the potential to create 60% more jobs than the coal mining industry (Christopher, Davis, Flemma, & Johnson, 2020).

The Mid-Atlantic OW industry faces various challenges in its effort to implement offshore wind projects. These challenges include the complexities of finalizing lease and location details based on input from regulators, concerns from the commercial fishing industry, and the sustainability of marine species. This paper describes these implementation challenges, offers recommendations to mitigate harm to marine species, and suggests ways to improve the process of addressing stakeholder concerns while promoting the implementation of OW in the Mid-Atlantic region.

Part I of this paper examines the existing legal framework governing offshore wind projects. It reviews the federal and state roles in the process and addresses various laws relevant to OW development along with the lack of regulation in some areas. Part II explores the implementation challenges that OW projects face in the Mid-Atlantic. It addresses threats to various marine species, notably the endangered North Atlantic Right Whale, and marine habitats. It also considers impacts to biodiversity, including the relation of biodiversity to climate change and how offshore wind structures could be beneficial and detrimental. The perspectives of the commercial and recreational fishing communities and the tourism industry are also considered. Finally, Part III proposes changes that need to be addressed to allow for a mutually beneficial outcome for the offshore wind industry and the aforementioned conflicting interests.

I. Existing Legal Framework

This part addresses the federal foundation and process for approving OW lease areas enforced by the Bureau of Ocean Energy Management. The state processes within New Jersey

intertwined with the federal process regulated by the New Jersey Board of Public Utilities and the New Jersey Department of Environmental Protection are also described in relation to offshore wind. Part I also reviews the laws in place that apply to OW development including the Environmental Species Act and the Magnuson Stevens Fisheries Management Act. Funding sources to support offshore wind development are also discussed.

A. *The Process of Siting Wind Turbines*

The legal framework governing U.S. ocean waters begins at the coast, also referred to as the "baseline." It extends 200 nautical miles from the baseline into the sea, the first 12 miles of which are the U.S.'s territorial sea (Vann, 2021). Offshore wind projects require not only federal involvement for being sited 15 nautical miles offshore, but also state involvement since the first 3 nautical miles from the coast are state waters. Therefore, any proposed wind energy project, including the underwater cables, is subject to a complex maze of federal and state regulations.

The Bureau of Ocean Energy Management (BOEM) is the federal permitting agency for areas within federal waters. BOEM approves siting for offshore wind energy leasing in a manner that is "safe and environmentally sound, prevents waste, and provides a fair return for public resources" (BOEM, 2021). The first step that BOEM takes is to find areas for offshore wind leasing. In order to decide an area, the considerations taken are the necessary wind strength, the distance to the location that needs energy, and how the areas are used for shipping, fishing, or military. BOEM then consults with stakeholders, different branches of government, and tribes. Environmental concerns are then considered within the chosen areas to configure which areas are most suitable for OW.

After an area is selected, BOEM holds auctions for interested companies and the leases are awarded. The companies then conduct surveys on their areas, create a detailed site

assessment for BOEM to review, and finally a construction plan for their proposed OW facility. BOEM reviews these plans and analyzes the environmental risks before it approves or denies the application for construction to begin. Communication with various groups is the major component within this process, along with extensive research prior to any approvals (BOEM, 2021).

At the state level, the New Jersey Board of Public Utilities (BPU) is the lead agency in approving offshore wind facilities. BPU's purpose lies in developing and regulating "a competitive, economically effective energy policy that promotes responsible growth and clean renewable energy sources while maintaining a high quality of life in New Jersey," as stated in its mission statement (State of New Jersey Board of Public Utilities, 2021). The company also serves as the coordinator between the OW NJ state regulations and federal regulations mandated by BOEM. The New Jersey Department of Environmental Protection (NJDEP) has jurisdiction over areas within 3 miles from the baseline and on land. NJDEP's first priority is to "reduce and respond to climate change," thus playing an active role in evaluating OW energy and its environmental impacts in the state (New Jersey Department of Environmental Protection, 2021).

In terms of funding, one applicable law for offshore wind projects is the Loan Programs Office's Title XVII Innovative Energy Loan Guarantee Program of the Energy Policy Act. This law requires the U.S. Department of Energy to issue loan guarantees to finance "the first deployments of a new technology to bridge the gap for commercial lenders" (Loan Programs Office, 2021). This support enables OW projects to launch until they are financially capable to manage themselves, at which point the loans will terminate. Since March 29, 2021, LPO has supplied $1.6 billion for projects totaling to about 1,000 MW of onshore wind (White House Briefing Room, 2021).

Federal and state administrations can collaborate on funding. For instance, the Department of Energy and the New York State Energy Research and Development Authority created the National Offshore Wind Research and Development Consortium. This foundation awards $8 million to 15 offshore wind research and development projects. An example of funding specific to the state level, the New Jersey Wind Turbine Tech Training Challenge is a grant program that awards $1 million to a New Jersey community college that creates an offshore wind turbine technician training program with an industry-recognized certificate program and pathway to an Associate's Degree or higher (New Jersey Economic Development Authority, 2021). Federal funding also exists such as the Port Infrastructure Development Grants by the U.S. Department of Transportation's (DOT) Maritime Administration, providing $230 million for port infrastructure projects (White House Briefing Room, 2021). Such funding helps offset the high costs of offshore wind development.

B. *Applicable Environmental Laws*

The offshore wind energy process intersects with and triggers several environmental laws. The Endangered Species Act (ESA) and the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) are the most relevant to offshore wind.[1]

Administered by the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), the ESA was enacted "to protect and recover imperiled species and the ecosystems upon which they depend" (U.S. Fish & Wildlife Service, 2020). The FWS is responsible for "terrestrial and freshwater organisms," and the NMFS in responsible for marine species such as whales and salmon (U.S. Fish & Wildlife Service, 2020). Species are listed as endangered or threatened based on the damage to the species' habitat, the usage of the species,

[1] The National Environmental Policy Act and the Federal Aviation Administration's authority are also triggered in this process, but a discussion of these laws is beyond the scope of this paper.

disease and predator exposure, lack of protection, and any natural or manmade influences affecting the species' existence (U.S. Fish & Wildlife Service, 2017). Critical habitats essential to the existence of a species are then designated for protection. OW projects need to comply with the ESA to ensure that the construction of wind turbines will not disturb or endanger any marine species since it is illegal for any listed animals to be harmed (notwithstanding the exception of permits).

As for the Magnuson-Stevens Fisheries Conservation and Management Act (MSA), this law protects "the long-term biological and economic sustainability of marine fisheries" by governing marine fisheries in U.S. federal waters (NOAA, 2021). The MSA consists of ten mandated guidelines to ensure responsible fisheries management. The most notable guidelines include: overfishing must be prevented while achieving the optimum yield from each industry (enforced by the Sustainable Fisheries Act (NOAA, 2021)), conservation must be based on the best available scientific data, conservation measures cannot discriminate between different states with variations between fisheries taken into account, the significance of fishery resources to communities and minimizing adverse economic impacts to these communities must be taken into account, and the measures taken should allow for the safety of humans at sea (NOAA, 2021).

In terms of OW, the MSA protects fishing industries in that the implementation of an OW project cannot threaten the fishing community. Additionally, the MSA seeks to ensure that fisheries will sustainably adapt to changes that the implementation of OW introduces in the marine environment. This law also encourages further communication between the OW industry and fishing industry in the development of OW projects.

States can have their own governance framework in addition to the federal acts. In New Jersey, the Offshore Wind Economic Development Act (OWEDA) was enacted to advise the

BPU "to establish a program for Offshore Wind Renewable Energy Certificates (ORECs) to incentivize the development of offshore wind facilities" (Department of Environmental Protection, 2021). ORECs are based on "the positive environmental attributes associated with one megawatt-hour (MWh) of electricity generated from offshore wind resources and consumed by retail customers" within the state (NYSERDA, 2021). The way that these renewable energy certificates function in New Jersey begins with ratepayers (customers) paying the distribution utility OREC administrator the OREC costs. These costs are then sold to the Offshore Wind Generator (OWG). The electricity from the OWG is then sold into a wholesale market that receives the revenues, and the certificates are transferred to an electricity supplier. The revenues are then distributed back to the customers (Beiter, Heeter, Spitsen, & Riley, 2020). With OWEDA, a 25 MW capacity OW project in territorial waters is allowed to be considered a qualified OW facility to receive ORECs, as long as it meets application requirements and shows economic and environmental state benefits (State of New Jersey Board of Public Utilities, 2018). OWEDA operates consistent with Executive Order No. 92 signed by Governor Phil Murphy to direct the future of OW energy in New Jersey in law, but also to identify a set of goals for the industry (NJ Gov, 2019).

II. Obstacles to Implementation of Offshore Wind Projects in the Mid-Atlantic

In addition to navigating a complex federal and state governance framework, offshore wind projects must consider a wide range of concerns from various stakeholders in the Mid-Atlantic marine environment. This part examines concerns raised within the fishing community, threats posed to marine species with particular attention to the endangered North Atlantic right whale, and finally how OW projects will be significant to marine biodiversity. BOEM addressed various aspects of these concerns in its *Vineyard Wind 1 Offshore Wind Energy Project*

Supplement to the Draft Environmental Impact Statement report (VYR), which is mentioned throughout this part. Although these concerns are specific to the Vineyard project, they are applicable to all Mid-Atlantic OW projects.

A. *Impacts to Human Communities*

Impacts from OW projects on human communities fit into three categories: (1) fishing, (2) tourism, and (3) Native American cultural impacts. The fishing and tourism industries in the Mid-Atlantic, and the rights of Native American communities, pose significant challenges to the implementation of OW projects in the region.

1. Fishing

One concern from the fishing community associated with OW facilities is the construction process. Anchoring the OW turbines can cause vessels to be prohibited from designated areas for hours to days. Although it is temporary, the catches and profits for those days will be affected. The cable placement would also have a similar impact leading to the prohibition or disturbance of fishing activities from "one day to several months" and from "several meters to 500 meters during active procedures" in distance (BOEM, 2020). Due to cable placements, the area of seafloor that may be disturbed is up to 8,153 acres, which can then impact fishing activities. This concern is said to be minor due to its temporary impacts (BOEM, 2020). BOEM has also noted that most of the construction will take place in the summer due to more favorable weather conditions. This would cause summer-dependent fisheries to be more impacted than those based in the winter. With the implementation of wind turbines in the ocean, commercial fisheries face "major adverse impacts" and for-hire recreational fishers face "moderate adverse impacts," as stated by BOEM in its VYR (BOEM, 2020).

Another concern lies in the associated noise with the construction, with pile driving as the most significant contributor, impacting the activities of nearby fish and invertebrates. During the construction of the offshore structure foundations, the noise could last hours at a time over a 6-to-10-year period. The transmission of the noise can cause behavioral changes to the nearby marine species, and can be expected to "extend radially less than 5.7 miles" for the Vineyard project (BOEM, 2020). These changes and possible mortalities of marine species can cause fishers to have reduced catches in their usual area due to the fish moving away from the sound.

BOEM determined, however, that the stock-level impact would be low within the Vineyard project: "The risk of reduced stock recruitment from pile-driving noise is considered low because the behavioral impacts on commercial fish species would only be present for the intermittent duration of the noise" (BOEM, 2020). Although it may cause fishers to temporarily relocate their equipment and vessels due to the changes in fish activity, it is expected that the fish would return to their original behaviors after construction. A relevant factor is that temporary displacement can lead to increased competition within the industry and gear conflicts due to the spatial restrictions. This competition between fisheries would be fueled by less mobile marine species such as lobster, crab, surf clam, and sea scallop since they would be less likely to spread too much. Competition of fishers within limited areas along with the factor of species dislocation could cause overfishing. Nevertheless, with these factors taken into consideration, BOEM anticipates the noise concern to be "negligible to minor" for the Vineyard project (BOEM, 2020).

Fishers express great concern over their gear not being able to safely operate with the spatial restrictions associated with the wind turbine structures. These impacts to commercial and recreational fishing include "entanglement or gear loss/damage, fish aggregation, habitat conversion, navigation hazards (including transmission cable infrastructure), and space use

conflicts" (BOEM, 2020). BOEM indicated within the VYR that mobile bottom-tending gear, such as the dredge, can get hung on the cable protection devices (e.g., rock, concrete mattresses, and half-shell) damaging the fishing gear, therefore being more likely to be displaced than fixed gear (BOEM, 2020). Inefficient equipment due to the new structures causes fishers' concerns about the impact on their catches and if there would be any consequential financial deficits. These impacts are stated to range from "negligible to moderate," however, based on the location of the individual fisheries and the equipment that is used by fisheries in the VYR (BOEM, 2020).

Another concern regarding potential impacts to fisheries is with the Cold Pool along the Mid-Atlantic Bight (MAB). The Cold Pool starts forming in the beginning of the spring due to "less mixing within the water column, a greater input of less dense freshwater into marine environments, and more intense sunlight at the sea surface" causing a "stratified water column" (Ganim, 2019). Therefore, warmer and less dense water stays on the shallower layers, while cooler, dense water stays in the deeper layers. This Cold Pool supports phytoplankton growth and behaviors of fish species. For instance, "longer lasting and cooler Cold Pools have been associated with higher recruitment success of yellowtail flounder" (NOAA, 2021).

Suzanne Hornick, founder of the Ocean City, NJ Flooding Committee and community member advocate who opposes the offshore wind project in the East coast, said, "We have an incredibly unique Cold Pool on the East Coast, which is what sustains our recreational fishing and commercial fishing. The stratification of our ocean on the East Coast contains many varieties of fish." If the stratum is affected and the behavioral actions of certain target marine species of fishermen is impacted, this may cause relocation of fishes and consequently fisheries. The wind turbines can cause greater mixing of the surface waters leading to a warmer bottom layer within the ocean, which could "increase stress on some shellfish and fish that are at the southern/inshore

extent…" (BOEM, 2020). Yet, it is uncertain how the installation of the turbines will impact the Cold Pool, and whether any of these adverse impacts would impact the fishing industry.

In terms of the commercial fishing economy, economic impact would involve considerations such as whether fishing can be continued within the wind lease area, the desired fishing species within the area, and the efficiency with which the vessel can change its fishing location. This would be difficult to measure since it would have to be conducted for each individual fishery. Instead, in order to include a projection of all commercial fisheries, BOEM used revenue exposures as its method of analysis. Revenue exposure is defined as "the dockside value of fish reported as being caught in individual wind lease areas" (BOEM, 2020).

Within the VYR, BOEM conducted revenue exposure projections based on the lease area and the expected year that projects are to be constructed. The results show revenue exposure to increase with more OW projects, meaning the dockside value of fish caught within the lease areas would increase (BOEM, 2020). The Atlantic surf clam and ocean quahog fisheries, which are prominent in lease areas of offshore New Jersey and south of Cox Ledge respectively, was shown to have the largest combined percent exposure and dollar value (BOEM, 2020). Through the projections made for the Vineyard project, the OW development seems to have the chance to increase the value of fishes within the lease areas allowing for a possible greater revenue. Thus, BOEM considers these impacts to be negligible due to the lack of significant negative impact.

The most significant impact on fisheries will be adaptation. With the installation of these OW projects, commercial and for-hire recreational fishermen will have to determine how to make it work for them. This impending need to adapt is the underlying cause driving the fishing community's concerns.

2. Tourism

Wind turbines have blades on average that are 50 meters long and are slightly larger than a football field, located more than 15 miles from shore (European Wind Energy Association, 2016). Although these turbines are located far into the ocean, they would still be visible from the coast due to their large size. This visual impact is the focus of OW facilities' potential impacts to tourism.

"Visual impacts are far and away number one," said Kris Ohleth, the Executive Director at Special Initiative on Offshore Wind. The turbine structure itself presents the most significant tourism concern. A study in New Hampshire was conducted where coastal recreation visitors along the seacoast in 18 different locations were asked about their overall perceptions of offshore wind energy development (OWD), and "77% of coastal visitors were supportive, 73% were accepting and 58% agreed that OWD would fit the N.H. seascape" (Ray, 2021). Additionally, the study found that the view of the offshore wind farm from their coast did not matter to the visitors because "'these are people with strong ties to the N.H. Seacoast,'" as described by Michael Ferguson, Assistant Professor of Recreation Management and Policy at the University of New Hampshire.

Similarly, Tim Dillingham, Executive Director of the American Littoral Society, said, "I've been looking at these [wind turbines] for the last 4 [to] 5 years and it's not a completely overwhelming impact on the view of the ocean. Even though I would like to see an empty ocean, it won't stop me from coming back," in response to his experience with the Rhode Island wind farm. According to BOEM in regard to the VYR, the wind turbines would be "unlikely to impact shore-based recreation and tourism in the geographic analysis area as a whole" (BOEM, 2020).

Thus, the overall impact on tourism was labelled as minor since the changed behavior of a few is unlikely to affect the entirety of the tourism industry.

Community members, such as Ms. Hornick, disagree with this conclusion. “In Ocean City, [New Jersey,] we have nothing but tourism. We have no industry; we manufacture nothing; we don't have casinos; we don't have nightlife; we have nothing. Our boardwalk is everything. So, to have our entire coastline disrupted by these giant things [turbines]… tourists won't come, property values drop, and our community loses a lot of money,” said Hornick. The turbines will be a permanent addition to the coastal viewscape and significant long-term impacts may occur in certain coastal communities.

After the implementation of wind turbines, red lights will be installed on the turbines for night aviation purposes. Thus, lighting could have long-term effects on tourism as well. In reference to the VYR, these lights are expected to be visible “from up to approximately 35 miles (56 kilometers) away from viewers standing on the shore (farther for viewers from elevated positions),” notwithstanding vegetation, atmosphere, and specific geographic location of the viewer (BOEM, 2020). However, BOEM considers the overall impact of lights to be a “negligible impact on recreation and tourism” for the Vineyard project since it would affect south-facing and elevated coastal lands the most, essentially meaning only specific locations would be impacted (BOEM, 2020). For those tourists that prefer a clear view, these lights would still cause reluctance to visiting communities near offshore wind projects. It may be possible that this reluctance by some tourists could affect the tourism industry within individual communities.

The noise resulting from the construction of the turbines, most prominently from the pile-driving phase, may also impact tourism. In studies conducted at the Block Island Wind Farm, noise that was generated reached “ambient levels at 164 feet,” showing that “adverse, intense and

disruptive, but short term and localized" construction sound will be heard from the coast (BOEM, 2020). This noise would interfere with the peaceful experience that tourists seek.

As a possible benefit, artificial reefs may be possible due to wind turbines, which can support recreational fishers' interests. Sightseeing boats may become a new business catering to tourists to see the wind turbines or new marine species that are attracted to the turbines. This would introduce a new attraction with tourism communities, possibly helping to compensate for the deficits that can occur with offshore wind development.

3. Native American Cultural Impacts

Native American rights also need to be considered. BOEM has consulted with the Native American community and other relevant stakeholders to protect offshore cultural resources. Native American archeological sites that were buried from the last Ice Age due to rising sea levels are included in these landscapes, along with Native American land after that period and post-contact with Americans. In the construction process, the anchoring and dredging, more prominently applying to shipwrecks, must be conducted in a manner that avoids any harm to cultural resources. In relation to possible harm to Native American culture, the impact is generally considered to be negligible since the land would be avoided within this process.

BOEM notes that for some of these landscapes, it would be impossible to avoid due to its scattered characteristics, and thus "offshore construction would result in geographically widespread and permanent adverse impacts on these resources" (BOEM, 2020). Submerged cultural environments, defined as paleolandscapes, are regarded as possible significant resources since they can include land from the time of Native American inhabitation before the last Ice Age. Native American land is considered important due to its relation to cultural beliefs and practices. As such, any impacts to cultural resources are considered to be major and long-term.

BOEM indicated that for the Vineyard Project, mitigation of these major adverse effects to moderate impacts on cultural resources must be codified within a Memorandum of Agreement between Vineyard Wind Construction and Operations Plan, BOEM, and "the Gay Head Light, the Nantucket Island Historic District National Historic Landmark (Nantucket NHL), the Chappaquiddick Island Traditional Cultural Property (Chappaquiddick Island TCP), and submerged ancient landforms that are contributing elements to the Nantucket Sound Traditional Cultural Property (Nantucket Sound TCP), as well as submerged ancient landforms on the Outer Continental Shelf (OCS) outside the Nantucket Sound TCP" (Bureau of Ocean Energy Management, 2020). This would most likely be the same format for future offshore wind projects as well. Although an agreement of mitigation methods is made with tribes, moderate impacts to Native American cultural resources are still possible.

Within the state, there are also efforts to interact with Native American communities in relation to OW development. Doug Copeland, the Development Manager of the Atlantic Shores offshore wind project, has been involved in outreach and policy on behalf of the company. He states that communication with Native Americans is "a part of our construction operation plan – our federal effort program. We have to engage with tribes; that is a part of our engagement permit."

B. *Threats to Marine Species*

Offshore wind turbines have to be anchored to the seafloor and a steel cylinder is buried into the seabed anywhere up to 30 meters deep (Armes, 2020) through pile driving. These methods can pose significant threats to marine species within the siting areas in the ocean due to the seafloor and ocean water disturbances. The seafloor is the habitat for these species, which will be disrupted by the construction of offshore wind turbines. For instance, "the adult/juvenile

demersal fish and benthic invertebrates in the direct path of bottom disturbing activities may experience some mortality or injury. During winter construction periods, demersal fish may experience higher levels of injury/mortality due to sluggish response under cold water conditions," as stated in the American Littoral Society's Special Publication on Protecting Offshore Fish and Fish Habitat in the Mid-Atlantic Ocean (American Littoral Society, 2021). Demersal fish are fish that live either on or right above the ocean floor, (Abby & Flynn, 2019) and benthic invertebrates are organisms that live on the bottom of the of the ocean (Currie, 2020). Eggs of these demersal fish and larvae can be in danger based on the areas of the turbines.

Additionally, by placing a hard structure within a soft bottom, the habitat is not only impacted through the disturbance of the floor, but also with the type of material. This may cause the soft-bottom marine species living there to relocate due to their new habitat to which they may not be able to adapt.

Dillingham observes, "If you take the current composition of waters and habitats, and you plop something into it – like hundreds of windmills – and add all the vessels [and] traveling in and out, it's a fairly safe bet to say that there will be some impacts…. The presence of [offshore wind facilities] will affect the presence of marine species. There are a lot of unanswered questions; things are not definitively 'good' or 'bad.' Our response is responsible siting."

Hard-bottom creatures, including black sea bass, Atlantic cod, and American lobster, would have a new habitat and, therefore, may see an increase in their population numbers. Whereas for soft-bottom species, including the summer flounder, Atlantic surf clam, and longfin squid, they would lose their habitat and need to relocate, which could possibly reduce population number.

NJDEP's Baseline Ecological Studies Data report determined that the areas of sediment that are disturbed are small relative to the total wind farm area (NJDEP, 2021). However, this does not rule out the possibility that the "construction activities adjacent to these habitat types could contribute to habitat loss, change the benthic community, initiate sediment disturbance, and change water quality," resulting in permanent impacts (American Littoral Society, 2021). Anchoring is said to "cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor" due to the possibility of harm to finfish and invertebrates and their habitats (BOEM, 2020). This impact is considered temporary and minor since the mortality from the direct contact would be recovered in the perspective of the overall species population, although the habitat will be permanently affected.

The noise associated with construction can cause short-term behavioral stress to nearby fish and invertebrate. The indicated radius of the noise transmission from pile driving for the Vineyard Report is "radially less than 5.7 miles (8 kilometers) around each pile, and the radius for injury or mortality is estimated to extend 285 feet (87 meters) from each pile" (BOEM, 2020). BOEM assured that none of the siting areas will overlap given these measurements to avoid accumulative damage, although impacts will occur. A study published in the Journal of Experimental Biology found that black sea bass, significant to the Mid-Atlantic Bight, "can hear sounds in the 80 to 1000 Hz range" (Dawicki, 2020). When compared to other fish species, they were found to be mostly similar, but were found to "have more sensitivity at lower frequencies," possibly putting them at increased risk with OW development (Dawicki, 2020). Studies conducted on the behavioral impacts of black sea bass and longfin squid with the noise of pile-driving found that although they are affected, they return to their original behavior after the noise is terminated (BOEM, 2020).

Julia Beaty, Fishery Management Specialist with the Mid-Atlantic Fishery Management Council, raised a concern regarding how long-term research and scientific surveys can continue to occur within these lease areas. “There are existing long-term scientific surveys designed to estimate abundance of fishery species in this region. They provide very important scientific advice for fisheries management. These surveys collect samples in specific locations based on a statistical survey design and will be unable to operate as they have for the past several decades once multiple wind projects are constructed. This raises concerns about the quality of information that we will have for fisheries management moving forward,” states Beaty. These surveys are critical in deciding quotas for fishermen along with the monitoring of marine species and habitat that require protection. With the introduction of offshore wind technology, the Biden administration has agreed to commit to NOAA Fisheries’ Federal Survey Mitigation Program. This program analyzes past surveys and then develops new survey designs with offshore wind technology factored in. NOAA stated, “This will fill regional scientific survey data needs over the life of offshore wind operations. Information and outcomes from these efforts will be shared with the public, industry, academia, and state and federal partners to ensure an open and transparent process” (NOAA, 2021). If enforced effectively, this program will promote “long-term data collection” and more sustainable fisheries.

The Northeast Fishery Science Center and NOAA plan to “operate or support surveys related to ecological monitoring and fisheries stock assessments” (BOEM, 2020). This will most likely be the case for all future offshore wind projects, along with improved research methods. Since offshore wind projects are still relatively new to the United States, the results of the research that is conducted will be fairly new. But if many of the turbines are being built simultaneously, it would not provide enough time and subsequently data to review the newly

discovered research in relation to the turbine environmental impacts and take them into consideration.

One of the major species of concern with OW projects on the East Coast is the endangered North Atlantic right whale (NARW). The NARW is "one of the world's most endangered large whale species" with an estimated "fewer than 400 North Atlantic right whales, with fewer than 100 breeding females left," as stated by the National Oceanic and Atmospheric Administration (NOAA) (NOAA, 2021). It was found that "between December and May, almost a quarter of the right whale population may be present in the (North Atlantic) region" from recent surveys done by the Northeast Fisheries Science Center and the Center for Coastal Studies (NOAA, 2021).

Vessel strikes are "one of the leading causes of serious injury and death of right whales" (BOEM, 2020). As a mitigation effort, BOEM reports that the vessels will be travelling at speeds lower than 10 knots. The lower speed reduces the likelihood of strikes because "the greatest rate of change in the probability of a lethal injury to a large whale occurs between vessel speeds of 8.6 and 15 knots" with 15 knots being much more likely, as stated within the study, *Vessel Collisions With Whales: The Probability of Lethal Injury Based on Vessel Speed* (Vanderlaan & Taggart, 2006).

Notwithstanding lower vessel speeds, a significant consideration is that "as many as 75 percent of known anthropogenic mortalities of the North Atlantic Right Whale likely resulted from collisions with large ships along the U.S. and Canadian eastern seaboard," as stated within the report, *Modeling the Effect of Vessel Speed on Right Whale Ship Strike Risk* (Kite-Powell, Knowlton, & Brown, 2007). Consequently, the offshore wind development company for the Vineyard project is required to check NARW sightings daily, shift their engines to neutral with

the sighting of any NARW or large whales and cannot restart until the animals are "out of the vessel path and beyond 328 feet," and all transiting vessels must have "a 1,640-foot for NARWs and 328-foot setback for other listed whale species." (BOEM, 2020). There must also be an Automatic Identification System to keep track of every vessel. With these rules in place, BOEM expects vessel traffic to be minimal and cause negligible impacts. Yet, it is uncertain how strictly vessels and construction companies will adhere to these rules, which is a gap in these mitigation efforts. Carelessness or lack of diligence can cause injury or death to a NARW or other whale species.

As for the high sound pressure levels caused most prominently with the pile driving, previous offshore wind projects have conducted relevant studies. Based on research undertaken on the first German offshore wind farm and porpoises, there was "a negative impact of pile-driving on relative porpoise detection rates" because they had moved to another location due to the noise (Dähne, et al., 2013). The results found that, "No porpoises were visually detected in the vicinity of the construction site… the nearest sighting was recorded at 20 km distance to the west of the driven pile" (Dähne, et al., 2013). This emphasizes that noise can impact the behaviors of species. Following the piling process, the study's data showed porpoise presence increased again around the site. However, the study expresses concern about the impact that multiple construction sites in close proximity can lead to "potentially decreased fitness due to multiple flight reactions and energy expenditure," and the possible "temporal habitat loss" due to displacement away from the site (Dähne, et al., 2013). The behavioral actions and concerns of the porpoises in this study are a possible outcome for other Eastern Coast marine mammals, such as the NARW.

Given that cetaceans are seriously impacted by noise, there is concern regarding how this noise will affect the right whale. “They’re going to pile drive. In doing this, the sound waves are going to disrupt the communication of the right whales,” said Hornick, expressing her concern for the right whale. The possibility exists that “Increased noise from wind turbine construction and operations and vessels could… directly impact important whale behaviors and interfere with the detection of critical acoustic cues,” as indicated within the VYR. One expert noted, “Marine mammals are particularly sensitive to noise pollution because they rely on sound for so many essential functions, including communication, navigation, finding food, and avoiding predators” (Stephens, 2019).

In relation to this concern, BOEM stated, “Pile driving will occur in open ocean areas where marine mammals may freely move away from the sound source” and the exposure is expected to result in only “recoverable auditory injuries and behavioral impacts” (BOEM, 2020). Additionally, since the construction and the noise from pile-driving will be occurring over a period of years, “the timing of pile driving would need to co-occur with the movements of an individual whale over the course of a year through each geographic analysis area” (BOEM, 2020). But, if the NARW is not fast enough or too distracted by the noise to move away freely and effectively, risks remain that this endangered species will be in harm’s way. Moreover, given the species’ vulnerability, any injury or impact to a NARW can be significant. In timing the pile driving with the movements of individual whales, the efficacy of this method turns on the degree of care taken by the construction team and the vigilance of enforcement.

As for the sound from the operation of the wind turbines, they are not expected to have a significant impact because it is “expected to be at or below ambient levels” from the turbine foundation, leading to “little to no impacts on individual marine mammals” (BOEM, 2020).

Similarly, the frequency range of transiting vessels is below the hearing range of marine mammals. Therefore, these impacts are categorized within the VYR as "minor for NARW due to avoidance of peak seasons of occurrence," and "moderate for all other marine mammals" (BOEM, 2020).

Helicopters used during operations are expected to fly at higher altitudes for the majority of time (other than landing and taking off) to avoid extensive behavioral impacts to marine mammals due to the sound. Short-term and temporary behavioral responses have the chance to occur if a whale is "located within 820 to 1,181 feet (250 to 360 meters) of the helicopter" (BOEM, 2020). If there is a NARW or any sighted large whale "within 1,500 feet (BOEM, 2020)," all aircraft are required to stay away and move to a safe distance (Oliver, 2013). Most of the impacts of concern occur during the construction portion of the offshore wind process, although helicopter flight paths pose risks during the operational phase. Moreover, the safety of NARW from any harm due helicopter noise is first based on the pilot noticing the whales from above and then moving away. Many of these mitigation efforts depend on the diligence of the construction companies.

Another consideration is how "entanglement in non-mobile fishing gear has been identified as one of the leading causes of mortality in North Atlantic right whales" (Knowlton, Hamilton, Marx, Pettis, & Kraus, 2012). The turbine structures pose higher risk of entanglement, further endangering the right whale species. With the new possible reef species on the structures, it may also entice increased fishing in the area. The interaction that NARW will have with the turbines along with the threat of entanglement after the turbine construction remains uncertain, which underscores the need for regulatory reform.

C. *Impacts to Biodiversity*

"In modern times… and even for the past 10-thousand years or so, almost all extinctions have been caused by anthropogenic influences…Species are now disappearing so quickly that we refer to the phenomenon as an extinction crisis or a biodiversity crisis" (Freedman). Catherine Brahic, the Environmental Editor of *The Economist*, commented on this issue with, "It's alarming because human societies basically depend on there being a diversity of organisms and ecosystems out there. So, the biodiversity crisis presents a threat to human societies" (The Economist, 2021). Although these observations to biodiversity overall, including terrestrial and marine, regulation of marine biodiversity is more difficult and requires more protective measures.

If the construction of these wind turbines is not carefully undertaken, it can impact more than just individual species. Marine biodiversity represents "an aggregation of highly inter-connected ecosystem components… encompassing all levels of biological organization from genes, species, [and] populations to ecosystems" (Cochrane, et al., 2016). Each individual species depends on the survival of another species, and that species depends on others. Therefore, any significant detrimental impacts to the population of vital species along the sea floor or in the ocean will impact the larger scaled web, propelling the biodiversity crisis. "Human activities produce a range of pressures on marine systems, some of which may lead to irreversible changes. This may have immediate consequences for patterns of biodiversity and consequently for the critical ecosystem services they provide" (Cochrane, et al., 2016).

On the contrary, there is opportunity for biodiversity benefits with offshore wind turbines as well. The turbines can serve as a habitat for new reef structures to form due to the hard-bottom turbine structures interacting with the soft-bottom habitat. These new reef structures can allow

for the increase of new species habitat and increase in population, offering a possible ecological benefit. The American Littoral Society's *Protecting Offshore Fish and Fish Habitat* determined that there is a chance of "enhanced biological productivity and improved ecological connectivity on account of… the functioning of offshore wind structures as artificial reefs" (American Littoral Society, 2021). The report also noted, "Although a monitoring program at a wind farm developed in Scotland showed a decrease in the number of fish during construction, there was an increase in fish at one year into operation," suggesting a possible beneficial outlook with the introduction of wind turbines.

BOEM has also acknowledged this outcome in its VYR in how "the presence of new structures could result in increased prey items for some marine mammal species," and the "'reef effect' that is associated with higher densities and biomass of fish and decapod crustaceans," where "reef effect" refers to new reef structures (BOEM, 2020). One example of this phenomenon noted in the VYR is "increased primary production and zooplankton abundance, increasing prey availability for mysticete whales" (BOEM, 2020). Increased prey resources could have a significant impact upon the food network since it could also have possible population increases within the predator species. Additionally, the turbine structures can lead to foraging opportunities including shellfish, other fish, and shelter (BOEM, 2020) that would attract some marine mammals to use the turbines as their new habitat to rest and feed.

The study, *Using Artificial-Reef Knowledge to Enhance the Ecological Function of Offshore Wind Turbine Foundations: Implications for Fish Abundance and Diversity*, found that there were "frequent increases in abundances of species associated with hard substrata after the establishment of artificial structures in the marine environment. Literature indicated that scour protection [placement of rock and sand to protect cable and prevent seabed deepening] meets the

requirements to function as an AR [Artificial Reef], often providing shelter, nursery, reproduction, and/or feeding opportunities" (Glarou, Zrust, & Svendsen, 2020). Another study was conducted using trophic web modelling tools to study the possible impacts towards benthos and fish aggregation caused by the turbine scour protections. Their results found "…that higher trophic levels such as piscivorous fish species, marine mammals, and seabirds responded positively to the aggregation of biomass on piles and turbine scour protections; and a change in keystone groups after the construction towards more structuring and dominant compartments," highlighting positive behavioral effects and stronger species groups following turbine implementation (Raoux, et al., 2017).

All of this information points to the chance that the population of a species can increase with the creation of a new habitat due to the turbine. By increasing the population of one species, the potential exists for its coordinating dependent species' population to increase as well, which leads to a possible cumulative effect of all of the populations within that food web to increase. This outcome would significantly promote marine biodiversity. An alternative exists where fishers may be tempted to take advantage of the aggregation of species near the turbines. If this were to happen, the temptation can lead to overfishing of a species directly, exacerbating the biodiversity crisis. Thus, not only do the offshore wind companies play a part in promoting sustainability of marine biodiversity but the fishing community does as well. Lack of coordination or oversight in one area could lead to an aggregation of issues resulting in more significant impacts.

"[We're] taking flat land and putting rich structure into it. It drives me insane that as coastal as New Jersey is, [the state] does not invest in science t. We don't know all the answers…We don't really know the impacts on the ocean," said Dillingham. Although past

studies may indicate a beneficial result of the turbines, it is still unclear if it will increase ecological efficiency or if only serves as an attraction for nearby species. Moreover, these impacts – whether positive or negative – would be long-term and not just a temporary change." We need to start thinking about projects that aren't built for the next 15 years. The ocean is something else; we need to start doing research about the ocean. We shouldn't be looking at it in 2021, but in 2035. We need to look at climate models then of how this place will have more of this species or less of this species," said Copeland. Marine biodiversity may not be the first concern that comes to mind with OW energy, but it is a prevalent factor affecting the future.

III. Recommendations for Reform

In response to the aforementioned concerns, there are various areas that can be improved regarding OW project approval, implementation, and monitoring. One of these areas involves law reform to promote efficient and complete documentation and planning. Another area involves clarifying what information in the OW process cannot be released due to confidentiality reasons. Additionally, the need for full engagement and collaboration across all stakeholders is necessary as a way to close gaps in the OW process. Finally, research prior to, during, and after installation of OW facilities must be undertaken.

A. *Policy Reform*

With the new processes that offshore wind brings, certain policy-based renovations can be considered to allow for greater efficiency. From better interactions within all of the sectors at work to improved documentation, the coordination of the processes can be improved. Julia Beaty is concerned about the pace at which the projects are progressing. "The pace that everything is happening isn't ideal. When projects reach a certain milestone, comments must be submitted on the assessment. Every week there seems to be a comment letter. If the process slowed down, it

would be so much easier to keep track of," said Beaty. From the public's perspective, the process may seem less progressive than it is behind the scenes for the stakeholders. It must be ensured that all of the documentation process within the planning stages are given ample time in every phase to be thoroughly reviewed. Sufficient time must be allocated not only for the drafts of the project plans, but also for comments after a proper analysis by the respective reviewers (depending on the phase of the project) and by the general public.

In addition, the processes that go into the development of offshore wind projects are extensive and tedious. Efforts must be undertaken to ensure that the necessary documents and other paperwork in the process are understandable. New Jersey's BPU recognized this necessity and took action: "We made our guidance document clearer… as you can imagine these are very large and complicated projects," said Jim Ferris. These documents must be readily understandable to those applying for project, but also for those reviewing and analyzing the completed documents. As Jim Ferris noted, "We are working under regulations and statutes for a very new industry and process… There are certainly still some areas that could improve. One of the things we do is after every solicitation we look at lessons learned, asking what we did well and what we can improve." The outcome of these discussions would inform how to address any inconsistencies and needed revisions within the documents to allow for a clearer and more efficient process.

Another suggestion that may ease the process and allow for efficiency is requiring collaboration. For the most part, the plans are conducted in a step-by-step manner where companies and regulators are involved in different capacities at each stage of the process. Within these steps, there may be space for greater communication between the entities involved. In this way, the regulators, construction companies, and stakeholders are constantly informed with

relevant information on the project and discussions are incorporated throughout the process. This not only improves the clarity within the process, but it also allows for a much more collaborative effort which is essential in offshore wind development.

Along with collaboration within a project, collaboration *between* projects can also occur. Where multiple lease areas have been approved, many plans are being formulated and completed simultaneously. Regulators responsible for analyzing and approving the plans can also give greater attention to plans of nearby lease areas. This would allow for discussion of possible cumulative impacts on marine species, and avoidance of future long-term concerns involving construction between the projects.

Although the offshore wind development companies may be reluctant to discuss some details of their project due to confidential material and competition with other companies, there is still information that would be useful to share with other companies in working plans. Although business development is a primary objective for these companies, the end goal is having the best possible implementation of OW development in the area with and all participants in the process communicating and cooperating to the maximum extent feasible. Julia Beaty suggested that BOEM should assume greater responsibility in the process. “BOEM needs to take a stronger role in requiring coordination across projects – they have that authority,” said Beaty. If the communication and collaboration does not exist within the offshore wind process now, a possible reform would be to have BOEM require it in the future. Collaboration is significant for the most effective outcome of offshore wind farms since these plans will overlap across one shared ocean.

Other forms of policy reform lie within the technology realm. The turbines need to have a monitoring system installed to collect observational data. This information can be collected via a

camera to observe species interactions, any fishery interactions, and viewing ocean life itself. The footage could also be livestreamed to the general public to allow for a platform of greater education and to expand interest in offshore wind turbines and their impacts on marine life. Moreover, BOEM has mentioned use of Aircraft Detection Lighting System (ADLS) to reduce light pollution in the Vineyard project. This is an effective measure since the lights would not be active when unneeded, it would reduce any possible disturbances to marine life near the light, and present less of a distraction to coastal tourists and communities in the day and night.

B. *Transparency and Outreach*

With the complexity of the offshore wind process, ensuring transparency in communication of relevant information is essential. Transparency can involve the documentation of the OW plans that are being proposed, along with stakeholder and regulatory actions and comments on the construction plans. On the topic of these pre-construction processes, Ms. Hornick says, "There was no public input and no public hearings… it's all about the money – it needs to be all about the people, all about the environment."

Jim Ferris identified a challenge with sharing information on OW project with the public. "These proposals contain proprietary modelling and equipment. If they were shared with the public, it would put competitors at an advantage." Due to the necessary protection of the businesses involved with the development plans, much of the information within the plans is not released during the planning phase. "Once the awards are made, the board makes this information public…on the Board [of Public Utilities'] website are public versions of evaluation reports from our consultants, but it's difficult to do that during the evaluation process," continued Ferris. This shows how the confidentiality factor is not well-known to the public, and thus sparks the transparency conflict between the public, regulators, and the OW development companies.

Therefore, although there may be information that cannot be given, stakeholders need to be more expressive about what they can and cannot share to the public to avoid the false perception secrecy.

The location of where the available information can be found and the areas open for public input also need to be clearer. The information is not only essential to the proprietors and construction companies, but also to impacted communities and the fishing industry. Hence, these documents should be easily accessible to all groups and also publicized more effectively to promote awareness of the existence of the documents. This inconsistency and confusion regarding the role of public comments exacerbates the public's transparency concerns. "There seems to be a lot of misinformation that stakeholders hear and repeat that is inaccurate, and some people rely on that information," continued Ferris. The process, the information and location of it, and what must be treated as confidential must be clarified to avoid further misunderstandings among the stakeholders in OW projects.

Along with the necessary revision of documents and websites to allow for improved access to sand clearer communication of information in the OW process, another aspect that has room for improvement is engagement. Offshore wind is not an independent project and engaging with all stakeholders is key. "Those are first principles – engagement; creating a space where they [people] can argue and discuss and respect outcomes," Mr. Dillingham noted. These projects cannot be seen as individual business investments, but rather a unified effort that will have a significant impact in many areas. As Dillingham mentioned, it can be "very expensive to gather people." But it is a necessary effort to ensure no gaps remain, especially with the consideration of permanent impacts on the environment.

BOEM has the ability to mandate engagement for OW agencies. Communication and engagement are critical in these multimillion dollar projects that have the potential to cause irreversible harm to the ocean. Additionally, these turbines are not temporary but here to stay for the next decades.

C. *The Necessity of Research*

There has been limited research to date on offshore wind turbines in the U.S. Therefore, it is necessary for environmental impact studies to be conducted in the construction and post-implementation phases of OW projects. This research is crucial for the future of not only the OW industry, but more importantly the impacts to the ocean and marine life. However, if all of the turbines are built within the same time frame, the collected research cannot be implemented for any of the turbines. Thus, if significant findings are found with an offshore wind turbine allowing for possible improvements, it would not be applicable to any of the turbines in the current project since it would already be too late. This gap highlights the risk associated with the speed of the construction process.

Furthermore, this research will allow for future policy revisions. Discoveries can be made of important measures that need to be undertaken for the protection of the marine environment following the turbine construction. Darlene Ketten, coauthor of *Review of Noise Impacts on Marine Mammals Yields New Policy Recommendations*, said, “The diversity of species is such that a one-size-fits-all approach isn't going to work. We need to understand how to avoid harm, and the aim is to provide guidelines to say if this or that species is in your area, here’s what you need to avoid” (Stephens, 2019). Ketten’s comment underscores how unpredictable the impacts to species can be due to variations among species. This is why the research conducted following

turbine placements is crucial to understanding the impacts caused. Moreover, these findings need to be documented to mitigate harm in future turbine placements.

This concept becomes even more essential with the consideration that endangered species such as the North Atlantic right whale are located within the areas of these offshore wind projects. Tim Cole, lead of the whale aerial survey team at the Northeast Fisheries Science Center and co-author of *Right Whale Use of Southern New England Wind Energy Areas Increasing*, said, "Implementing mitigation measures by all companies holding leases will be crucial and should be adapted and reevaluated continually in relation to the whales' use of the area. Given the large-scale shifts that the species is experiencing, a variety of studies will be needed to understand potential changes in right whale distribution patterns and to inform appropriate strategies for future wind energy development" (NOAA , 2021).

Fisheries also do not have experience adapting to turbines in the ocean, leading to potential complications due to the new experience. In reference to the Vineyard project, BOEM notes how "management plans include measures such as fishing seasons, quotas, and closed areas, which constrain how the fisheries are able to operate and adapt to change…Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale" (BOEM, 2020). The effectiveness of these plans can only be seen after implemented; therefore, the utmost care must be applied in the construction of these plans.

Offshore wind is significant not only to humans for the possible benefits that it can reap, but also critical to marine species whose lives may be at risk. Possible avenues of harm caused by offshore wind can be analyzed via the research on an existing turbine, thus emphasizing the importance of investing in proper research throughout the OW development process. The

conflict of whether this research can be applied to turbines within the same project remains unclear, however, due to the short period within which the turbine construction is expected to occur. If research reveals that more effective methods of turbine development exist or necessary policy modifications should be implemented that could reduce harm to an endangered or other marine species, slowing down the process to allow for the needed changes must be considered before continuing construction with inefficient techniques.

Finally, such research means nothing without the proper exposure. The research must be shared with all stakeholders in the OW process to ensure implementation of necessary changes to the procedures. More importantly, this research must be absorbed and understood by these participants. It is the time given to understand the flaws and successes of the procedure that will allow for the most effective outcome for the environment. "We live in this digital world where all the information is out there… As you develop this information, make it available to the people," said Dillingham.

One such area of research includes the Mid-Atlantic Ocean Data Portal, which consists of a vast amount of information regarding species' locations, fishing areas, offshore wind lease areas, vessel transit pathways, and more (MARCO, 2021). This portal is a valuable resource for the development of offshore wind projects in the Mid-Atlantic. However, if the portal is not given enough exposure, the time and energy invested into acquiring and displaying that information is lost. Effective sharing, communication, and understanding of research is essential. This research will determine the future of the offshore wind industry in America.

Conclusion

Offshore wind energy is developing rapidly in the United States. Yet, there are many potential impacts and considerations about this process that need to be understood and

effectively communicated. Proper communication among stakeholders, regulatory agencies, and fishing communities is critical to ensure that the utmost precaution is afforded in protecting marine species in OW projects.

Offshore wind development is a very new process in the Mid-Atlantic region. With the state agencies such as NJDEP and NJ BPU along with the federal agency BOEM involved in the OW approval and implementation process, many regulatory complexities exist that need to be understood and streamlined. Gaps in this process become critical when involving delicate marine and endangered species that may be put at risk with OW facilities.

The introduction of offshore wind in the Mid-Atlantic is meant to help propel America's journey towards more efficient environmental sustainability. Potential reforms are necessary to enhance transparency and accountability in this process and analyze research in order to implement new findings. The pace of the process should be slowed, especially given that these turbines will be permanent for the next decade once installed. Similar to the fight against climate change, offshore wind in the Mid-Atlantic must be a communicative, cooperative, and constantly evolving system benefiting from new knowledge and ongoing discussions.

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