October 23, 2020

James Bennett
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Office of Renewable Energy
Bureau of Ocean Energy Management
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Re: BOEM's obligations under Migratory Bird Treaty Act in Vineyard Wind I Construction and Operation Plan Environmental Impact Statement

Dear Mr. Bennett:

Our organizations, National Audubon Society, Connecticut Audubon, Audubon Society of Rhode Island, National Wildlife Federation, Defenders of Wildlife, Mass Audubon, New Jersey Audubon, and Audubon New York write in the interest of advancing the responsible development of Vineyard Wind I, as well as other offshore wind projects planned across the Atlantic Outer Continental Shelf. We first want to commend the Bureau of Ocean Energy Management (BOEM) on the improvements incorporated in the supplement to the Draft Environmental Impact Statement (SEIS), namely considering cumulative impacts. However, as we addressed in our comments to BOEM in response to both the Draft Environmental Impact Statement (DEIS) and the SEIS, we have concerns regarding BOEM's assessment of impacts to birds and particularly to the agency's application of the Migratory Bird Treaty Act (MBTA). We appreciate the steps BOEM and Vineyard Wind have taken thus far to develop offshore wind more responsibly and look forward to working with BOEM, Vineyard Wind, and other developers to ensure that the MBTA is properly employed.

The MBTA states that, "[u]nless and except as permitted by regulations . . . it shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill . . . any migratory bird."[1] For decades, the Department of Interior (DOI) has interpreted the MBTA to encompass "incidental takes" of migratory birds, including from wind turbines. It was not until the 2017 Jorjani Opinion M-37050 that the DOI limited the MBTA's legal scope to only include actions that purposely take migratory birds. However, on August 11, 2020, the U.S. District Court for the Southern District of New York found that "the Jorjani Opinion's interpretation runs counter to the purpose of the MBTA to protect migratory bird populations."[2] The court found that the MBTA's unambiguous text makes clear that killing a migratory bird "by any means or in any manner," regardless of how, is covered by the statute.[3] As such, the district court struck down the Jorjani Opinion as unlawful, restoring the MBTA's protections for migratory birds from incidental takes.[4]

[1] Migratory Bird Treaty Act, 16 U.S.C. § 703(a).
[2] *NRDC v. DOI*, No. 18-CV-4596, 2020 WL 4605235, at *8 (S.D.N.Y. Aug. 11, 2020).
[3] *Id.* at *9–10.
[4] *Id.* at *14.

Accordingly, BOEM cannot rely on the Jorjani Opinion to ignore the need to protect migratory birds from incidental takes that may occur as a result of the Vineyard Wind I project. In approving the Vineyard Wind I project, BOEM must ensure that measures are in place that protect migratory bird populations that utilize the Vineyard Wind lease area at all times of year (e.g. for migration, foraging, breeding, wintering), consistent with the MBTA. Efforts to minimize and monitor for potential disturbance to migratory birds should be clearly outlined in Final Environmental Impact Statements and included in any resulting project approvals.

Although the U.S. Fish and Wildlife Service lacks substantial local information regarding collisions with offshore wind turbines, evidence from offshore wind development in Europe suggests that birds may experience risk from collision and displacement in and around offshore wind energy (OWE) projects. Given the foreseeable growth of offshore wind turbines in the coming decades, it is imperative that measures be put in place to assess the risk level to migratory birds from OWE projects and provide information that can be used to effectively mitigate risks to migratory bird populations. It is then imperative that any needed mitigation be put in place, pursuant to BOEM's permitting authority.

Therefore, in light of the referenced court decision and to comply with the MBTA, we have drafted a document to guide BOEM and developers to ensure that development of OWE properly addresses, minimizes, and mitigates risk to migratory birds to help BOEM comply with their obligations under the MBTA and permitting authorities pursuant to the Outer Continental Shelf Lands Act[5].

The attached document, entitled "Addressing Avian Interactions with Offshore Wind", is refined from recommendations by national and state conservation organizations to protect birds as offshore wind energy is developed. It provides relevant context and specific methodology for the following monitoring and mitigation framework for offshore wind projects, beginning with Vineyard Wind I:

A. Avoid and minimize potential impacts to birds from construction and operations of the offshore wind energy project based on the best available science.
B. Measure realized displacement patterns and collision rates to birds from the OWE project, with monitoring pre- and post-construction.
C. Estimate risk of exposure and collision for nocturnal migrants in addition to coastal and marine birds.
D. Provide plans for adaptive management, such that new technologies can be incorporated to better monitor interactions and minimize fatalities of birds for the operational life of the project.
E. Commit to promote avian conservation for those taxa which may experience some cumulative population-level losses as a result of offshore wind energy development and modify plans as those impacts are better known post-construction.

At a minimum, given the current state of technology, the monitoring plan for all projects should incorporate:

A. Pre-construction monitoring to enable adequate baseline assessments of bird movement and distribution within and around the wind development area (WDA),

[5] 43 U.S. Code §1337

B. Deployment of best available technologies, currently marine radar, to assess exposure of nocturnal migrants through the WDA either individually or collaboratively with public or private partners,
C. An adequate timeline for post-construction displacement and collision monitoring,
D. An adaptive management framework that supports testing and implementing new monitoring and minimization technology,
E. A commitment to publicly sharing all raw monitoring data.

In the attached document, we propose specific methods to address these gaps and facilitate better understanding of avian risk and impacts from offshore wind. Some of these recommendations (e.g. marine radar or other pre-construction monitoring technologies that require a stable floating platform) may fall beyond the scope of what can realistically be Vineyard Wind's responsibility for this focal project, given the current construction timeline, and should not delay this timeline. However, we expect BOEM to use this document as a blueprint, not only to inform the monitoring plan for Vineyard Wind I, but also to guide the agency's own avian research and mitigation priorities for Vineyard Wind I and other future OWE projects within the region.

Thank you for considering our concerns regarding BOEM's responsibilities under the MBTA. We recognize the importance of responsible offshore wind developments and expect our recommendations to contribute to the success of such projects moving forward.

Sincerely,

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Addressing Avian Interactions with Offshore Wind

Considerations for Monitoring and Adaptive Management at Vineyard Wind I.

1 Introduction

This is a pivotal moment for U.S. offshore wind energy development along the Atlantic Coast. Many states have adopted ambitious offshore wind goals and are supporting a variety of offshore wind projects that provide emissions-free energy, healthier air free of mercury and other toxins, and thousands of well-paying, clean energy jobs. All told, east coast projects capable of producing more than 25,000 megawatts of power are expected to be operational along the Atlantic within the next 15 years, ensuring enough clean renewable electricity to power at least 12 million homes.

While one of the greatest population-level threats to birds is loss of suitable habitat due to climate change (Wilsey et al.), the proposed Vineyard Wind I offshore wind energy project will not immediately reverse harmful climate trends. Global warming is a delayed response—regardless of our actions to reduce greenhouse gas emissions today, our planet will continue to experience the effects of yesterday's emissions for more than a decade. For birds to survive these changes, we need to limit all other population-level impacts[6] to the best of our ability.

Even with its immense long-term benefits, offshore wind power poses risks to the environment and must be developed responsibly. Wind farm construction and operation can potentially displace birds from prime feeding and breeding areas, interfere with their migration routes, and pose a risk of collision. Almost all groups of birds including pelagic, coastal, and land birds have the potential to be impacted by offshore wind development. However, by understanding the realized risks, and building mitigation frameworks, BOEM can ensure the industry develops projects responsibly for birds.

U.S. offshore wind is a new industry. However, nearly three decades of offshore wind energy (OWE) development in Europe have shown that offshore wind power can be responsibly sited, constructed, and operated if appropriate mitigation measures are implemented to protect local wildlife (Fox and Petersen 2019). Additionally, avian monitoring and best management plans developed for U.S. onshore wind provide a blueprint for mitigation which could be applied to the offshore environment. While we recognize there are differences in the U.S. marine ecosystem that present new challenges for responsibly developing offshore wind projects, technologies are currently under development which will better inform both direct and indirect impacts of wind energy to birds.

2 Purpose

This document is meant to provide recommendations for an adaptive management framework for the Bureau of Ocean Energy Management (BOEM) to set a standard at Vineyard Wind I, with the following goals:

A. Avoid and minimize potential impacts to birds from construction and operations of the offshore wind energy project based on the best available science.

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[6] We define population-level impacts as natural or anthropogenic impacts that cause direct or indirect mortality, or physiological or behavioral responses, to a number of individuals of the same species, such that the rate of population growth for that species or population of species is affected.

B. Measure realized displacement patterns and collision rates to birds from the OWE project, with monitoring pre- and post-construction.
C. Estimate risk of exposure and collision for nocturnal migrants in addition to coastal and marine birds.
D. Provide plans for adaptive management, such that new technologies can be incorporated to better monitor interactions and minimize fatalities of birds for the operational life of the project.
E. Commit to promote avian conservation for those taxa which may experience some cumulative population-level losses as a result of offshore wind energy development and modify plans as those impacts are better known post-construction.

This document considers two primary risks to birds from OWE projects during and after construction:

A. Displacement
B. Collision

with particular consideration for marine birds with high collision and displacement vulnerability,[7] nocturnal migrants, and Endangered Species Act (ESA) listed species--all of which are protected by the Migratory Bird Treaty Act.

We recognize that permitting processes make some of these monitoring efforts not appropriate for Vineyard Wind to accomplish alone, pre-construction. In such cases we have indicated that we expect BOEM to facilitate implementation of technologies for these efforts.

3 Adaptive Management

Most wind projects onshore are required to draft an Adaptive Management Plan, usually in the form of a Bird and Bat Conservation Strategy (BBCS) or Avian Protection Plan (APP) in consultation with the U.S. Fish and Wildlife Service (USFWS). We recommend that BOEM require the same as part of Vineyard Wind's Mitigation and Monitoring Plan. Adaptive Management Plans outline:

A. methods to avoid and minimize impacts during construction and operation to birds and bats,
B. pre- and post-construction monitoring plans to better measure potential impacts of projects to avian populations,
C. mitigation strategies and population risk thresholds for implementing those strategies,
D. monitoring for the effectiveness of those strategies, and
E. blueprints for introducing new strategies to minimize and monitor take as necessary.

Any management and monitoring plan at this stage in U.S. offshore wind development must be adaptive as BOEM, USFWS, and the developers work together to collect and analyze data at both a project scale and cumulatively. We have provided specific adaptive management protocols to address each avian risk below.

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[7] As provided by Willmot et al. 2013.

4 Displacement

4.1 Monitoring to document population-level effects of displacement

Monitoring protocols should be designed to collect data that would support answering the following questions:

A. Are species of marine birds displaced from wind development areas (WDAs) by construction and operation of turbines and new infrastructure in the marine environment and, if so, by how much?
B. Does the presence of the turbine array impact migration routes for trans-Atlantic migrants[8]?

Determining whether Vineyard Wind I will cause avian displacement is best answered by pre- and post-construction survey comparisons.

To conduct a robust displacement analysis, projects should use the best available methods and technologies. We currently recommend protocols that rely on a combination of vessel and digital aerial surveys and movement tracking data (from telemetry and satellite technology, as appropriate). Each of these methods has its own limitations, but when used in combination, can accurately capture changes in distribution for all species which may interact with the turbine array. While we recognize that regional surveys are necessary to cover the cumulative displacement effects for this area, the level of survey coverage we are proposing would be project-specific and answer the question at a project scale.

Monitoring for displacement should cover more area than would be necessary for a simple site assessment; instead of determining species present, monitoring for displacement should be able to detect fine scale differences in spatial use by birds before and after project construction and operation. This cannot be done if the study area is limited to the OWE project's footprint.

We recommend the protocols below for measuring avian displacement. We recognize that many of these are more efficiently accomplished through a larger, regional effort, and we support Vineyard Wind using this avenue for less time sensitive monitoring needs. However, the expected time frame for Vineyard Wind I's construction likely precludes a regional effort to provide the critically needed pre-construction monitoring data.

4.1.1 Pre- and post-construction avian tracking studies

We suggest tracking studies incorporate the following considerations.

A. Installation of automated radio telemetry receivers (e.g. Motus receivers) throughout the turbine array to detect nano-tagged individuals and estimate flight height and direction throughout the array and within a buffer on all sides of the array. Alternative receivers or tag readers may also be considered, but in all cases the receivers should be placed to detect flight height, species, time, direction of flight, and data downloads should be automated.
B. Funding for the purchase and deployment (and satellite time as necessary) of wildlife tracking tags for at-risk species. Species should be chosen in consultation with experts to

[8] Trans-Atlantic migrants are any birds which migrate over the open Atlantic Ocean.

prioritize species that are ESA-listed, of high conservation concern, of high likelihood of exposure to the area, and feasible to capture. This may include, but is not necessarily limited to:

   a. Automated radio telemetry nanotags for species like Roseate Tern, Piping Plover, Upland Sandpiper, Semipalmated Sandpiper, and nocturnal migrants for which this technology is appropriate.
   b. GPS satellite tags for larger at-risk species like Great Shearwater and Common Eider.
   c. Geolocators and altimeters, or similar technology, for nocturnally migrating passerines for which nanotag technology cannot be applied.

C. Tags should be deployed to a reasonable proportion of target populations for two years prior to construction as well as two years post-construction, so that comparisons can be made between movement patterns and habitat use before and after construction.
D. Tagging should target not only a variety of species (discussed above) but also different life stages, which may exhibit different behaviors around wind energy facilities.
E. Floating Motus towers are being tested. Incorporating this technology prior to construction would facilitate gathering baseline movement data for species which cannot take larger tagging technology.
F. All data should be publicly available (this applies to all monitoring data).

BOEM's responsibility: We recognize that it may be unrealistic for Vineyard Wind to gain permission to deploy floating structures prior to the construction of Vineyard Wind I. However, we expect BOEM to plan for, facilitate, and fund the deployment of such structures, as part of a regional effort, in the Vineyard Wind I lease array, as well as other lease areas in the Atlantic OCS, so that movement data may be collected within the affected areas pre-construction, allowing for before and after comparisons of avian habitat use within the lease areas.

4.1.2 Pre- and post-construction aerial transects

In order to detect differences in avian distribution pre- and post-construction, the surveys should be designed to account for detection bias, cover the lease area and its surroundings, and collect high resolution data. We recommend employing high definition still or video aerial surveys, following protocols provided by Thaxter and Burton (2009) and Williams (2015), and survey design similar to those used by Winiarski et al. (2014b) and Petersen (2006). We specifically suggest the following:

A. Study area includes a minimum buffer of at least 20 km around lease and construction areas[9].
B. Aerial transects 3 km apart that cover the entire study area.
C. Flights at altitude of 500-650 m above mean sea level at a constant speed of 185 km/h, or a flight altitude and speed that can safely navigate the WDA while accurately attributing birds to species and/or taxa sub-group.

[9] Heinänen et al. (2020) found evidence that loons exhibit displacement effects up to 15 km from the turbine array, while Peschko et al. (2020) found that kittiwake exhibit displacement effects up to 20 km and guillemots up to 9 km. This evidence suggests that some species may experience displacement effects up to 20km. Therefore, a survey area encompassing this larger buffer from the OWD footprint is necessary to properly capture potential displacement effects.

D. GPS technology on the plane, allowing for at least 2 m accuracy of bird observations.
E. To the extent possible, surveys should be repeated three times within each sampling window and survey windows should be scattered throughout the year.
F. Survey protocols should be repeated for consecutive years before and after construction, covering a minimum of
    a. two years pre-construction, and
    b. two years post-construction.
G. Analysis that accounts for differences in detection probability based on species, flight height, and environmental factors and models.

4.1.3 Pre- and post-construction vessel transects

In many cases, aerial surveys are unable to consistently distinguish between species within groups (e.g. Common Terns from Roseate Terns). Given the endangered status and the relatively high collision risk of Roseate Terns (Willmot et al. 2013), it is vital that Vineyard Wind supplement aerial surveys with vessel based surveys pre- and post-construction to evaluate species-specific displacement effects. Williams et al. (2015) and Winiarski et al. (2014a) provide effective methods for integrating survey methods. Vessel surveys should be used to supplement digital aerial surveys until aerial surveys are verified to collect high enough resolution data to distinguish between Common and Roseate Terns.

4.2 Best management practices to minimize displacement

4.2.1 Data transparency and adaptive management

Data collected during pre-construction and post-construction monitoring from Vineyard Wind I, and all projects in federal waters, **should be shared publicly** and incorporated into future Construction and Operation Plans for subsequent projects.

4.2.2 Construction timing

4.2.2.1 Cable construction

A. Projects should avoid nearshore cable laying during low tide during periods of nesting, staging, and migration (e.g. between mid-July and mid-September in southern New England) to minimize disturbing species like Common Terns and ESA-listed endangered Roseate Terns.
B. Projects should avoid installation of export cable conduits during the nesting season (e.g. from April 1 to August 31 in southern Massachusetts) to avoid disrupting beach-nesting birds (i.e. ESA-listed threatened Piping Plover and MA-listed Least Terns in Massachusetts). If beach-nesting birds choose to nest in the area then construction either needs to halt or avian construction monitors need to be hired to prevent mortality of chicks within 1000 m of the construction site.

4.2.2.2 Wind Development Area Construction and Vessel Traffic

As feasible and relevant, developers should minimize disruption in avian core use areas[10], from September 1 to March 1 to reduce impacts to wintering marine birds.[11] The Vineyard

[10] as defined in Spiegel et al. 2017, which indicates the Vineyard Wind I lease area does not currently overlap with core use areas.

[11] Seaducks (Silverman et al. 2013) and alcids (Powers 1983; Veit and Manne 2015), which winter off the coast of southern New England, are especially vulnerable to disturbance from vessel and helicopter traffic (Garthe and Hüppop 2004; Furness 2012)

Wind I lease area has been well sited outside of current core use areas, so this minimization strategy is only relevant for vessel traffic transiting through core use areas to the WDA.

5 Collision

5.1 Monitoring collision risk and realized collision rates

The monitoring protocol should be designed to answer the following questions:

A. Which species are predicted to be most at risk for collision within the lease area?
B. What is the observed rate of collision for birds with the wind turbines?

Vessel and aerial transect surveys, behavioral monitoring, and tracking studies add to our understanding of collision risk (via habitat use, macro-avoidance, and movement within and around the wind development area), but they cannot measure realized collision rates. Vessel surveys are prone to high observer and detection bias, as many species avoid vessels, while aerial surveys cannot yet consistently determine differences between similar species.

In order for behavioral observations to reliably estimate collision rates and account for imperfect detection of collisions, observations would need to be conducted at a substantial sample of turbines for nearly eight hours per day at each turbine included in the study. Such surveys and behavioral observations would also need to be conducted at night to account for seabirds that forage nocturnally. We do not see either of these as being safe or realistic for Vineyard Wind to apply.

Determining realized collision rates is critical to properly account for take of ESA-listed birds as well as birds protected by the Migratory Bird Treaty Act and therefore must be a part of Vineyard Wind's monitoring plan.

We recognize that no existing monitoring technology is capable of attributing actual collisions to species, so we propose a combination of technologies, which can be applied together to better extrapolate predicted and observed collision rates.

5.1.1 Estimating Turbine Collision Risk

5.1.1.1 Monitoring to assess risk pre-construction

As stated in the Biological Assessment, the USFWS recommended the placement of visibility sensors on the meteorological towers to collect data on the occurrence, frequency, and duration of poor visibility conditions, in order to better determine collision risk. As of the publication of the Biological Assessment, no meteorological towers are on the outer continental shelf. We ask that if these towers are deployed they be utilized to also assess collision risk to ESA-listed species pre-construction. These platforms could possibly also serve as a location for vertical radar.

BOEM's responsibility: We recognize that it may be unrealistic for Vineyard Wind to gain permission to deploy floating structures prior to the construction of Vineyard Wind I. However, we expect BOEM to plan for, facilitate, and fund the deployment of such structures in the region as well as other regions scheduled for development.

5.1.1.2 Monitoring to assess risk post-construction

Tracking technologies, as they are applied to assess displacement, may also help to inform collision risk through macro-avoidance rates, but tags would need to be placed on a substantial number of individuals in order to provide reliable estimates.

5.1.2 Estimating Realized Number of Turbine Collisions

We recognize that technologies are not yet verified and available to accurately detect avian collisions at offshore turbines, but many are currently in development. With that in mind, we recommend BOEM require the following:

A. Once available, developers should commit to employing strike detection technologies to monitor collisions for the life of the project.
B. We suggest developers contribute to developing and testing priority technologies chosen in consultation with USFWS, Department of Energy Wind Energy Technology Office, and BOEM. Ideal technologies should strive to provide methods of validation, detect birds across a range of body sizes (40g to 1kg) and flight heights, and be appropriate to the species assemblage found in the impacted area.
C. Developers should consult with experts about whether existing resources can be leveraged to assess realized collision risk. Some of the possibilities which would help to estimate collision rates are provided below:
    a. Synchronized sensor arrays[12]
    b. WTBird
    c. Thunk
    d. DOE, NYSERDA, Tethys, NPPL, and other databases of current developing

BOEM's responsibility: BOEM should incentivise and support testing the efficacy of detection-deterrent/detection-curtailment technology in the offshore environment, in collaboration with developers, USFWS, state agencies, and conservation partners as it becomes available in the offshore environment.

5.2 Best management practices to minimize collision risk

5.2.1 Adaptive management

New technologies to detect incoming targets have been developed for the onshore environment and are being tested. Once detected, these technologies can initiate automatic communications that may allow for smart curtailment. Such technologies, like Identiflight for large bodied birds, MERLIN radar, and others, are being used successfully for onshore wind projects and may soon be appropriate for the offshore environment.

The Adaptive Management Plan should include a commitment to deploy relevant detection-deterrent/detection-curtailment technologies when commercially available and to implement necessary minimization strategies when sufficiently tested.

BOEM's responsibility: BOEM should incentivise and support testing the efficacy of detection-deterrent/detection-curtailment technology in the offshore environment, in collaboration with developers, USFWS, state agencies, and conservation partners as it becomes available in the offshore environment.

[12] as in Suryan et al. 2016

5.2.2 Minimize turbine collisions

A. As Vineyard Wind has already outlined in the Construction and Operations Plan (COP), Federal Aviation Administration (FAA) compliant lighting will be employed, which reduces attraction of nocturnal migrants and nocturnal foraging seabirds. NEXRAD RADAR systems have been successfully used to activate navigation lighting only upon approaching aviation. Aircraft Detection Lighting Systems (ADLS) are also currently in use at onshore wind projects in the U.S. We recommend this or similar systems.

B. As Vineyard Wind has already outlined in the COP, anti-perching devices will be integrated on the turbines to avoid attraction from marine birds.

C. Deploying MERLIN radar or similar early warning systems at the wind farm can alert operators to approaching migratory and individual birds under mortality risk conditions to automatically implement minimization responses, including temporary idling of turbines. As described above, we recognize these systems may not be readily available for the offshore wind environment, but we expect projects to allow for deployment of these technologies when available.

6 Monitoring nocturnal migrants protected by the MBTA and ESA

A few studies have tracked individual birds up to several tens of minutes or even hours but have not investigated altitude or changes in altitude per se (e.g., Gudmundsson 1994). From these, we know that passerine migrants fly relatively low in the atmosphere most nights (≤ 1,200 m; Gauthreaux 1991), and that the flight altitudes of large groups of migrants can be affected by air temperature, location of boundary layers, turbulence, precipitation, and other atmospheric variables (Richardson 1978, 1990; Kerlinger and Moore 1989; Bruderer et al. 1995; Bowlin et al. 2015).

Because Siemens Gamesa's latest 14MW direct drive wind turbine's rotor swept area measures at 222m in diameter, and is roughly 247m in height,[13] we would expect that nocturnal migrants may be at risk of collision, especially during inclement weather events.

We recommend applying the use of radio telemetry and vertical marine radar, in addition to acoustic monitoring. In addition to the recommendations outlined below, we have provided some recommendations for detection and avoidance technologies that would apply to nocturnal migrants in previous paragraphs.

6.1 Monitor species site use via acoustic monitoring

We recommend that passive acoustic monitoring technology is installed with the capacity for the receivers to upload data remotely for analysis in near real-time. However, this passive acoustic monitoring does not assess/measure flux through the array and therefore acoustic data has limitations in addressing data gaps for nocturnal migrants. Evidence suggests that empidonax flycatchers and vireos, two of the most abundant nocturnal migrant groups, do not emit nocturnal flight calls, and therefore would not be accounted for using acoustic monitoring (Evans and Rosenberg 2000). Additionally, this method does not reliably determine the number of birds calling and cannot provide flight altitude, both essential for estimating collision risk.

[13] https://m.energytrend.com/news/view/18092.html

6.2 Monitor species-level migration patterns with radio telemetry

Using nanotags on trans-oceanic passerine migrants during spring and fall migration would help to inform species specific exposure to the area, flight heights and direction, and should be considered as a way to add detail to our understanding of the risk to migrating passerines.

6.3 Monitor migration trends and flux with vertical marine radar

Onshore wind projects detect nocturnal migratory bird movement using vertical marine radar. The most important data collected with marine radar is magnitude (i.e. flux), timing, and altitude of the birds, and this data can be compared with weather data. **This is a significant data need for the WDA, and closing this data gap across the WDAs is a priority for our group.**

We suggest that marine radar be installed and activated as soon as possible prior to construction using a platform or buoy to obtain baseline data. We recommend BOEM contact Robb Diehl at USGS to inform possible installation of vertical marine radar on floating platforms or buoys within the wind development area. In the case that marine radar cannot be installed prior to construction, we recommend radar to be incorporated on existing structures to cover bird movement patterns within the WDA.

BOEM's responsibility: We recognize that it may be unrealistic for Vineyard Wind to gain permission to deploy floating structure prior to the construction of Vineyard Wind I. However, we expect BOEM to plan for, facilitate, and fund the deployment of such structures in the Vineyard Wind I lease array, as well as other lease areas in the Atlantic OCS, as part of a regional effort, so that migration data may be collected within the affected areas pre-construction, allowing for before and after comparisons of nocturnal migrant movement patterns in and around the lease area.

7 Considerations for marine birds protected by MBTA and ESA

Although beyond the scope of a monitoring framework or plan, ensuring that impacts to seabirds are minimized is a priority. Almost half of all seabird species are known or suspected to be experiencing population declines (Croxall et al. 2012).

With other stressors such as climate change, sea level rise, diminishing prey, and ongoing bycatch from the fishing industry, it is critical that all sectors, including offshore wind, contribute to avoiding and minimizing impacts on seabirds to help prevent species from becoming federally listed by USFWS as threatened or endangered.

For both seabirds of conservation concern and currently listed endangered or threatened species under the ESA, we recommend that data be collected on these species' interactions with turbines as they migrate and forage.

8 Advanced conservation planning

Although beyond the scope of a monitoring framework or plan, we propose that BOEM require a plan for avian species conservation and habitat restoration in advance of project construction. We suggest BOEM support efforts to offset any potential losses (i.e. target age classes most influential to population growth) and target species and populations that are more vulnerable to impacts (as in Willmot et al. 2013). Below are some potential priority projects that BOEM and developers could support.

8.1 Roseate Tern

A. Create new nesting habitat for Common and Roseate Terns in Long Island Sound, Massachusetts and the Gulf of Maine and support predator management and monitoring at current nesting colonies to improve rates of recruitment to the breeding population
B. Monitor local colonies for annual number of breeding pairs and fledging rates
C. Risk assessment and targeted actions at overwintering locations
D. Restore habitat and develop refugia to increase resiliency of this species in response to climate change and sea level rise
E. Sustain and grow sand lance and other forage fish populations in New England

8.2 Piping Plover

A. Protect, enhance, and manage beach-nesting habitat through predator control and public outreach programs
B. Protect and expand wintering habitat

8.3 Red Knot

A. Expand stopover areas, prioritizing Nantucket Sound, Delaware Bay, and other vital horseshoe crab breeding habitat, and protect these areas from disturbance
B. Sustain and grow horseshoe crab populations

8.4 Nocturnal Migrant Songbirds

A. Restore coastal forest habitat in southern New England and Long Island to provide staging habitat for songbirds that make trans-Atlantic migrations.
B. Restore and enhance forest nesting habitat in the northeast to provide breeding (e.g., cover costs associated with forest management that promotes breeding habitat and improves forest resilience).

8.5 Waterfowl

Restore foraging habitat on wintering grounds, prioritizing non-commercial blue mussel fisheries.

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