United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD, 21401

31 May 2024

Lorena Edenfield
Environmental Protection Specialist
Environment Branch for Renewable Energy
Bureau of Ocean Energy Management
45600 Woodland Road
Sterling, Virginia 20166

RE: Biological Opinion for the Maryland Offshore Wind Energy Project; Project code: 2024-0020701

Dear Ms. Edenfield:

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) based on our review of the Bureau of Ocean Energy Management's (BOEM) proposed authorization of the construction, operation, maintenance, and decommissioning of the Maryland Offshore Wind project (Project). The Opinion considers the Project and its effects on the federally listed threatened rufa red knot (*Calidris canutus rufa*), threatened piping plover (*Charadrius melodus*), and endangered roseate tern (*Sterna dougallii dougallii*). The consultation for the Project also considered the Project's effects on the federally threatened eastern black rail (*Laterallus jamaicensis jamaicensis*), endangered northern long-eared bat (*Myotis septentrianalis*), proposed endangered tricolored bat (*Perimyotis subflavus*), and candidate monarch butterfly (*Dnaus plexippus*), which are addressed below. The proposed project is located in the Outer Continental Shelf (OCS) Lease Area A-0490. The project proponent is US Wind, Inc. (Lessee), Baltimore, Maryland.

This Opinion is issued to BOEM as the lead Federal action agency, in accordance with Section 7 of the Endangered Species Act (16 USC §1531-1544, 87 Stat. 884), as amended (ESA). Other Federal agencies whose actions are addressed by this consultation include the Bureau of Safety and Environmental Enforcement (BSEE) and U.S. Army Corps of Engineers (USACE), each taking action under their respective statutory and regulatory authorities related to the subject project, as detailed in BOEM's December 2023 Biological Assessment (BA) for this project. BOEM's request for formal consultation was received on December 18, 2023.

This Opinion is based on information provided in BOEM's BA (BOEM 2023a), draft Environmental Impact Statement (DEIS; BOEM 2023b), the Construction and Operations Plan (COP; TRC Companies 2024), correspondence between the Service and BOEM staff (phone calls and e-mails), and other sources of information. The consultation history is located after the Literature Cited. A complete decision file for this consultation can be made available at the Service's Chesapeake Bay Field Office in Annapolis, Maryland.

Concurrences

BOEM determined that the proposed action would have "no effect" on the federally threatened seabeach amaranth (*Amaranthus pumilus*) and petitioned Bethany Beach firefly (*Photuris bethaniensis*). The Service acknowledges receipt of BOEM's no effect determinations.

The BA included a request for Service concurrence with the following "may affect, not likely to adversely affect" determination(s).

Eastern black rail (*Laterallus jamaicensis jamaicensis*), federally listed threatened

Onshore

Within the onshore portion of the action area, habitat for the eastern black rail includes the freshwater emergent and forested shrub wetlands located within and near the Old Basin Cove and Deep Hole inshore export cable work. Although Maryland and Delaware are considered historical strongholds for eastern black rail in the Northeast, population estimates report the number of breeding pairs as 0 to 10 in Delaware and 15 to 30 in Maryland (USFWS 2019). The project would utilize barges in these locations to install the inshore export cable that traverses Indian River Bay. Barges would introduce noise and artificial lighting, which may result in temporary impacts to the eastern black rail from disturbance or avoidance behavior but is not anticipated to impact feeding, breeding, or sheltering. The Service considers these effects to be insignificant.

Offshore

We have no evidence that the eastern black rail migrates or ventures offshore. Any individuals of this species that may occur offshore over the life of the Maryland Offshore Wind project are expected to be storm-blown or otherwise accidental strays. Thus, the risk of any adverse effects to these species from the offshore components of the Maryland Offshore Wind project is discountable.

Effect Determination

The Service concurs with BOEM's determination that the proposed action "may affect, but is not likely to adversely affect," the eastern black rail. Although the project increases exposure to the noise and lighting within inshore wetland environments, the Service considers the effects to be insignificant due to noise and lighting being temporary and not impacting their ability to feed, breed, or shelter.

Northern long-eared bat (*Myotis septentrianalis*), federally listed endangered

Onshore

Within the onshore portion of the action area, suitable habitat for the northern long-eared bat is present in the forested portion of the construction footprint for the onshore substations. During the summer, northern long-eared bats may roost singly or in maternity colonies underneath bark, or in cavities or crevices of live trees and snags. Based on current available data, the Service has no documented presence of the species within or adjacent to the action area. Although the BA cites the potential presence of northern-long eared bats based upon acoustic data collected by Delaware's Department of Natural Resources and Environmental Control (DNREC), the Service received clarification from DNREC that the calls were likely false positives and the methodology inconsistent with Service bat survey guidelines (H. Niederriter, DNREC, email to S. Deeley, Service, Nov 08, 2023 and Nov 21, 2023). The Service's current range maps indicate that they are not likely to be present in the project area (USFWS ECOS 2024). However, BOEM has chosen to assume presence of the northern long-eared bat in the onshore project area. Assuming presence, the onshore components of the Project may affect the northern long-eared bat through habitat loss and disturbance from tree removal. In addition, noise, exhaust, and vehicle presence and movement. during construction could result in disturbance potentially impacting breeding and sheltering during the daytime hours.

Offshore
No suitable foraging habitat for northern long-eared bats exists in the offshore environment. Research on the presence or absence of northern-long eared bats in marine environments is limited. Bat species have been detected offshore along the mid-Atlantic coast, but the farthest *Myotis* species were detected was about 7 miles from shore (Sjollema et al. 2014), suggesting it is unlikely for the northern long-eared bat to be found using the Lease Area OCS-A 0490, which is over 10 miles from the mainland (Ocean City, Maryland). Acoustic detectors on US Wind, Inc.'s Metocean Buoy did not record any northern long-eared bats between 2021 and 2023 (Normandeau Associates 2024). Bat acoustic detectors deployed on US Wind, Inc.'s survey vessels in 2021 and 2022 did not record any northern-long eared bats; however, of the 148 total individual bat echolocation detections, 34 percent were not clear enough to be identified to the species level (ESS Group, LLC 2022). There are many examples of bats being killed by barotrauma or collision with onshore wind turbines, and bats encountering offshore turbines could be killed by these mechanisms as well.

Though northern long-eared bats may occur offshore occasionally, other bat species occur offshore more regularly and in higher numbers, and our understanding of bats' use of the offshore environment is far from complete. Thus, we fully support and appreciate the inclusion of bats in the Maryland Offshore Wind Avian and Bat Post-Construction Monitoring Plan.

Effect Determination
Based on best available information, use of the offshore action area's airspace over Lease Area OCS–A 0490 by northern long-eared bats is undocumented, and thus we consider adverse effects to this species from the offshore components would be discountable. While the proposed Project would have impacts to suitable summer roosting habitat, the impacts would be minimized with time-of-year restrictions for tree clearing and therefore considered insignificant and "not likely to adversely affect" the northern long-eared bat.

The Service concurs with BOEM's determination that the proposed action "may affect but is not likely to adversely affect" the northern long-eared bat. Our concurrence with BOEM's determination is predicated upon full implementation of the following Conservation Measures, proposed by BOEM and US Wind, Inc. (Lessee) in the BA:

- Tree clearing activities will be conducted between October 1 to March 31.
- If tree clearing is anticipated to occur outside of this period, Lessee will consult with the Service to develop appropriate avoidance, minimization, and mitigation measures.

Tricolored bat (*Perimyotis subflavus*), federally proposed endangered

Onshore
Within the onshore portion of the action area, suitable habitat for the tricolored bat is present within the forested portion of the construction footprint for the onshore substations. During the summer, tricolored bats roost primarily among live and dead leaf clusters of live or recently dead deciduous hardwood trees as well as other tree types. Acoustic data collected by DNREC did not indicate the presence of tricolored bats in the Indian River Bay vicinity (H. Niederriter, DNREC, email to S. Deeley, Service, Nov 08, 2023 and Nov 21, 2023). The Service's current range maps indicate that the species may be present within the project area (USFWS ECOS 2024). Based on current available data, the Service has no documented presence within or proximate to the action area. However, BOEM has chosen to assume presence of the tricolored bat in the onshore project area. Assuming presence, the onshore components of the Project may affect the tricolored bat through habitat loss and disturbance from tree removal. In addition, noise, exhaust, and vehicle presence and movement during construction could result in disturbance potentially impacting breeding and sheltering during the daytime hours.

Offshore
No suitable foraging habitat for tricolored bats exists in the offshore environment. Although tricolored bats have been observed on islands and offshore environments along the Atlantic Coast including Gulf of Maine (Peterson 2016), Assateague Island (Johnson and Gates 2008), and Martha's Vineyard (Buresch 1999), it is unclear whether the species utilized vessels to travel some or all of the way to these locations. Acoustic detectors on US Wind, Inc.'s Metocean Buoy did not record any tricolored bats between 2021 and 2023 (Normandeau Associates 2024). Bat acoustic detectors deployed on US Wind, Inc.'s survey vessels in 2021 and 2022 did not record any tricolored bats; however, of the 148 total individual bat echolocation detections, 34 percent were not clear enough to be identified to the species level (ESS Group, LLC 2022). There are many examples of bats being killed by barotrauma or collision with onshore wind turbines, and bats encountering offshore turbines could be killed by these mechanisms as well.

Though tricolored bats do occur offshore occasionally, other bat species occur offshore more regularly and in higher numbers, and our understanding of bats in the offshore environment is far from complete. Thus, we fully support and appreciate the inclusion of bats in the Maryland Offshore Wind Avian and Bat Post-Construction Monitoring Plan.

Effect Determination
Although the ESA does not require conferencing on species proposed to be listed unless the action is likely to jeopardize the continued existence of the species, BOEM assessed the effects of the proposed action to tricolored bats and requested a conference. Therefore, this section shall serve as our conference concurrence.

While the proposed Project would have impacts to suitable summer roosting habitat, the impacts would be minimized through the use of time-of-year restrictions for tree clearing. Based on best available information, use of the offshore action area's airspace over Lease Area OCS – A 0490 by tricolored bats is undocumented, and thus the risk of any adverse effects to this species from the offshore components would be discountable.

The Service concurs with BOEM's determination that the proposed action "may affect but is not likely to adversely affect" tricolored bats. Our conference concurrence with BOEM's determination of the project is predicated upon full implementation of the following Conservation Measures, proposed by BOEM and US Wind, Inc. in the BA:

- Tree clearing activities would be conducted between October 1 to March 31.
- If tree clearing is anticipated to occur outside of this period, Lessee will consult with the Service to develop appropriate avoidance, minimization, and mitigation measures.

If the tricolored bat is listed under the ESA during the term of this action and there is no significant new information and there have been no significant changes that could alter the content of this conference concurrence regarding effects to tricolored bat, BOEM should contact the Service in writing to affirm the validity of the conference concurrence and request it be adopted as a standard concurrence to ensure continued coverage under the ESA.

Monarch butterfly (*Danaus plexippus*), candidate species

BOEM determined that the proposed action "may affect, but is not likely to adversely affect," the monarch butterfly.

Onshore
Within onshore portions of the action area, suitable reproductive habitat is not present. No milkweed plant species required for monarch butterfly reproduction are present and the Project would not replant temporarily disturbed areas with herbaceous plants such as milkweed. However, monarch butterflies may use trees, shrubs, and forbs within the action area for nectar (feeding) or sheltering. Proposed onshore activities would occur within forested or developed lands, which may temporarily disturb monarch butterflies that are feeding or sheltering in the area by noise, exhaust, and vehicle presence and movement associated with construction and could also remove habitat through grading and tree removal.

Offshore
We have no evidence that the monarch butterfly migrates or ventures offshore. Any individuals of this species that may occur offshore over the life of the Maryland Offshore Wind project are expected to be storm-blown or otherwise accidental strays. Thus, adverse effects to the monarch butterfly from the offshore components of the Maryland Offshore Wind project would be discountable.

Effect Determination
Although the ESA does not require conferencing on candidate species, BOEM assessed the effects of the proposed action to monarch butterfly and requested a conference. Therefore, this section shall serve as our conference concurrence. The Service concurs with BOEM's determination that the proposed action is not likely to jeopardize the continued existence of the monarch butterfly. While the proposed Project would have temporary and permanent impacts to vegetation that may be used by monarch butterfly for feeding or sheltering, due to the lack of milkweed in areas of impact and the limited project footprint in vegetated areas, we expect any habitat loss to be insignificant.

The BA does not provide Conservation Measures specific to monarch butterflies. The Service recommends that BOEM implement the following measures to avoid and minimize impacts to monarch butterfly:

- Plant only native vegetation and pollinator-friendly species whenever possible.
- If milkweed were discovered, the Service recommends that BOEM implement the following minimization measures:
    - Consult with the Service on the use of herbicide for right-of way maintenance and in other portions of the Project where habitat is likely to occur.
    - Avoid clearing milkweed from May 15 through September 30, when monarch caterpillars may be present.

If the monarch butterfly is listed under the ESA during the term of this action and there is no significant new information and there have been no significant changes that could alter the content of this conference concurrence regarding effects to monarch butterfly, BOEM should contact the Service in writing to affirm the validity of the conference concurrence and request it be adopted as a standard concurrence to ensure continued coverage under the ESA.

Compensatory Mitigation

On May 6, 2024, BOEM and US Wind, Inc. submitted a revised Construction and Operations Plan which included compensatory mitigation for the Maryland Offshore Wind project. On May 28, 2024, the Service, BOEM and US Wind, Inc. met to discuss and incorporate revisions to the compensatory mitigation Conservation Measure and discuss potential compensatory mitigation projects. Once projects have been identified and meet established criteria outlined in the Conservation Measure, we will appropriately credit US Wind Inc. for its contributions to conservation efforts.

The Service is committed to working closely with offshore wind lessees to ensure that take is addressed effectively. We will collaborate to identify and develop well-defined projects that include quantifiable goals, baseline data, comprehensive monitoring plans, adaptive management frameworks, defined timelines, and regular reporting requirements. By doing so, we aim to ensure that mitigation measures are effective, measurable, and contribute significantly to addressing impacts on the species.

We understand the importance of providing clear guidelines and support throughout this process. The Service will work with lessees to address concerns for each project component and maintain open communication to facilitate a smooth implementation and evaluation process. Our goal is to establish a structured framework that supports lessees in achieving successful mitigation outcomes. We are confident that through this collaborative approach, we can maintain strong working relationships and achieve positive results for both the industry and impacted listed species.

Biological Opinion on the Effects of the Maryland Offshore Wind Project on the Piping Plover (*Charadrius melodus*; threatened), Rufa Red Knot (*Calidris canutus rufa*; threatened) and Roseate Tern (*Sterna dougallii dougallii*; endangered).

Prepared for:
Bureau of Ocean Energy Management
Office of Renewable Energy Programs
Washington, D.C.

Prepared by:
U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
Annapolis, Maryland

Preparers:
Julie Thompson-Slacum
Sabrina Deeley
Melissa Phillips-Hagedorn

Field Office Supervisor:
Genevieve LaRouche

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BACKGROUND AND INTRODUCTION

This document represents the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) based on the Service's review of the Bureau of Ocean Energy and Management's (BOEM) December 2023 Biological Assessment (BA) and its effects on the federally threatened piping plover (*Charadrius melodus*) and rufa red knot (*Calidris canutus rufa*) and endangered roseate tern (*Sterna dougallii dougallii*) in accordance with Section 7 of the Endangered Species Act (ESA) (87 Stat. 884, as amended; 16 USC §1531 *et seq*.). BOEM is the lead Federal action agency for this consultation (50 CFR §402.07).
Section 7(a)(2) of the Endangered Species Act (ESA), 16 USC §1536(a)(2), states that each Federal agency shall, in consultation with the Secretary, ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. In fulfilling these requirements, each agency is to use the best scientific and commercial data available. Regulations interpreting and implementing the requirements of Section 7(a)(2) are found in 50 CFR part 402. BOEM is the lead Federal action agency for the consultation (50 CFR §402.07).

Information Standard

Section 7(a)(2) and the regulations implementing it require that both action agencies and the Service employ best scientific and commercial data available in carrying out their consultation responsibilities [16 USC §1536(a)(2); 50 CFR §402.14(d) and (g)(8)][1]. The Service's policy on Information Standards Under the Endangered Species Act [59 FR 34271 (July 1, 1994)] calls for the review of all scientific and other information to ensure that the information used by the Service to implement the ESA is reliable, credible, and represents the best scientific and commercial data available.

Uncertainty arising from a lack of information is inherent in biological evaluations and, when significant, can limit confidence in the conclusions drawn from the information or, in some cases, make drawing conclusions difficult. When significant data gaps exist, the Service applies the ESA's "best available scientific information" standard as well as the standards of reasoned decision-making under the Administrative Procedure Act. The Service may also construct reasonable assumptions to fill those gaps, provided they have a rational basis to inform such an approach. For example, the Service may find that surrogate species information can be used to address and reduce uncertainty arising from incomplete or contradictory information. When the scientific literature, surrogate species information, and expert opinion do not support consistent biological determinations, the Service must consider the weight of scientific authority in evaluating expert opinions and the basis for those opinions.

This Opinion contains (among other things) a description of the project, species affected, and anticipated impacts. The Service based its findings on its independent review of the best scientific and commercial data available. In doing so, the Service evaluated information in Service files and the scientific literature and conferred with species and technical experts regarding species ecology, phenology, behavior, and the effects of wind turbines on listed birds.

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[1] 50 CFR §402.14(g)(8) also states that the Service "will give appropriate consideration to any beneficial actions taken by the Federal agency or applicant…"

Moreover, in preparing this Opinion, the Service reviewed the results of collision risk models with respect to the effects of the proposed project on local and range-wide, ESA-listed avian populations. For offshore wind energy development projects, the collision risk models estimate the numbers of piping plover, rufa red knot, and roseate tern that are reasonably certain to collide with the project's wind turbine generators (WTGs). Models are used to synthesize complex data and assist in the formulation of predictions. Our confidence in a model's projections is determined by a number of factors, such as the amount and quality of the available data and understanding of relevant physical and biological processes; appropriate variance in input estimates and number of model iterations (for stochastic models); use of sensitivity tests to explore effects of changes in parameter estimates; consistency of model projections with those of other related models (or logical explanations for deviations); and comparisons between model projections and empirical evidence from past experience with similar or related questions. In assessing the results of the models used to explore the potential impacts of the Maryland Offshore Wind project, we carefully considered these factors and judiciously considered model predictions in the formulation of our findings.

DESCRIPTION OF PROPOSED ACTION

Project Description

As defined in the ESA Section 7 regulations (50 CFR §402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas." The Federal action under consideration in this Opinion is approval by BOEM of a Construction and Operations Plan (COP), submitted to BOEM by US Wind, Inc. (Lessee) in August 2020 which would authorize US Wind, Inc. for construction, operation and maintenance (O&M), and eventual decommissioning of an up to 2,000-megawatt (MW) offshore wind energy facility known as the Maryland Offshore Wind Project. The Maryland Offshore Wind Project consists of three phases, MarWin (300 MW), Momentum Wind (808 MW), and build-out of the remaining lease area to fulfill future demand.

The following is a summary of the proposed action. Additional details are located in the BA and the COP (BOEM 2023a, TRC Companies 2024). Figure 1 provides an overview of the project location and orientation while Figure 3 displays onshore and inshore project components.

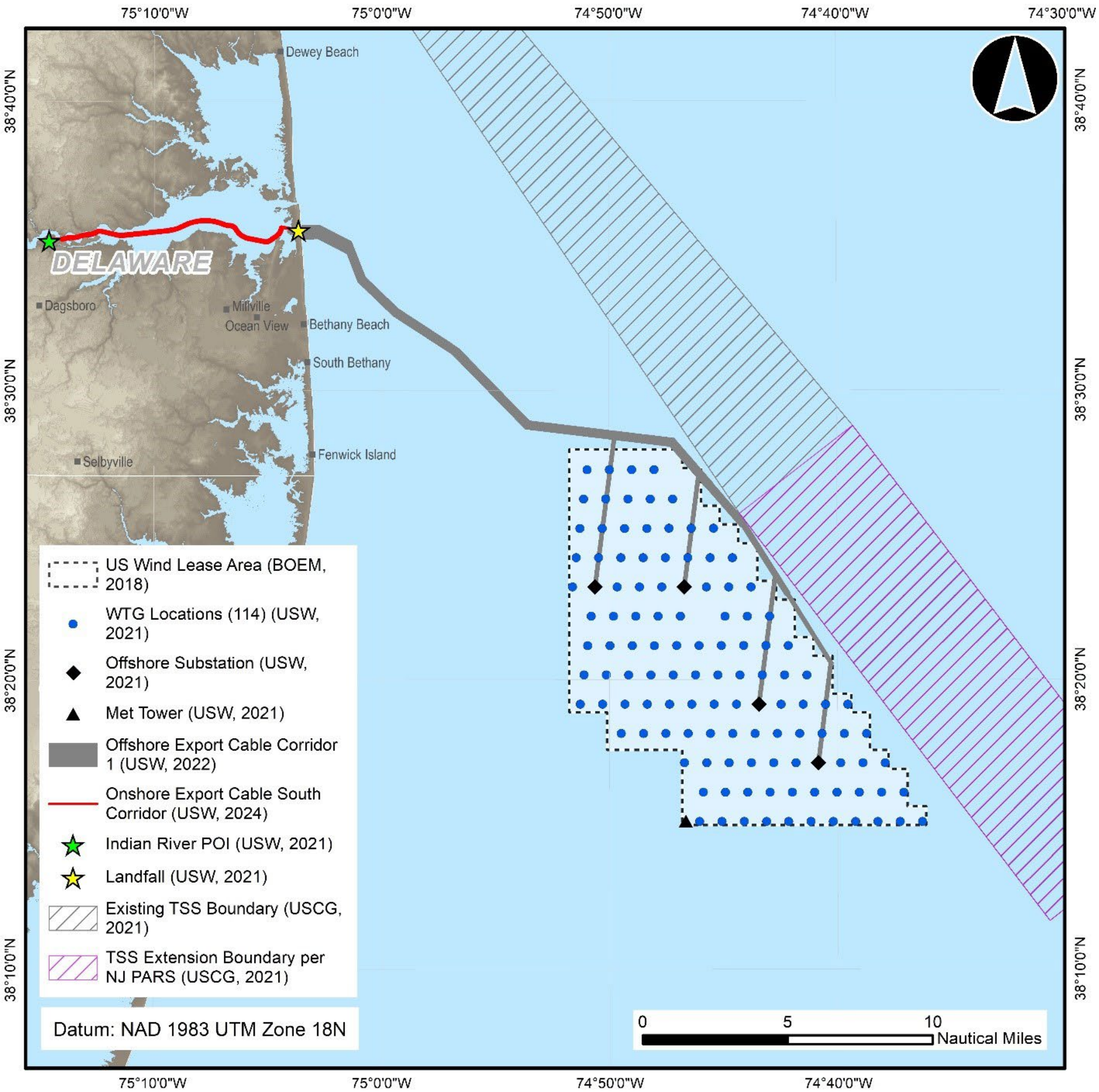


Figure 1. Maryland Offshore Wind project vicinity and proposed project footprint (TRC Companies 2024).

Offshore Project Area

<u>Location</u>

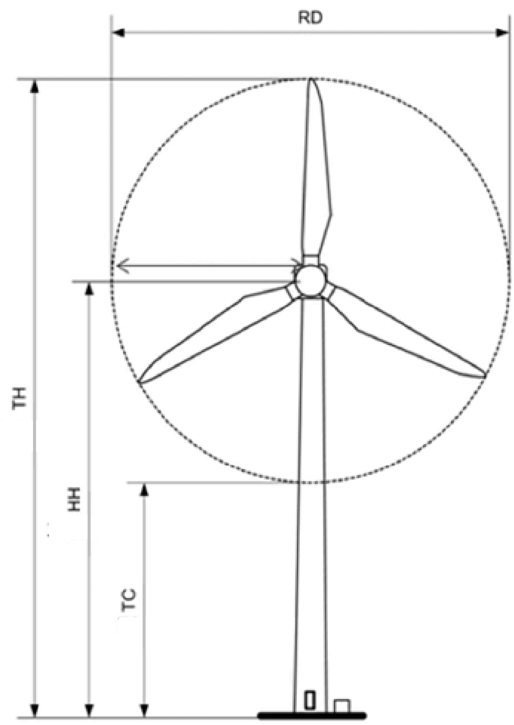
The Maryland Offshore Wind offshore project area is located approximately 10.1 miles (16.25 kilometers [km]) east of Ocean City, Maryland (Figure 1). The WTGs and offshore substations (OSSs) are located within the BOEM Renewable Energy Lease Area OCS-A 0490 (Lease Area), The Lease Area is about 18 (29 km) miles from westernmost edge to easternmost edge and 19 miles (30.58 km) from northernmost to southernmost edge and a total of 80,000 acres (32,375 hectares).

Wind Turbine Generators (WTGs)

Up to 114[2] WTGs, ranging from 14.7 to 18-MW capacity, would be constructed in a grid pattern with 0.89 miles (1.43 km) in an east-west direction and 1.17 mi (1.89 km) in a north-south direction between WTGs. WTG design components are displayed in Figure 2 and specifications for Maryland Offshore Wind are summarized in Table 1. Each WTG consists of a monopile foundation driven into the ocean floor using a hydraulic impact hammer. After installation, scour protection will be placed around the base of the monopile.

Figure 2. Wind turbine design components (adapted from Saffour and Omar 2010).

Rotor Diameter **(RD)**
Total Height **(TH)**
Hub Height **(HH)**
Air Gap (or Tip Clearance **(TC)**)



[2] The Maryland Offshore Wind project design envelope includes up to 121 WTGs. The proposed action in the BA includes a 1 mile (1.9 km) setback from the Traffic Separation Scheme from Delaware Bay which removes 7 WTG locations, resulting in a total of 114 WTGs.

Table 1. WTG design specifications for Maryland Offshore Wind (BOEM 2023a).

WTG Specification	Measurements
Rotor Diameter	820 feet (250 m)
Total Height MSL[1]	938 feet (286 meters (m))
Hub Height MSL	528 feet (161 m)
Air Gap (or tip clearance)[2]	118 feet (36 m)
Rotor Swept Zone[3]	118 feet (36 m) to 938 feet (286 m)

[1]Mean sea level (MSL)
[2]The Air Gap (or tip clearance) is measured between the mean surface level and the lowest point of the WTG blade.
[3]The Rotor Swept Zone is equal to Total Height minus the Air Gap.

Offshore Substations

The proposed project would construct up to four OSSs, each with a rated capacity of up to 400 MW, to collect and export the power generated by the WTGs. The OSSs would be placed within the rows of the WTGs. Each substation would consist of two components, a foundation (monopile or jacket) and a topside. Monopiles would be installed using hydraulic impact hammer or vibratory hammer while jacket foundations would be installed using piling or suction buckets. Both options would install scour protection around the base. The topside would contain the decks housing the electrical and support equipment, including possibly a helideck. Topside specifications for Maryland Offshore Wind are summarize in Table 2.

Table 2. Topside design specifications for Maryland Offshore Wind (TRC Companies 2024).

Topside Specification	Measurements
Width	Up to 131 feet (40 m)
Length	Up to 262 feet (80 m)
Height above Foundation Interface	Up to 197 feet (60 m)
Height Mean sea level	197 feet (60 m)

Meteorological (Met) Tower

The Met Tower would support project operations and long-term monitoring. It would be installed on the southwest corner of the Lease Area. The Met Tower would be equipped with white and yellow marine lanterns as well as directional fog signals. It would be constructed using a bottom-fixed structure composed of a steel lattice mast, steel deck, and steel brace caisson-style foundation. The Met Tower would stand at a height of approximately 328 feet (100 m) above mean sea level, while the platform deck supporting the mast would be approximately 3,000 square feet (279 square meters).

Inter-Array Cables

The inter-array cables would interconnect a small grouping of WTGs to the OSSs, gathering power to export to shore. The inter-array cables would be installed in a narrow temporary trench and buried to a target depth of 3.3 ft (1 m) to 9.8 ft (3 m). There would be approximately 4 to 6 WTGs connected per grouping and approximately 4 to 7 WTG groupings connected to each OSS, for a total of approximately 22 WTG strings.

Offshore Export Cables

The offshore export cables would transfer the electricity from each OSS to the cable landing location at 3R's Beach at Delaware Seashore State Park in Sussex County, Delaware. A total of up to four offshore export cables, one for each OSS, would be installed in a temporary trench and buried to a target depth of 3.3 ft (1 m) to 9.8 ft (3 m), not more than 13.1 ft (4 m). Depending upon site conditions, the offshore export cable route corridor would be approximately 1,968 ft (600 m) wide.

<u>Vessels</u>
The proposed project would utilize a variety of construction and support vessels, such as jack-up cranes, tugs, cargo barges, heavy lift, dredging, rock-dumping, crew transfer, and accommodations to construct the offshore project components. Vessel traffic would average 4 trips per day during construction and average 37 vessels in use at one time. Vessels would travel between the offshore project area and would be built at a Sparrow's Point facility near Baltimore, Maryland. The port would be used as a staging facility for offshore project components.

Onshore Project Area

<u>Location</u>
The project would make landfall in Sussex County, Delaware, and continue west to the project end point which is the point of interconnection at the Indian River substation in Dagsboro, Delaware (Figure 3).

<u>Cable Landfall Location</u>
The proposed project would bring the offshore export cable onshore at 3R's Beach at Delaware Seashore State Park in Sussex County, Delaware. The offshore export cables would transition onshore by horizontal directional drilling (HDD) - drilling a tunnel underwater and/or underground and pulling the cables into up to four cable ducts and pulling the cables into subterranean transitions vaults. The onshore cable landfall location is expected to have a footprint of approximately 0.57 acres (0.23 hectares).

<u>Inshore Export Cable Corridor</u>
The inshore export cable route would begin at Old Basin Cove and would traverse Indian River Bay to Deep Hole. Up to four cables would be buried up to 3 to 7 feet (1 to 2 meters). Cables would be installed for a total combined length of 42 miles (68 kms) within a 1,640-foot (500 meter) corridor. In the shallow, southern portions of Indian River Bay, cable installation would utilize a barge-mounted vertical injector and be planned during periods of high water to avoid dredging. Cable installation in the remaining portions of Indian River Bay would use mechanical or hydraulic dredging. The total area of dredging would be up to 39 acres (0.16 square kilometers) and the total amount of dredge material would be up to 73,676 cubic yards (56,329.344 cubic meters). The dredged material would be placed at the onshore substations site to allow for dewatering before being disposed of at upland disposal facilities (landfills). At Deep Hole, the cables would exit the underground duct into underground transition vaults and travel underground to the onshore substations.

Figure 3. Inshore project footprint (TRC Companies 2024).

<u>Onshore Substation</u>
The proposed project would build up to three new substations in Dagsboro, Delaware to serve as the final point of interconnection for power distribution to the existing grid. The new substations would connect to the existing Delmarva Power and Light's Indian River substation by a short overhead line approximately 500 feet (152 meters long). The total permanent footprint from the onshore substation construction and access road would be up to 10.3 acres (4.2 hectares).

<u>Port Facilities</u>
The project would construct a waterfront operations and maintenance facility in the Ocean City, Maryland vicinity. The facility would consist of office space, a coordination center, crew support and warehouse space as well as quayside and berthing areas for crew transfer vehicles.

<u>Construction Equipment</u>
Construction equipment would vary depending on construction locations. For the HDD locations, equipment would include a drilling rig, mud pumps, drilling fluid cleaning systems, pipe-handling equipment, excavators, generators, and trucks. Inshore work would utilize barge, jack-up, tugs, small work boats, crane, excavator, winches, generators, and lights. Equipment for onshore substation construction would include cranes, earth-moving equipment, and related

construction equipment

Vegetation Removal
The project would permanently impact up to 10.3 acres (4.2 hectares) of forested vegetation for the onshore substations construction. The project would complete post-construction habitat restoration for temporarily cleared areas.

Timing
The proposed project would begin construction in 2024 and be completed in 2028. Land-based construction would commence in 2024 and finish in 2027. Offshore construction would commence in 2024 and finish in 2028. Commissioning, the process of testing WTGs before operations, would occur from 2025 through 2028 (TRC Companies 2024).

Operations and Maintenance
The project is anticipated to have an operating term of 35 years which commences upon COP approval. The project would perform routine operations and maintenance for WTGs and OSSs using crew transfer vessels and service operation vessels. Larger vessels originating from additional ports in Maryland, Virginia, or Delaware may be used for routine or unplanned maintenance.

Decommissioning
US Wind, Inc. would be required to submit an application to BSEE for approval before commencement of decommissioning. The decommissioning application process for WTGs, OSSs and associated project components would include an opportunity for consultation with municipal, state, and Federal management agencies. Unless otherwise authorized by BSEE, US Wind, Inc. would have to complete decommissioning within 2 years of the lease termination.

Conservation Measures

The Service's Consultation Handbook defines "Conservation Measures" as "actions to benefit or promote the recovery of listed species that are included by a Federal agency as an integral part of a proposed action under ESA consultation. These actions will be taken by the Federal agency or applicant and serve to minimize or compensate for project effects on the species under review" (USFWS and NMFS 1998). Conservation Measures may include actions that the Federal agency or applicant have committed to complete in a biological assessment or similar document. When used in the context of the ESA, "Conservation Measures" "represent actions pledged in the project description that the action agency or the applicant will implement to further the recovery of the species under review and can contribute to the Federal agency's ESA Section 7(a)(1) responsibilities. Such measures may be tasks recommended in the species' recovery plan, should be closely related to the action, and should be achievable within the authority of the action agency or applicant." Additionally, "If the conservation measure…does not minimize impacts to affected individuals in the action area, the beneficial effects of the conservation measure are irrelevant to the incidental take analysis" (USFWS and NMFS 1998).

The following Conservation Measures have been adopted by BOEM and/or Lessee (i.e., in the BA, COP, DEIS and via subsequent correspondence) to avoid, minimize, or offset project effects on the piping plover, rufa red knot and roseate tern. Additional ongoing, long-term commitments adopted by BOEM and/or Lessee to reduce the uncertainty associated with potential project effects for each of the listed bird species are listed below as Monitoring, Modeling and Mitigation Measures.

1. Wind Turbine Generator Configuration and Maintenance

a. Lessee will ensure that the WTGs provide an air gap (minimum blade tip elevation to the sea surface) to minimize collision risk to birds[3] (e.g., roseate terns) that may fly close to the ocean surface.

b. To minimize the attraction of birds to operating WTGs, Lessee will install bird-perching deterrent devices on WTGs and OSSs to the maximum extent practicable.

c. Lessee will submit for BOEM, BSEE, and Service review, and for BOEM and BSEE approval, a Bird Deterrent Plan to discourage perching on offshore infrastructure by birds. Prior to approval of the plan, BOEM and BSEE will address all Service comments. The Bird Deterrent Plan will include the type(s) and locations of bird perching-deterrent devices, include a maintenance plan for the life of the projects, allow for modifications and updates as new information and technology become available, and track the efficacy of the deterrents. The Bird Deterrent Plan will be based on best available science regarding the effectiveness of perching deterrent devices on minimizing collision risk. The location of bird-deterrent devices will be proposed by Lessee based on best management practices applicable to the appropriate operation and safe installation of the devices. A draft Bird Deterrent Plan will be submitted at least 90 days before the start of WTG construction, and a final plan will be approved at least 30 days before the start of construction.

2. Offshore Lighting

While complying with all Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM lighting, marking and signage requirements:

a. Lessee will limit lighting during offshore operations to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of birds.

b. Lessee will use red flashing FAA lights on the WTGs instead of constant white light, to reduce further bird attraction, and will use an Aircraft Detection Lighting System (ADLS) to significantly reduce the number of hours FAA lighting will be illuminated. Lessee will use an FAA-approved vendor for the ADLS, which will activate the FAA

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[3] Some Conservation Measures taken directly from the BA or BOEM correspondence include references to species other than the listed birds addressed in this BO. In such cases, the applicability of that measure to non-listed species is not a binding provision of this BO; however, its implementation may be required by BOEM under other authorities.

hazard lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night. Lessee will confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the Fabrication and Installation Report.[4]

c. Lessee will use yellow flashing marine navigation lights on the WTGs, instead of constant white light, to reduce further bird attraction, and will use down lighting and down shielding to the maximum extent practicable. Lessee will light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc around the structure. To minimize the potential of attracting migratory birds, the top of each light will have existing shielding to minimize upward illumination.

3. Onshore Project Siting

Lessee will locate onshore project elements, such as cable landfalls, cable infrastructure, onshore facilities, construction laydown areas and access roads, in previously disturbed areas, where feasible, to avoid impacts to nesting beaches.

4. Horizontal Direction Drilling

Lessee will utilize horizontal directional drilling (HDD) for cable installation to avoid impacts to nesting beaches.

5. Onshore Lighting

Lessee will minimize lighting-related impacts by using best management practices, where feasible. Examples of best management practices to minimize the adverse impacts of artificial onshore lighting will include not lighting the onshore facility at night except in the case of an emergency that requires an immediate response, and the use of down-shielded light fixtures to reduce the visibility of light by birds, bats, and insects flying above the facility.

6. Work In Benthic Habitats

To minimize impacts to spawning horseshoe crabs, which are a food source for rufa red knots in the Delaware Bay region, Lessee will implement the following work windows:

- No in-water work (e.g., cable installation, HDDs, dredging) in Indian River Bay and Atlantic beach landfall from March 1 through September 30.
- No onshore, land-based HDD activities at the Atlantic beach landfall from April 15 through September 30.

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[4] In the effects table of this BO, the Service provides concurrence that aircraft obstruction lighting using the ADLS is expected to have a discountable effect on the behavior of listed birds.

7. Compensatory Mitigation

At least 180 days prior to the start of commissioning of the first WTG, Lessee would distribute a Compensatory Mitigation Plan for piping plovers, rufa red knot, and roseate tern to BOEM, BSEE, and the Service for review and comment. BOEM, BSEE, and the Service would review the Compensatory Mitigation Plan and provide any comments on the plan to the Lessee within 60 days of its submittal. Lessee would be required to resolve all comments on the Compensatory Mitigation Plan to BOEM, BSEE, and the Service's satisfaction before implementing the Plan and before commissioning of the first WTG.

The Compensatory Mitigation Plan would provide compensatory mitigation actions to fully offset the impact of the incidental take of piping plover, rufa red knot, and roseate tern. The Compensatory Mitigation Plan would require that the compensatory mitigation be implemented by the fifth year of WTG operation.

The Compensatory Mitigation Plan would include:

(1) a quantification of the level of offsets to fully offset the impact of the incidental take expressed in the ITS, based on scientifically recognized techniques and methodologies for each of the impacted species; piping plover, rufa red knot, and the roseate tern.
(2) detailed description of the mitigation actions for each species (e.g., nest protection, predator control, habitat enhancement or restoration, etc.).

- Piping plover examples: Habitat enhancement, predator control, reduction of disturbance at wintering sites, etc.
- Rufa red knot examples: habitat restoration, reduce displacement from peregrine falcons, red tide rehabilitation, etc.
- Roseate tern examples: habitat maintenance or restoration at nesting colonies, establishment of buffer zones around staging areas, etc.

(3) the specific location for each mitigation action.
(4) a timeline for completion of the mitigation measures.
(5) details of the mitigation mechanisms (e.g., conservation bank, in-lieu fee, applicant-proposed mitigation).
(6) best available science linking the compensatory mitigation action(s) to the projected level of collision mortality; and
(7) monitoring and reporting to ensure the effectiveness of the mitigation actions in offsetting take.

Every 5 years for the life of the project, and as detailed below, BOEM would coordinate with BSEE, the Service, and Lessee to assess the effectiveness of compensatory mitigation for collisions of piping plover, rufa red knot, and roseate tern with the Maryland Offshore Wind WTGs.

- BOEM would take the lead in coordinating this effort with the appropriate state and federal agencies.

- Mitigation assessments would include, at a minimum: implementation status; monitoring plan and data, status, and results; and adaptive management plans for the following 5 years.
- Additional mitigation assessments (addressing minimization and/or compensatory mitigation) may be carried out at any time upon request by BOEM, BSEE, the Service, or Lessee, based on new information or changed circumstances. These periodic mitigation assessments for Maryland Offshore Wind may eventually be integrated into a regional or coastwide adaptive monitoring and impact minimization framework.

Note: The remaining measures are intended to address significant data gaps in avian use of offshore areas, collision modelling, compensatory mitigation and effects of electromagnetic fields (EMF) to prey sources. They are not intended to avoid or minimize impacts, such as collision risk, at this time.

8. Collision Risk Model Support

BOEM has funded the development of a Stochastic Collision Risk Assessment for Movement (SCRAM, Adams et al. 2022), which builds on and improves earlier collision risk modeling frameworks. The Service fully supports SCRAM as a scientifically sound method for integrating best available information to assess collision risk for the three listed bird species addressed in this Opinion. The first phase, SCRAM version 1.0.3, was released in early 2023 and the model results reflect a number of consequential data gaps and uncertainties. BOEM released SCRAM v2.0.3 (Gilbert et al. 2022) for use in May 2024. We expect that the current limitations of SCRAM will decrease substantially over time as more tracking data are incorporated into the model (e.g., from more individual birds tagged in more geographic areas, improved bird tracking capabilities, and emerging tracking technologies).

Via this Conservation Measure, BOEM commits to continue funding the refinement and advancement of SCRAM, or its successor, with the goal of continually improving the accuracy and robustness of collision mortality estimates. This commitment is subject to the allocation of sufficient funds to BOEM from Congress. This commitment will remain in effect until one of the following occurs:

i. The Maryland Offshore Wind Project ceases operation;
ii. BOEM determines, and the Service concurs, that a robust weight of evidence has demonstrated that collision risks to all three listed birds from Maryland Offshore Wind WTG operation are discountable; or
iii. BOEM determines, and the Service concurs, that further development of SCRAM (or its successor) is unlikely to improve the accuracy or robustness of collision mortality estimates.

9. Collision Risk Model Utilization

BOEM will work cooperatively with the Service to re-run the Band (2012) Annex 6 model and SCRAM model (or its successor) for the Maryland Offshore Wind project according to the following schedule:

- At least annually for the first 3 years of WTG operation.
- At least every other year for years 4 to 10 of WTG operation (i.e., years 4, 6, 8, and 10).
- At least every 5 years between year 10 and the termination of WTG operation (i.e., years 15, 20, 25, and 30).

Between these regularly scheduled model runs, BOEM will also re-run the Band (2012) model and SCRAM model (or its successor) within 90 days of each major model release or update, and at any time upon request by the Service or Lessee, and at any time as desired by BOEM. Prior to each model run, BOEM and the Service will reach agreement on model inputs based on best available science.

The above schedule may be altered upon the mutual agreement of BOEM and the Service. The schedule is subject to sufficient allocation of funds to BOEM from Congress. This commitment will remain in effect until one of the following occurs:

i. The Maryland Offshore Wind Project ceases operation;
ii. BOEM determines, and the Service concurs, that a robust weight of evidence has demonstrated that collision risks to all three listed birds from the Maryland Offshore Wind WTG operation are discountable; or
iii. BOEM determines, and the Service concurs, that further model runs are unlikely to improve the accuracy or robustness of collision mortality estimates.

10. Monitoring and Data Collection

BOEM will require that the Lessee develops and implements an Avian and Bat Post-Construction Monitoring Plan[5] in coordination with the Service, Delaware Department of Natural Resources and Environmental Control (DNREC), Maryland Department of Natural Resources (MDNR), and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring. Prior to commencing offshore construction activities, Lessee must submit an Avian and Bat Post-Construction Monitoring Plan for BOEM, BSEE, and Service review. BOEM, BSEE, and the Service will review the Avian

[5] The post-construction monitoring plan will address listed and non-listed birds and bats. This Opinion addresses only turbine collision risk for three listed birds, and only those elements of the plan related to collision of these three species are binding provisions of this Opinion. However, implementation of the full plan may be required by BOEM under other authorities. In addition, the Service may provide separate monitoring recommendations for other species (e.g., listed bats, non-listed birds) and/or other issues (e.g., assessing behavioral change of listed or non-listed species) as technical assistance pursuant to the ESA, the Migratory Bird Treaty Act (40 Stat. 755; 16 USC §703-712, as amended), and/or the National Environmental Policy Act (83 Stat. 852; 42 USC §4321 *et seq.*).

and Bat Post-Construction Monitoring Plan and provide any comments on the plan within 30 calendar days of its submittal. The Lessee will resolve all comments on the Avian and Bat Post-Construction Monitoring Plan to BOEM, BSEE, and the Service's satisfaction before implementing the plan and prior to the start of WTG operations. The objectives of the monitoring plan will include: (1) to advance understanding of how the target species utilize the offshore airspace and do (or do not) interact with the wind farm; (2) to improve the collision estimates from SCRAM (or its successor) for the three listed bird species; and (3) to inform any efforts aimed at minimizing collisions or other project effects on target species.

a. Monitoring. Lessee will conduct monitoring as outlined in the Maryland Offshore Wind Bird and Bat Monitoring Framework. The Avian and Bat Post-Construction Monitoring Plan will allow for changing methods over time (see Conservation Measure 5.d, below) in order to regularly update and refine collision estimates for listed birds. The plan will include an initial monitoring phase involving deployment of Motus radio tags on listed birds in conjunction with installation and operation of Motus receiving stations on WTGs in the Lease Area following offshore Motus recommendations.[6] The initial phase may also include deployment of satellite-based tracking technologies (e.g., GPS or Argos tags).

b. Annual Monitoring Reports. Lessee will submit to BOEM (at renewable_reporting@boem.gov), BSEE (via TIMSWeb with a notification email sent to protectedspecies@bsee.gov), and the Service's Chesapeake Bay Field Office (at CBFOprojectreview@fws.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 12 months of completion of the last avian survey. The report will include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. BOEM, BSEE, and the Service will use the annual monitoring reports to assess the need for reasonable revisions (based on subject matter expert analysis) to the Avian and Bat Post-Construction Monitoring Plan.

c. Post-Construction Quarterly Progress Reports. Lessee will submit quarterly progress reports during the implementation of the Avian and Bat Post-Construction Monitoring Plan to BOEM (at renewable_reporting@boem.gov), BSEE (via TIMSWeb with a notification email sent to protectedspecies@bsee.gov), and the Service's Chesapeake Bay Field Office (at CBFOprojectreview@fws.gov) by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The

[6] The post-construction monitoring plan will address listed and non-listed birds and bats. This Opinion addresses only WTG collision risk for three listed birds, and only those elements of the plan related to collision of these three species are binding provisions of this Opinion. However, implementation of the full plan may be required by BOEM under other authorities. In addition, the Service may provide separate monitoring recommendations for other species (e.g., listed bats, non-listed birds) and/or other issues (e.g., assessing behavioral change of listed or non-listed species) as technical assistance pursuant to the ESA, the Migratory Bird Treaty Act (40 Stat. 755; 16 USC §703-712, as amended), and/or the National Environmental Policy Act (83 Stat. 852; 42 USC §4321 *et seq.*).

[6] https://motus.org/groups/atlantic-offshore-wind/

progress reports will include a summary of all work performed, an explanation of overall progress, and any technical problems encountered.

d. Monitoring Plan Revisions. Within 30 calendar days of submitting the annual monitoring report, Lessee will meet with BOEM, BSEE, and the Service to discuss the following: the monitoring results; the potential need for revisions to the Avian and Bat Post-Construction Monitoring Plan, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If BOEM, BSEE, or the Service determines after this discussion that revisions to the Avian and Bat Post-Construction Monitoring Plan are necessary, BOEM may require Lessee to modify the Avian and Bat Post-Construction Monitoring Plan. If the reported monitoring results deviate from the impact analysis included in this Opinion, Lessee will transmit to BOEM recommendations for new mitigation measures and/or monitoring methods.

   The frequency, duration, and methods for various monitoring efforts in future revisions of the Avian and Bat Post-Construction Monitoring Plan will be determined adaptively based on current technology and the evolving weight of evidence regarding the likely levels of collision mortality for each listed bird species. The effectiveness and cost of various technologies/methods will be key considerations when revising the plan. Grounds for revising the Avian and Bat Post-Construction Monitoring Plan include, but are not limited to: (i) greater than expected levels of collision of listed birds; (ii) evolving data input needs (as determined by BOEM and the Service) for SCRAM (or its successor); (iii) changing technologies for tracking or otherwise monitoring listed birds in the offshore environment that are relevant to assessing collision risk; (iv) new information or understanding of how listed birds utilize the offshore environment and/or interact with wind farms; and (v) a need (as determined by BOEM and the Service) for enhanced coordination and alignment of tracking, monitoring, and other data collection efforts for listed birds across multiple wind farms/leases on the OCS.

   BOEM will require Lessee to continue implementation of the Avian and Bat Post-Construction Monitoring Plan) until one of the following occurs: (i) the Maryland Offshore Wind Project ceases operation; (ii) BOEM determines, and the Service concurs, that a robust weight of evidence has demonstrated that collision risks to all three listed birds from Maryland Offshore Wind WTGs operation are negligible (i.e., the risk of take from WTG operation is found to be discountable); or (iii) BOEM determines, and the Service concurs, that further data collection is unlikely to improve the accuracy or robustness of collision mortality estimates and is unlikely to improve the ability of BOEM and Lessee to reduce or offset collision mortality (see Conservation Measure 7, below).

e. Operational Reporting (Operations). Lessee will submit to BOEM (at renewable_reporting@boem.gov) and BSEE (via TIMSWeb with a notification email sent to protectedspecies@bsee.gov) an annual report summarizing monthly operational data calculated from 10-minute supervisory control and data acquisition (SCADA) data for all WTGs together in tabular format: the proportion of time the WTGs were operational (spinning at >x rpm) each month, the average rotor speed (monthly revolutions per minute[rpm]) of spinning WTGs plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. Any operational data considered by Lessee to be privileged or confidential must be clearly marked as confidential business information and will be handled by BOEM and BSEE in a manner consistent with 30 CFR §585.114. BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the impact analysis included in this Opinion.

f. Raw Data. Lessee will store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to BOEM, BSEE, and the Service, upon request for the duration of the Lease. Lessee will work with BOEM to ensure the data are publicly available. All avian tracking data (i.e., from radio and satellite transmitters) will be stored, managed, and made available to BOEM, BSEE, and the Service following the protocols and procedures outlined in the agency document entitled, *Guidance for Coordination of Data from Avian Tracking Studies*, or its successor.

11. Incidental Mortality Reporting[7]

a. Lessee must provide an annual report to BOEM, BSEE, and the Service documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report will contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information.

b. Observation of a dead listed bird or bat will be reported to BOEM (at renewable_reporting@boem.gov), BSEE (via TIMSWeb with a notification email sent to protectedspecies@bsee.gov), and the Service as soon as practicable (taking into account crew and vessel safety), ideally within 24 hours and no more than 3 days after the sighting. If practicable, the dead specimen will be carefully collected and preserved in the best possible state, contingent on the acquisition of the necessary wildlife permits and compliance with the Lessee health and safety standards. Birds with Service bands will be reported to the USGS Bird Banding Lab (BBL)[8]. Also, see Monitoring Requirements at the end of this Opinion.

12. Electromagnetic Fields (EMF) Research

[7] Incidental observations are extremely unlikely to document any fatalities of listed birds that may occur due to WTG collision. While this Conservation Measure appropriately requires documentation and reporting of any fatalities observed incidental to O&M activities, the Avian and Bat Post-Construction Monitoring Plan will make clear that lack of documented fatalities in no way suggests that fatalities are not occurring. Likewise, the agencies will not presume that any documented fatalities were caused by colliding with a WTG unless there is evidence to support this conclusion.

[8] https://www.pwrc.usgs.gov/bbl/

Due to the importance of horseshoe crabs to the region, US Wind will conduct a study of the potential EMF effects of the Maryland Offshore Wind project on horseshoe crabs.

ACTION AREA

The action area is defined (50 CFR §402.02) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The Service has determined that the action area for this project includes the entire BOEM Renewable Energy Lease Area, the vertical height of the WTGs, the offshore and inshore cable route areas, cable landfall site, staging areas, port facilities/upgrades, and the onshore substation(s), as well as the extent of project-related noise and lighting (vertically and horizontally).

More specifically, the offshore portion of the action area includes the BOEM Renewable Energy Lease Area OCS-A 0490 (Lease Area) located approximately 10.1 miles (16.25 km) east of Ocean City, Maryland (Figure 1). The Lease Area is an irregularly-shaped, triangular polygon approximately18 miles (29 km) from west to east and 19 miles (30.58 km) from north to south, which is a total of 80,000 acres (32,375 hectares). The offshore cable route is 1,968 feet (600 m) wide and extends from the lease area to the cable landfall location at 3R's Beach at Delaware Seashore State Park in Sussex County, Delaware . The offshore portion of the action area also extends vertically from below the seafloor (due to benthic disturbance during construction) to above the total height of the WTG.

The onshore portion of the action area includes the 3R's Beach cable landfall site at Delaware Seashore State Park in Sussex County, Delaware and project staging areas which consist of approximately 0.57 acres (0.23 hectares). The inshore portion of the action area includes the cable route as it continues 42.24 miles (68 km) through Indian River Bay until it connects to the substations in Dagsboro, Delaware. In addition, the action area includes the existing Indian River substation and three new substations which cover 19.04 acres (7.71 hectares) (Figure 3).

STATUS OF THE SPECIES

Per the implementing regulations for Section 7 of the ESA (50 CFR §402.14(g)(2)), the Service must "Evaluate the current status and environmental baseline of the listed species or critical habitat." The following summarizes the species' general life history drawn primarily from Service assessment, listing, and recovery documents, as well as threats, demographics and population trends, and recovery strategy.

Piping Plover

Listing and Life History

In January 1986, the piping plover was listed under the provisions of the ESA as endangered in the Great Lakes watershed of both the U.S. and Canada and as threatened in the remainder of its range (50 FR 50726). Three populations of piping plover are recognized and distinguished by their distinctive breeding grounds—the Great Lakes (endangered), the Atlantic Coast (threatened), and the Northern Great Plains (threatened) of the United States and Canada. Additionally, the Service has approved recovery plans for each breeding population (USFWS 2009).

All three populations winter along the U.S. coast from North Carolina to Texas, as well as in Mexico and the Caribbean. The two inland breeding populations, the Great Lakes and the Northern Great Plains, breed on the shorelines of the Great Lakes and along the major river systems and alkali lands and wetlands in the Northern Great Plains, respectively. The Atlantic Coast piping plover population breeds on coastal beaches from Newfoundland to North Carolina (USFWS 2009). Atlantic Coast piping plovers are present on beaches between Virginia and Maine during the breeding season, generally between March 1 and August 31, though migrants may be present into October.

Occasional migratory stopovers by Great Lakes piping plovers in New Jersey and Virginia have been documented (Stucker et al. 2010, A. Van Zoeren, email to Service, April 14, 2023). We have no information about their routes to or from these sites (including wintering sites further south). We consider the likelihood that they will be affected by the proposed project discountable and will re-evaluate this determination if warranted by new information or further analysis. We have no evidence that piping plovers from the Northern Great Plains population migrate or otherwise occur offshore of Delaware or Maryland. Therefore, the two inland breeding populations (i.e., the Great Lakes and Northern Great Plains populations) are not considered in this Opinion.

The Atlantic Coast piping plover population is known to occur within the action area, as the population breeds on coastal beaches from Newfoundland to North Carolina and winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USFWS 1996), and therefore is addressed in this Opinion.

The piping plover is a small shorebird approximately 7 inches long with a wingspan of about 15 inches. These territorial birds nest above the high tide line on coastal beaches, sandflats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, washover areas cut into or between dunes, and deposits of suitable dredged or pumped sand. Piping plover nests consist of a shallow scrape in the sand, frequently lined with shell fragments and often located near small clumps of vegetation. Females lay up to four eggs that hatch in about 25 days. Piping plovers generally fledge only a single brood per season but may renest several times if previous nests are lost or, infrequently, if a brood is lost within several days of hatching. Flightless chicks follow their parents to feeding areas, which include the intertidal zone of ocean beaches, ocean washover areas, mudflats, sandflats, wrack lines, and the shorelines of coastal ponds, lagoons, and salt marshes. Piping plover adults and chicks feed on marine macroinvertebrates such as worms, fly larvae, beetles, and crustaceans. Surviving chicks fledge after about 25 to 35 days (USFWS 1996).

Migration is the least understood part of the piping plover annual cycle, but technology such as nanotags, banding, and intensive survey efforts have begun to shed some light on the subject. For example, these efforts have helped identify important stopover sites as well as provide a better understanding of fall migration arrival and departure timing (USFWS 2020a). Significant stopover sites along the Atlantic Coast include South Point, located on Ocracoke Island in North Carolina. South Point was discovered to be a significant stopover site in 2016 because results of abundance and resighting surveys documented 14.7 percent of Atlantic Coast breeders and 9.9

percent of the global population of plovers migrated through South Point between July and October (Weithman et al. 2018). Piping plovers from all three breeding populations were resighted at South Point, but 96 percent of the resights were from the Atlantic Coast population. Individuals from all three breeding populations were also observed at two inlet beaches in North Carolina between 2009 and 2014 (Addison and McIver 2014a, 2014b). Masonboro Inlet and Rich Inlet are used more as stopover sites, but small populations remain throughout the winter (Addison and McIver 2014a, 2014b). Southbound migratory departures of tagged adult piping plovers from breeding sites in Massachusetts and Rhode Island to their wintering grounds occurred between early July and early September with the majority departing in late July (Loring et al. 2020a). These results are supported by southbound piping plovers beginning to arrive in South Carolina (Cohen et al 2018) and South Point (Weithman et al 2018) in July. Results from additional nanotags deployed on piping plovers in Virginia and Maryland in 2023 (K. Walker, USFWS, pers. comm. 2023) are pending, but may contribute to our understanding of Atlantic Coast piping plover migratory patterns.

Threats

Threats to piping plovers on the Atlantic Coast include habitat loss and degradation, human disturbance of nesting birds, predation, and oil spills (USFWS 1996). All of the major threats—habitat loss and degradation, disturbance, predation—identified in the 1986 listing rule and 1996 revised recovery plan remain persistent and pervasive (USFWS 2020a).

Habitat loss and degradation result from development, as well as from beach stabilization, beach nourishment, beach raking, dune stabilization, and other physical alterations to the beach ecosystem. Development and artificial shoreline stabilization pose continuing widespread threats to the low, sparsely vegetated beaches juxtaposed with abundant moist foraging substrates on which breeding Atlantic Coast piping plovers rely. Threats from human disturbance and predation remain ubiquitous along the Atlantic Coast. Human disturbance of nesting birds includes foot traffic through protected areas, kites, off leash pets, fireworks, mechanical raking, construction, and vehicle use. These disturbances can result in crushing of eggs, nest abandonment by adults, and death of chicks (e.g., through effects to their energy budgets). Predation on piping plover chicks and eggs is intensified by development because predators such as foxes (*Vulpes vulpes*), rats (*Rattus norvegicus*), raccoons (*Procyon lotor*), skunks (*Mephitis mephitis),* crows (*Corvus* spp.), and gulls (*Larus* spp.) thrive in developed areas and are attracted to beaches by human food scraps and trash. Unleashed dogs (*Canis familiaris*) and cats (*Felis domesticus)* also disturb courtship and incubation and prey on chicks and adults (USFWS 1996, 2020a). Notwithstanding absence of recent spill events in the breeding range, six oil spills that affected Atlantic Coast piping plovers between 1989 and 2003 (Mierzykowski 2009) provide evidence of a continuing moderate threat to breeding Atlantic Coast piping plovers (USFWS 2009).

Within the wintering and coastal migration range, threats to piping plovers include habitat degradation and increasing human disturbance. Although progress toward understanding and managing threats in this portion of the range has accelerated in recent years, substantial work remains to fully identify and remove or manage migration and wintering threats (USFWS 2020a).

Two additional threats have been identified in recent Service reviews (USFWS 2020a). Climate change (especially sea level rise) and WTGs are likely to affect Atlantic Coast piping plovers throughout their annual cycle. Some aspects of climate change remain uncertain, but ongoing acceleration of sea level rise is well documented. Further increases in sea level rise rates are foreseeable with a high degree of certainty, and effects of sea level rise on Atlantic Coast piping plovers and their habitat will be partially determined by coastal management decisions (USFWS 2020a).

Although threats from offshore WTGs are foreseeable, their magnitude remains poorly understood (USFWS 2020a). In recent years, the advancement of BOEM's wind leasing and project reviews has increased the degree of certainty for future offshore project locations. In addition, with BOEM support, important species-specific information has been acquired in the past decade (i.e., Loring et al. 2019, 2020a) to help assess project effects. However, some key risk factors (e.g., avoidance rates) remain largely unknown, and information is lacking to assess site specific and collective effects of wind energy projects. The number and locations of future proposed onshore WTGs remain unclear, as do the timing and extent of full coastwide buildout of offshore WTGs. Any effects of the WTGs on migrating birds (e.g., collision, behavioral effects) are even more difficult to study and characterize offshore than on land. Eight offshore wind projects along the Atlantic Coast have completed Section 7 ESA formal consultation. The total anticipated incidental take from these projects is approximately 83 piping plovers over the projects' lifespans (30 to 35 years). At least five Atlantic OCS offshore wind projects are required by BOEM to provide compensatory mitigation for impacts to piping plovers, which may offset anticipated effects from those projects. For details on anticipated take by project, see Appendix A.

Demographics and Population Trends

Piping plovers are considered mature at age one (USFWS 1996) and may breed the first spring after hatching, although some birds do not breed their first year (Elliot-Smith and Haig 2020). Although some birds do not obtain a mate in some years, most birds breed each year (Elliot-Smith and Haig 2020). Piping plovers have been documented to live more than 11 years; however, we estimate based on typical survival rates that the average lifespan is approximately 5 to 6 years (USFWS 2023a). Estimates of annual adult survival in the 2000s on Long Island (70 percent) and eastern Canada (73 percent) were similar to those reported from the late 1980s in Massachusetts (74 percent) and Maryland (71 percent). Two Atlantic Coast population viability analyses (PVAs) conducted in the 2000s confirmed the consistent finding of earlier piping plover PVAs that extinction risk is highly sensitive to small changes in adult and/or juvenile survival rates (Calvert et al. 2006, Brault 2007). Progress toward recovery could be slowed or reversed by even small, sustained decreases in survival, and it would be difficult to increase current fecundity levels sufficiently to compensate for widespread long-term declines in survival (USFWS 2009).

The 2023 Atlantic Coast piping plover population estimate of 2,593 pairs was more than triple the estimate of 790 pairs at the time of the 1986 ESA listing. Overall population growth is tempered by substantial geographic and temporal variability (Table 3; Figure 4). In the recovery plan, the Atlantic Coast piping plover population is delineated into four recovery units including

Atlantic (Eastern) Canada[9], New England, New-York-New-Jersey (NY-NJ) and Southern (USFWS 1996). The largest population increase between 1989 and 2023 occurred in New England (648 percent), and the NY-NJ recovery unit experienced a net increase of 97 percent between 1989 and 2023 (Figure 4). However, the NY-NJ population declined sharply from a peak of 586 pairs in 2007 to 378 pairs in 2014, before rebounding to 631 pairs in 2023. Net growth in the Southern recovery unit population was 17 percent between 1989 and 2023, but the Southern population decreased 40 percent between 2016 and 2023. In Eastern Canada, where increases have been short-lived, the population posted a net 19 percent decline between 1989 and 2023. Declines in the Eastern Canada and Southern recovery units typify long-standing concerns about the uneven distribution and abundance of Atlantic Coast piping plovers (USFWS 2024).

Table 3. Estimated numbers of pairs* of Atlantic Coast piping plovers, 2014-2023 (USFWS 2024)

	Eastern Canada	New England	NY-NJ	Southern**	Total
2014	186	861	378	354	1,779
2015	179	914	416	362	1,871
2016	176	874	496	386	1,932
2017	173	874	497	359	1,903
2018	181	916	486	295	1,878
2019	190	980	540	309	2,019
2020	158	1,047	508	277	1,990
2021	180	1,264	576	269	2,289
2022	179	1,352	618	241	2,390
2023	189	1,541	631	232	2,593
average	179	1,062	515	308	2,064

*Recovery criteria: Eastern Canada=400. New England=625. NY-NJ=575. Southern=400. Total=2,000
**Only the portions of the Southern recovery unit nesting in Delaware and Maryland are considered in this BO.

The additive effects from multiple offshore wind projects may impact some piping plover recovery units more than others. Atlantic Coast piping plovers breeding in more northerly recovery units will have to navigate more offshore wind projects, compared to those that breed further south, as they migrate between wintering and breeding grounds. This could put the already vulnerable Eastern Canada recovery unit at greater risk of collision with WTGs but impacts to breeding populations in other precarious parts of the range, including the NY-NJ and Southern recovery units, should not be discounted if their migration flight paths intersect large numbers of WTGs.

[9] Canadian Wildlife Service documents and literature published since 2002 refer to piping plovers breeding in Nova Scotia, New Brunswick, Prince Edward Island, Quebec, and Newfoundland as the piping plover melodus subspecies or the "eastern Canada population." This subpopulation coincides exactly with the geographic area termed "Atlantic Canada Recovery Unit" in the Service's 1996 Recovery Plan. To reduce confusion, we refer to the Eastern Canada recovery unit.

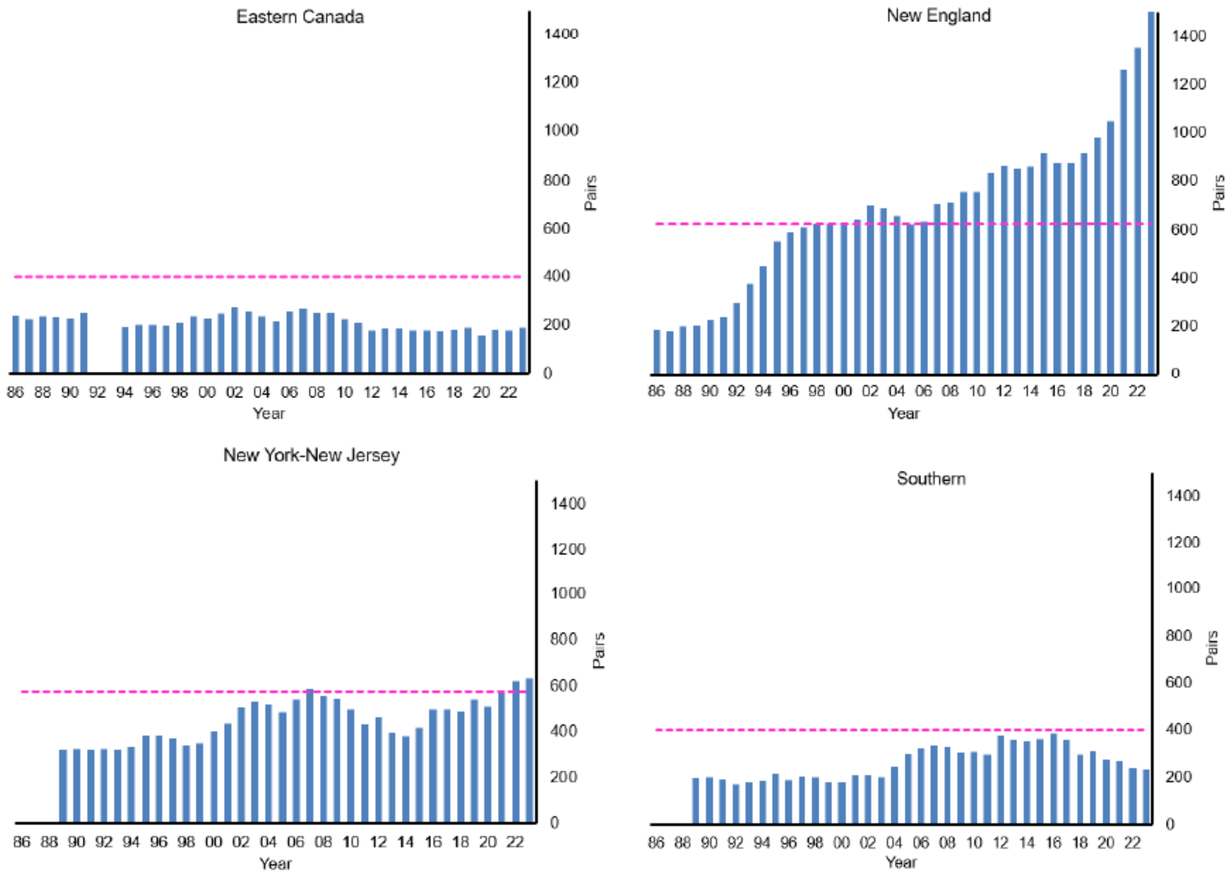

Figure 1. Abundance of Atlantic Coast piping plover breeding pairs by recovery unit, 1986-2023. Blue bars denote the annual pair estimate. Dashed pink lines indicate abundance objectives established in the 1996 revised recovery plan.

Figure 4. Abundance of Atlantic Coast piping plover breeding pairs by recovery unit, 1986-2023. Blue bars denote the annual pair estimate. Dashed pink lines indicate abundance objectives established in the 1996 revised recovery plan (USFWS 2024).

Atlantic Coast piping plover productivity is reported as number of chicks fledged per breeding pair. Rangewide productivity for the Atlantic Coast population from 1989 through 2006 was 1.35 chicks fledged per pair (annual range 1.16 to 1.54), and overall productivity decreased with decreasing latitude (Eastern Canada 1.61, New England 1.44, NY-NJ 1.18, Southern 1.19). Including more recent years, average annual productivity for the U.S. Atlantic Coast from 1989 to 2023 was 1.24 fledged chicks per pair. The overall U.S. Atlantic Coast productivity estimate was 1.09 fledged chicks per pair in 2021, 1.17 in 2022, and 1.04 in 2023—the fourth lowest since 1989 (USFWS 2024).

Although overall population growth has reduced the Atlantic Coast piping plover’s vulnerability to extinction since listing under the ESA, the distribution of population growth remains very uneven. The New England recovery unit constitutes a stronghold, but the Eastern Canada breeding population declined 29 percent between 2007 and 2023, and the Southern recovery unit has declined sharply since 2016. Future trends in breeding abundance will help inform assessments of whether current habitat and ongoing management are sufficient to sustain growth attained since 2014.

Recent information demonstrates the important effect of wintering site conditions on annual survival rates, a factor to which piping plover populations are highly sensitive. A recent study found that piping plovers using recreationally disturbed habitats with significant modifications to the habitat had lower survival rates and lower body condition than birds that used less disturbed habitat without modifications (Gibson et al. 2018). The effect of anthropogenic disturbance in the wintering range on annual survival rates, shows that demography is more complex than previously understood. Demographic modeling using this new information has the potential to better inform the relationships among vital rates and could facilitate more effective conservation efforts (USFWS 2020a).

Recovery

The security of the Atlantic Coast piping plover is fundamentally dependent on even distribution of population growth across the breeding range, in order to maintain a sparsely-distributed species with strict biological requirements in the face of environmental variation, buffer it against catastrophes, and conserve adaptive capacity (USFWS 2020a). Recovery criteria established in the recovery plan define population and productivity goals for each recovery unit, as well as for the population as a whole. Attainment of these goals for each recovery unit is an integral part of a piping plover recovery strategy that seeks to reduce the probability of extinction for the entire population by: (1) contributing to the population total; (2) reducing vulnerability to environmental variation (including catastrophes); and (3) increasing likelihood of genetic interchange among subpopulations. Recovery depends on attainment and maintenance of the minimum population levels for each of the four recovery units. Any appreciable reduction in the likelihood of survival of a recovery unit will also reduce the probability of persistence of the entire population (USFWS 1996).

As described in the recovery plan (USFWS 1996), the recovery criteria, which reflect the conservation tenets of representation, redundancy, and resiliency[10], for the Atlantic Coast piping plover population include:

1. Maintain a total of 2,000 breeding pairs, distributed among the four recovery units, for at least 5 years—400 pairs in Eastern Canada, 625 pairs in New England, 575 pairs in NY-NJ, and 400 pairs in the Southern unit;
2. Verify the adequacy of a 2,000-pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term;
3. 5-year average productivity rate of 1.5 chicks per pair in each recovery unit;
4. Institute long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each recovery unit; and

[10] The Service frequently describes conservation needs via the conservation principles of resiliency (ability of species/populations to withstand stochastic events which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions which may include behavioral, morphological, genetics, or other variation) (collectively known as the 3Rs) (Wolf et al. 2015, Smith et al. 2018). For Section 7(a)(2) purposes, representation, redundancy, and resiliency can be translated into the reproduction, numbers, and distribution (RND) of a species.

5. Ensure long-term maintenance of wintering habitat sufficient in quantity, quality, and distribution to maintain survival rates needed for a 2,000-pair population.

None of the recovery criteria have been fully met.

Rufa Red Knot

Listing and Life History

Six subspecies of red knot (*Calidris canutus*) are recognized, each with distinctive migration routes and annual cycles. The rufa subspecies, (*Calidris canutus rufa*) is the only subspecies known to occur along the Atlantic Coast of the United States (USFWS 2014). The Service listed the rufa red knot as threatened under the ESA in 2015 (79 FR 73705).

The rufa red knot is a medium-sized (9 to 10 inches long) shorebird that migrates annually between breeding grounds in the central Canadian Arctic and four wintering regions: (1) the Southeast United States and through the Caribbean; (2) the western Gulf of Mexico from Mississippi through Central America and along the western coast of South America (Western); (3) northern Brazil and extending west along the northern coast of South America (North Coast of South America); and (4) Tierra del Fuego at the southern tip of South America (mainly in Chile) and extending north along the Patagonian coast of Argentina (Southern). This subspecies shows very high fidelity to wintering region, with habitat, diet, and phenology varying appreciably among birds from different regions (USFWS 2014).

The Service identified four recovery units in the recovery plan corresponding to the four wintering populations: the Southern, the North Coast of South America (NCSA), the Southeast United States/Caribbean (SEC), and the Western. Although birds from the Western wintering population and associated recovery unit are known to occasionally occur on the Atlantic Coast (USFWS 2014), we consider the likelihood that they will be affected by the proposed project discountable. Therefore, the Western wintering population and recovery unit is not addressed in this Opinion. We expect rufa red knots from each of the other three wintering populations and their associated recovery units to potentially occur in the action area throughout the annual cycle. Therefore, the Southern, NCSA, and SEC wintering populations and recovery units are addressed in this Opinion.

Rufa red knots require upland tundra for nesting, with low, sparse, herbaceous vegetation (e.g., *Dryas spp*., lichens, moss), located near freshwater wetland or lake-edge foraging habitats. Pair bonds form soon after the birds arrive on the breeding grounds, in late May or early June, and remain intact until shortly after the eggs hatch. Female rufa red knots lay only one clutch per season and typically do not lay a replacement clutch if the first is lost. The usual clutch size is four eggs, though three-egg clutches have been recorded. The incubation period lasts approximately 22 days from the last egg laid to the last egg hatched, and both sexes participate equally in egg incubation. Young are precocial, leaving the nest within 24 hours of hatching and foraging for themselves. Females are thought to leave the breeding grounds and start moving south soon after the chicks hatch in mid-July. Thereafter, parental care is provided solely by the males, but about 25 days later (around August 10) males also abandon the newly fledged juveniles and move south. Not long after, they are followed by the juveniles. On the breeding grounds, rufa red knots mainly eat insects (USFWS 2014).

Coastal habitats used by rufa red knots in migration and wintering areas include both high-energy oceanfront or bayfront areas, as well as tidal flats in more sheltered bays and lagoons. Preferred nonbreeding microhabitats are muddy or sandy coastal areas, specifically, the mouths of bays and estuaries, tidal flats, and unimproved tidal inlets, with sparse vegetation and open vistas to avoid predation. Quality roosting habitat (i.e., close to feeding areas, protected from predators, with sufficient space during the highest tides, free from excessive human disturbance) is limited. In coastal nonbreeding areas, rufa red knots feed on invertebrate prey in the intertidal zone, mainly mollusks such as small bivalves and snails. However, horseshoe crab eggs are a preferred food wherever they occur (USFWS 2014).

Some rufa red knots migrate more than 9,300 miles one-way, one of the longest migrations of any animal. Migrating rufa red knots can complete non-stop flights of 1,500 miles or more. Migrants converge on vital stopover areas to rest and refuel along the way, although smaller numbers of migrating birds can occur in suitable habitats anywhere along the coast. In the Northeast, northbound migrants are generally present in May and early June. Delaware Bay is considered the single most important spring stopover area, supporting an estimated 50 to 80 percent of all rufa red knots each year. Birds stopping in Delaware Bay achieve very high rates of weight gain feeding on the eggs of spawning horseshoe crabs (*Limulus polyphemus*). However, Delaware Bay is only one in a network of essential staging areas, where large numbers of birds recover from long migration flights, rapidly regaining weight before departing on the next leg of their journey.

A growing body of evidence indicates that a substantial portion of northbound rufa red knots depart the U.S. Atlantic Coast (Florida to Delaware Bay) on a northwest trajectory overland to their final stopover areas along Hudson Bay in Canada. Some birds do continue along the Atlantic Coast north of Delaware Bay, and some of those birds may cross the OCS. However, the overland route appears to be the predominant flyway for this leg of the northbound migration (USFWS 2014, USFWS 2021, Loring et al. 2020b, Smith et al. 2023, Perkins 2023, unpublished satellite data) and this route entirely avoids the OCS. During spring, Loring et al. (2020b) reported a higher occurrence of exposure to wind energy areas (WEAs)[11] in Federal waters under adverse weather conditions (i.e., low visibility and some precipitation). This is consistent with previous research showing that shorebirds are more likely to migrate during adverse weather conditions (including headwinds, reduced visibility, and precipitation) in spring compared to fall due to less stable atmospheric conditions and greater time constraints to reach breeding areas (O'Reilly and Wingfield 1995).

After the breeding season, departure from the breeding grounds begins in mid-July and continues through August. Along the U.S. Atlantic Coast, southbound red knots start arriving in July. Numbers of adults peak in mid-August and most depart by late September, although tracking and resightings have shown some birds stay through November (Perkins 2023, Wallover et al. 2014,

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[11] Wind energy areas, as defined in Loring et al. 2019, include wind planning areas and wind lease areas. Wind planning areas are areas that are being considered for wind power development.

Niles et al. 2012, Harrington et al. 2010, Harrington 2001). Well-known fall stopover sites along the U.S. Atlantic Coast include the coasts of Massachusetts and New Jersey (USFWS 2014).

In one study of northern-wintering rufa red knots, the total time spent along the U.S. Atlantic Coast (including spring, fall, and for some birds, winter) averaged 218 days (range 121 to 269 days) (Burger et al. 2012), or about 60 percent of the calendar year. In addition to migration flights, seasonally resident rufa red knots are also known to make regional flights, some of which cross the OCS. Seasonally resident birds occurring in the mid-Atlantic may include nonbreeding adults during the breeding season, juveniles at any time of year, birds on extended stopover or staging visits, and birds during the early part of the wintering season. Rufa red knots also have been documented making regional flights opposite the main migration trajectory (i.e., south in spring, north in fall), a phenomenon known as reverse migration that is likely an attempt to find optimal food or other conditions for the stopover period (USFWS 2014; C. Hunter, email, Service, July 6, 2022; F. Sanders, email, Service, August 9, 2023

Threats

The Service completed a Species Status Assessment (SSA; USFWS 2020b) that classified 24 threats to the rufa red knot (Table 4). Threats are classified as High Severity (threat is driving rufa red knot ESA threatened status), Moderate Severity (threat causes additive mortality and/or negative synergistic effects), and Low Severity (minor or potential threat) in the SSA.

Table 4. Rufa red knot threats identified in the SSA, by severity (USFWS 2020b).

High	Moderate	Low
• loss of breeding and nonbreeding habitat due to sea level rise • coastal engineering/stabilization • coastal development • Arctic ecosystem change • likely effects related to disruption of natural predator cycles on the breeding grounds • reduced prey availability throughout the nonbreeding range • increasing frequency and severity of asynchronies in the timing of the species' annual migratory cycle relative to favorable food and weather conditions	• hunting • predation in nonbreeding areas (e.g., by peregrine falcons [*Falco peregrinus*]) • harmful algal blooms • human disturbance • oil spills • wind energy development (especially near the coasts)	• beach cleaning • agriculture • research activities • disease

One new threat has been identified that was not considered at the time of listing, namely Arctic habitat damage caused by overabundant goose populations. At this time, the Service considers goose overpopulation a Moderate Severity threat, but the Service recognizes the high uncertainty around how geese may be impacting rufa red knot reproductive rates (USFWS 2021).

Although threats from offshore WTGs are foreseeable, their magnitude remains poorly understood (USFWS 2021). Offshore wind energy development is likely to contribute at least some additional contributions to mortality in the coming decades (USFWS 2021). Watts et al. (2015) found that rufa red knots have notably low limits of sustainable mortality from anthropogenic causes, such as hunting, oil spills, and WTG collisions. In recent years, the advancement of BOEM's wind leasing and project reviews has increased the degree of certainty for future offshore project locations. In addition, important species-specific information has been acquired in the past decade (Loring et al. 2018, Loring et al. 2020b, Perkins 2023), much of it with BOEM support, to help assess project effects. However, some key risk factors (e.g., avoidance rates) remain largely unknown, and information is lacking to assess site-specific and collective effects of wind energy projects. The number and locations of future proposed onshore WTGs remain unclear, as do the timing and extent of full coastwide buildout of offshore WTGs. Any effects of the WTGs on migrating birds (e.g., collision, behavioral effects) are even more difficult to study and characterize offshore than on land. Eight offshore wind projects along the Atlantic Coast have completed Section 7 ESA formal consultation. The total anticipated incidental take from these projects is approximately 2,100 rufa red knots over the projects' lifespans (30 to 35 years). At least five Atlantic OCS offshore wind projects are required by BOEM to provide compensatory mitigation for impacts to rufa red knots, which may offset anticipated effects from those projects. For details on anticipated take by project, see Appendix A.

Demographics and Population Trends

Rufa red knots exhibit low fecundity, delayed maturity, and high annual survival. The rufa red knot's typical life span is at least 7 years, with the oldest known wild bird at least 21 years old. Age of first breeding is at least 2 years (USFWS 2014). Adult birds are known to sometimes forego breeding and remain in nonbreeding habitats during the breeding season (USFWS 2014, Martínez-Curci et al. 2020) but it is unknown how prevalent this phenomenon is; whether it varies spatially or temporally; and whether it is correlated with bird age, environmental conditions, or other variables. Additional adult birds that fly north, perhaps as high as half in some years, do not initiate nests (A. Smith, pers. comm., 2023). The rufa red knot's breeding success varies dramatically among years in a somewhat cyclical manner. Two main factors seem to be responsible for this annual variation: abundance of small rodents (by indirectly affecting predation pressure on shorebirds) and weather (USFWS 2014).

Preliminary analysis suggests that an average reproductive rate in the range of 1.5 to 2 chicks per pair may be necessary for a stable population (Wilson and Morrison 2018), but further work is needed to refine this estimate. Modeling by Schwarzer (2011) suggests that populations are stable at around 8.75 percent juveniles among wintering birds, but this is also a preliminary estimate. Analysis of 2005 to 2018 data from the Delaware Bay staging area, which supports an estimated 50 to 80 percent of all rufa red knots each spring, found a mean recruitment rate of 0.075 (ASMFC 2022).

Baker et al. (2004) estimated adult survival rates for the Delaware Bay stopover population at 84.6 percent from 1994 to 1998, but only 56.4 percent from 1998 to 2001. McGowan et al. (2011) calculated a survival rate of about 92 percent for Delaware Bay from 1997 to 2008. The ASMFC (2022) found an annual apparent survival rate of 93 percent at Delaware Bay from 2005 to 2018. For birds wintering in Florida, Schwarzer et al. (2012) found an average annual adult survival rate of 89 percent, with the 95 percent confidence interval overlapping the 92 percent survival estimate from McGowan et al. (2011). The similarity of Florida versus Delaware Bay survival rate estimates suggests that the key factors influencing survival may be acting outside of the wintering grounds (Schwarzer et al. 2012).   Preliminary population modeling based on resightings from Delaware Bay, New Jersey (Niles et al. unpublished report.), and analyses carried out by Ausems (MS in prep) indicate that survival rates may be in decline (A. Smith, pers comm., 2024). Further analysis is needed to compare the methods and results from this study against other survival estimates, and to characterize the demographic implications if declining survival rates are confirmed.

Based on best available information, the current total rangewide abundance estimate is just over 66,500 rufa red knots, distributed across the four recovery units (Table 5). We conclude with moderate confidence that that the NCSA and the SEC recovery units are stable relative to the 1980s. Evidence suggests the Western recovery unit may be declining, although certainty about this conclusion is low. The Southern recovery unit experienced a well-documented decline of about 75 percent during the 2000s, as well as a geographic contraction within these wintering grounds. The Southern wintering population has been stable since 2011 but has not shown any signs of recovery to date (USFWS 2020b, Matus 2021, Norambuena et al. 2022, 2023).

The decline of the Southern recovery unit, which historically supported the largest population, drove a decline of the subspecies as a whole, mirrored in declines at several migration stopover areas and in analyses of various national and regional datasets. Overharvest of the horseshoe crab in Delaware Bay is considered the key causal factor in this decline, though numerous other past, ongoing, and emerging threats have also been identified, as discussed above (USFWS 2020b). The Service has determined that the horseshoe crab bait harvest has been adequately managed to avoid further impacts to rufa red knots at least since 2013 (USFWS 2014, USFWS 2022).

Table 5. Current estimates of rufa red knot abundance by recovery unit.

Wintering Population/Recovery Unit	Abundance Estimate	Certainty	Source
Southeast U.S./Caribbean (SEC)[1]	15,500	Moderate	Lyons et al. 2017
North Coast of South America (NCSA)	31,065	Moderate	Mizrahi 2020
Southern[2]	14,484	High	Castellino and González pers. comm. 2023, Castellino 2023, Norambuena et al. 2023, Norambuena et al. 2022, Matus 2021
Subtotal	***61,049***		
Western[3]	5,500	Low	D. Newstead, emails, Service, October 2, 2019, March 6 and June 3, 2020
Total	**66,549**		

[1] Includes an estimated 10,400 birds in the Southeastern U.S. and 5,100 birds in the Caribbean.
[2] The 2022 and 2023 estimates include ground surveys of Patagonia, which varied in geographic coverage and methodology, and which were not conducted in 2021.
[3] Birds from the Western unit are known to occur in the mid-Atlantic during migration, but the predominant flyway for these birds is through the midcontinent (Newstead et al. 2013, Perkins 2023). Thus, we consider the effects to them discountable in our assessment of wind energy development on the Atlantic OCS and omit them from further calculations.

In summary, the overall status of the rufa red knot is stable but depleted. The NCSA and SEC recovery units are stable, the Southern recovery unit has stabilized at about 25 percent of its size as documented approximately 40 years ago, and the Western recovery unit may be declining.

Recovery

The essential recovery strategy for the rufa red knot is to prevent erosion of this subspecies' limited inherent adaptive capacity by maintaining representation and improving resiliency and redundancy, to support the rufa subspecies as it copes with inexorably changing conditions (i.e., from climate change) across its range and across its annual cycle. Conservation of each recovery unit contributes to representation, redundancy, and resiliency and is essential for the recovery of the entire subspecies. The recovery plan includes 10 recovery criteria that address representation, redundancy, and resiliency for each recovery unit and for the subspecies as a whole. The recovery plan establishes population targets for each recovery unit, based on 10-year average abundance, and addresses other conservation needs for the rufa red knot, chiefly a wide-ranging network of nonbreeding habitats managed in a manner compatible with the population goals (USFWS 2023b).

Roseate Tern

Listing and Life History

The North Atlantic roseate tern subspecies is divided into two populations that breed in two discrete areas and rarely mix. The northeastern population, federally listed as endangered, breeds on coastal islands from Eastern Canada to New York. The Caribbean population, federally listed as threatened, breeds on islands in the Caribbean Sea from the Florida Keys to the Lesser Antilles. Both populations winter on the north and east coasts of South America (USFWS 2023**c**) and both were listed under the ESA in 1987 (52 FR 42064). The two populations have separate recovery plans.

We have no evidence that roseate terns from the Caribbean population migrate through or otherwise occur offshore of Delaware or Maryland as these birds spend their entire life cycle south of the action area. Therefore, the Caribbean population is not considered in this Opinion. We expect the northeastern population to occur in the action area during the breeding season, post-breeding dispersal period, and fall and spring migration.

The roseate tern is a medium-sized sea tern about 15 inches (38 cm) long with a wingspan of about 30 inches (76 cm). This species is exclusively marine, usually breeding on small islands, but occasionally on sand dunes at the ends of barrier beaches. All recorded nest sites in the Northeast have been in colonies of common terns (*Sterna hirundo*). Roseate terns usually select the more densely vegetated parts of the nesting area, and typically nest under or adjacent to objects that provide cover or shelter.

Roseate terns arrive in the Northeast in late April. Most eggs are laid between May 18 and June 22, but small numbers of pairs continue to lay eggs in late June and throughout July. Eggs are laid in a shallow scrape on bare sand, soil or stones, but the birds gradually accumulate nesting material during incubation so that a substantial nest often results. The usual clutch size is one or two eggs, though a small minority of clutches contain three or even four eggs. Occasionally two females lay in the same nest. Both males and females incubate the eggs and brood and feed the chicks. The incubation period is about 23 days and begins when the first egg is laid. The chicks are brooded or tended by one parent while the other parent forages for food. Chicks usually fledge between 25 and 29 days of age. Fledglings start to accompany their parents to the feeding grounds within 4 to 5 days. During the breeding season, roseate terns forage over shallow coastal waters around the breeding colonies (USFWS 1998), typically within 31 miles (50 km) of the colony (Loring et al. 2019).

Roseate terns are specialist feeders on small, schooling marine fish and usually feed over open water, often over tidal channels, tide rips, and sandbanks (Gochfeld and Burger 2020). They frequently feed in mixed flocks with other tern species and concentrate in places where prey fish are brought close to the surface, either by predatory fish chasing them from below or by vertical movements of the water (Gochfeld and Burger 2020). In pelagic waters, they feed over predatory fish and marine mammals that drive prey to the surface (Goyert 2013). Roseate terns tend to return regularly to the same fishing areas, sometimes far from the breeding colony. Important prey species include sand lance (*Ammodytes sp.*) and herring (*Clupea spp.*) (USFWS 1998). The distribution and abundance of sand lance and herring have been positively associated with the spatial patterns of roseate terns, indicating the importance of these prey species to adults as well as chicks (Goyert 2014). Although roseate terns show some trophic plasticity, their relatively narrow trophic niches suggest they may have less flexibility to withstand poor foraging conditions compared to other tern species (Staudinger 2019). Foraging distances are related to prey availability; roseate terns forage over shallow coastal waters within 3 to 15 miles (4 to 24 km) of breeding colonies when fish are available but may feed as far as 50 to 60 miles (80 to 97 km) offshore (USFWS 2020b).

During the post-breeding period in July and August, adults and fledglings disperse to staging areas. Key staging areas for roseate terns include sites in the Cape Cod and Islands region of southeastern Massachusetts (Gochfeld and Burger 2020). Staging areas are critical for juvenile and adult birds to optimize their body condition in preparation for southbound migration (USFWS 2020b). Roosting habitats for nonbreeding roseate terns along the Northeast/mid-Atlantic Coast include open beaches, coastal inlets, river mouths, sand spits, and tidal flats. Terns may also rest on the surface of open water, and on jetties or other artificial structures (S. von Oettingen, email, Service, March 8, 2022; Oswald et al. 2023; Loring et al. 2023).

Roseate terns migrate south from late August to mid-September (Loring et al. 2019, Mostello et al. 2014). Geolocator data from six roseate terns tagged at Bird Island, Massachusetts suggest that southbound migration flight paths are transoceanic until reaching the Caribbean, where birds may stopover (Mostello et al. 2014). Most northeastern roseate terns are believed to winter on the north and east coasts of South America. Wintering habitats include beaches and remote sandbars. Although several roost sites have been discovered along the coast, wintering birds appear to spend most of their time foraging at sea, and they frequently rest on the water for periods of minutes to hours both day and night (Mostello et al. 2014, Gochfeld and Burger 2020, Oswald et al. 2023). During spring migration, roseate terns tagged with geolocators crossed the Atlantic Ocean towards Cape Cod in a route that was similar to but inshore of their fall migration route (Mostello et al. 2014). Recent research results from a study of roseate terns suggest that, during both southbound (fall) and northbound (spring) migration, roseate terns may spend a substantial amount of time on the water's surface during the day and, to a lesser extent, night (Oswald et al. 2023).

Roseate terns are known to occur along the Delaware and Maryland Coast for about 6 months out of the year, from April through September (Mostello 2015). This species has been reported to utilize Delaware and Maryland beaches, coastal bays, and offshore waters during its spring and fall migrations. Although there is no known occurrence of roseate terns nesting in Delaware, the species was documented nesting on Assateague Island, Maryland in the 1930s (Stewart and Robbins 1958; Gochfield and Burger 2020) and, except for one other occurrence, have not nested there since (Erwin 1979). Today, about 90 percent of the northeastern roseate tern colonies concentrate on three islands to breed, two of which are located in Massachusetts' Buzzards Bay (Bird Island and Ram Island) and the other in eastern Long Island Sound (Great Gull Island; USFWS 2020b).

Threats

Threats identified in the roseate tern recovery plan include predation, limited food availability near colonies, storm events, an imbalanced sex ratio, and shoreline erosion impacting nesting habitat (USFWS 1998). Roseate tern habitat is impacted by invasive vegetation, as well as sea level rise driven by climate change. Climate change is also a factor in forage fish availability, including changes in fish community composition that favor less suitable prey species. Staging habitat is critical to adult and juvenile roseate terns because it allows roseate terns to accumulate energy resources for migration in preparation for their first migration south. Predation of adults, chicks, and eggs may cause major disruption of nesting, leading to repeated shifts away from affected breeding colonies, sometimes to breeding sites that are less suitable. However, anthropogenic disturbance appears to cause greater impacts to staging roseate and common tern flocks than wildlife disturbance causes (USFWS 2020b). Roseate and common terns may be displaced from preferred habitat near foraging areas to less suitable areas by repeated disturbance from recreational beach users, and hatch-year terns may not accumulate sufficient energy resources to complete migration or may arrive at wintering grounds in a depleted state (USFWS 2020b).

Although threats from offshore WTGs are foreseeable, their magnitude remains poorly understood (USFWS 2020c). In recent years, the advancement of BOEM's wind leasing and project reviews has increased the degree of certainty for future offshore project locations. In addition, important species-specific information has been acquired in the past decade (Mostello et al. 2014, Loring et al. 2019), much if it with BOEM support, to help assess project effects. However, some key risk factors (e.g., avoidance rates, migration flight altitudes) remain largely unknown, and information is lacking to assess site-specific and collective effects of wind energy projects. The timing and extent of full coastwide buildout of offshore WTGs remains unclear. Any effects of the WTGS on migrating birds (e.g., collision, behavioral effects) are difficult to study and characterize in the offshore environment. Eight offshore wind projects along the Atlantic Coast have completed Section 7 ESA formal consultation. The total anticipated incidental take from these projects is approximately 2 roseate terns over the projects' lifespans (30 to 35 years). At least one Atlantic OCS offshore wind project is required by BOEM to provide compensatory mitigation for impacts to roseate terns, which may offset anticipated effects from that project. For details on anticipated take by project, see Appendix A.

<u>Demographics and Population Trends</u>
The oldest known roseate tern was over 25 years old, but a life span around 9 years may be more typical. Survival probability may be heterogeneous within the population (Gochfeld and Burger 2020, CTDEEP undated). Roseate terns begin breeding at age three or four. Breeding is thought to occur annually among northeastern birds, but some mature adults (usually females) may be unmated in some years (Gochfeld and Burger 2020). There is an unequal sex ratio, with more females than males. Best available demographic estimates at the time of the recovery plan were associated with high uncertainty and were inconsistent with observed population trends. Those values were 0.83 for average annual adult survival, 1.2 fledglings per pair for average productivity at the largest colonies, and 0.20 for survival from fledging to first breeding (USFWS 1998). Low productivity (less than 0.9 chick fledged per pair) is generally limited to small colonies and/or to transitory incidents of predation. Regionwide, the long-term average annual productivity is about 1.1 young fledged/pair, somewhat higher at the large stable colonies, but lower at sites subject to higher predation (Gochfeld and Burger 2020).

Recent population modeling supported the assumption that smaller colonies appear to be more ephemeral (USFWS 2020c). Although ephemeral, these smaller colonies support more unique genetic diversity than the larger, long-established populations. To assess the stability of the species, the colonization and abandonment of breeding colonies were modeled as discrete events (USFWS 2020c). The modeled population would collapse to zero (within 50 years, with greater than 50 percent probability) for mean productivity less than 1.2, mean adult survival less than

0.82, or mean juvenile survival less than 0.7. These values are precariously close to recent estimates of mean values for these parameters, indicating that there is little margin for maintaining the population should adverse factors affect productivity, adult survival, or juvenile survival (USFWS 2020c).

The northeastern roseate tern population is assessed in two subregional groups: the warm water subregional group south and west of Cape Cod, and the cold water subregional group north and east of Cape Cod, including Canada. The warm water subregion includes more than 90 percent of the total population, the majority of which breeds on only three islands. The cold water subregion breeding colonies are more widely scattered and generally have less than 100 breeding pairs—in some years none. Diets may differ between subregions, and limited exchange of breeding birds occurs between them (USFWS 2020c); nevertheless, it is vital to maintain the genetic diversity of the metapopulation (USFWS 2020c).

The total northeastern roseate tern breeding population was estimated to be 4,374 breeding pairs at peak period count in 2019 (see Table 6) and 5,322 breeding pairs at peak count in the most recent 2022 estimate (M. Harrington, Service, pers. comm. 2023). The U.S. breeding population has exceeded 4,000 breeding pairs annually since 2016. Canada's total roseate tern population has been below 100 breeding pairs since 2008, hovering between 50 and 65 breeding pairs. Since 1987, breeding pair numbers have exhibited up and down trends lasting several years each. From 1987 to 1990, breeding pair numbers increased at average rates of 4 to 5 percent per year. From 1991 to 1992 numbers declined by about 20 percent, attributed to Hurricane Bob. The increasing trend resumed and then continued from 1992 to 2000 when it abruptly reversed. Declines of about 4 percent per year were observed from 2000 to 2008, possibly reflecting a change in post-fledging survival of hatch-year roseate terns and their recruitment into the breeding population. The increasing (1992-2000) and decreasing (2000-2008) trends were manifested at all the large colonies and evidently resulted from factors that affected the entire warm water subregion.

Between 2008 and 2013, the breeding pair population slowly increased. During the most recent trend since 2014, the number of breeding pairs rapidly increased. The recent increase of about 5 percent per year was primarily attributed to a substantial increase in breeding pairs in the Buzzards Bay colonies (USFWS 2020c).

Table 6. Peak period roseate tern breeding pair counts, 2010 to 2019 (USFWS 2020c).

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Canada Subtotal	43	65	43	54	51	51	63	49	51	63
U.S. Subtotal	2,970	3,043	3,089	3,136	3,560	3,901	4,021	4,446	4,542	4,311
Rangewide Total	**3,013**	**3,108**	**3,132**	**3,190**	**3,611**	**3,952**	**4,084**	**4,495**	**4,593**	**4,374**

The combined average annual estimated productivity from 2010 to 2019 for the cold water subregion breeding colonies (about 0.9 chick fledged per pair) appears to be nearing the warm water subregion colonies productivity of about 1.0 chick fledged per pair. Annual average productivity estimates for the two subregions were not always similar, most likely affected by predation events or limited accessibility to suitable forage fish. Although recent data indicate the roseate tern population is stabilizing from past fluctuations, there is great uncertainty as to the long-term population viability (USFWS 2020c). In summary, the overall status of the roseate tern is stable to increasing but punctuated by periods of decline. Population variability can affect the viability of a species as much or more than population size (USFWS and NMFS 1998).

Recovery

The recovery plan establishes a population target of 5,000 peak period nesting pairs and at least 5 large colonies with at least 1 fledged chick per pair for 5 consecutive years. The plan also identifies the use of long-term agreements to assure protection and management of breeding habitats through long-term agreements (USFWS 1998).

The southern extent of the roseate tern range contracted significantly since the species was listed and appears to have been further reduced with the loss of small breeding colonies on southern and central Long Island. The northern extent of the breeding range has not contracted, although some small colonies in Canada and Maine are no longer occupied. The genetic viability of the species is dependent on the existence of small, cold water subregion breeding colonies as well as the larger warm water subregion colonies. Continued loss of these small colonies could preclude the species from being recovered as the redistribution of genetic variation between the two subregions is affected (USFWS 2020c).

STATUS OF CRITICAL HABITAT

Piping Plover

The Service designated critical habitat for wintering piping plovers of all three breeding populations in 2001 (66 FR 36038) and revised the designation in 2008 (73 FR 62816) and 2009 (74 FR 23476). The critical habitat extends along the Atlantic Coast from North Carolina through Texas; therefore, the critical habitat does not overlap the action area and is not considered in this Opinion.

Rufa Red Knot

The Service proposed critical habitat for the rufa red knot in 2021 (86 FR 37410) and published a revision to the proposal in April 2023 (88 FR 22530); no final rule has been published to date. The proposed critical habitat is restricted to the coasts and does not overlap the action area; therefore, critical habitat for this species is not considered in this Opinion.

Roseate Tern

There is no proposed or designated critical habitat for the roseate tern; therefore, critical habitat for this species is not considered in this Opinion.

ENVIRONMENTAL BASELINE

In accordance with 50 CFR §402.02, the "environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline."

Status of the Species in the Action Area

Although the body of information about use of the Atlantic OCS by piping plover, rufa red knot, and roseate tern has been growing in recent years, our understanding of the species' presence in the OCS, and more specifically the Maryland Offshore Wind action area, is still limited. We consider all best available information to anticipate and describe the status of the species in the action area.

Tracking data used to assess the number and behavior of listed birds in the action area has been collected by researchers since 2007 and tracking technologies have advanced considerably since that time. However, studies far offshore are logistically and technologically challenging, and our understanding of how these species use the action area remains incomplete. Without sufficient tracking data, the number of birds passing through the action area cannot be accurately estimated. Based on the limited accuracy of the tracking data available to date, we assume that all parts of the action area are equally likely to be utilized by listed species. We attempt to characterize levels of listed species' use within the action area relative to the surrounding Atlantic OCS and adjacent coastline, but we do not have enough information to discern differences in utilization that may exist across the latitudinal or longitudinal gradients of the action area.

Piping Plover

Based on the location of the Maryland Offshore Wind project, we expect piping plovers from each of the Atlantic Coast population's four recovery units – Eastern Canada, New England, NY-NJ, and Southern – to occur in the action area during many months of the year (Table 7).

Piping plovers occur along the Delaware and Maryland coastline and are occasionally observed on or near Cape Henlopen, Delaware and Assateague Island, Maryland, and surrounding beaches. All known nesting activity in Delaware and Maryland is restricted to low-lying barrier island flats and spits that also feature moist foraging substrates away from the ocean intertidal zone, and is outside of the onshore portion of the action area (USFWS 2024).

Table 7. Expected piping plover occurrence by activity and month in the Maryland Offshore Wind action area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Offshore												
Northbound Migration		X*	X	X	X							
Southbound Migration						X	X	X	X*	X*		
Onshore												
Breeding												

*Only early- and late-migrants are expected to occur during these months, representing relatively few birds compared to other months with expected piping plover occurrence.

The Maryland Offshore Wind action area encompasses Lease Area OCS-A 0490 (see *Action Area* above for more detail). The Lease Area is located within a migration corridor for juvenile and adult piping plovers. The piping plover migration corridor measures 131 miles (211 km) wide at the latitude of the Maryland Offshore Wind Lease Area. At 11 miles[12] (18 km wide, the width of the Lease Area occupies about 8 percent of the width of the piping plover migration corridor at this latitude (see *Effects of the Action* - *Methods for Estimating Numbers of Collisions* below for more detail). Below, we summarize major studies on the presence and behavior of piping plovers in the vicinity of the offshore portion of the action area.

A study fitted 150 adult piping plovers with digital Very High Frequency (VHF) radio transmitters at nesting areas in Massachusetts and Rhode Island and tracked using land-based stations distributed from Massachusetts to Virginia (Loring et al. 2019). Seventy piping plovers were detected by tracking stations during migratory departure flights. The study assessed occurrence in WEAs within the latitudinal bounds of coastal towers using interpolated flight paths (Figure 5). Interpolations generated from tracking tower detections on long distance offshore flights were sometimes widely separated in time and space, and as a result subjected to large locational error. To address uncertainty in model output, the study considered locations as occurring within WEAs when the mean interpolated track intersected a WEA, and when the track's error distribution was less than 30-km. Using this method, mean interpolated tracklines from 4 piping plovers were estimated to cross Lease OCS A-0490 (Figure 5). Piping plovers migrated offshore directly across the mid-Atlantic, from breeding areas in southern New England to stopover sites spanning from Long Island, New York to North Carolina. Estimated exposure to WEAs in Federal waters along the Atlantic Coast was higher for birds tagged in Massachusetts than for birds tagged in Rhode Island. For 22 birds tagged in Massachusetts, peak estimated WEA exposure occurred within four hours of local sunset (19:00 hours), with 36 percent (8 birds) occurring at night and 64 percent (14 birds) during daylight (Loring et al. 2019). During

[12] For irregular shaped wind farms, width at latitude of Lease Area centroid is calculated using total perimeter length/4. For Maryland Offshore Wind, the width used was 17km for Band and 19km for SCRAM. The average of these two numbers was used for width at latitude of Maryland Offshore Wind Lease Area.

offshore migratory flights, piping plovers flew at mean flight speeds of 42 km/hr and altitudes of 288 m (interquartile range of model uncertainty = 36 to 1031 m above sea level)[13].

Estimates of flights from Loring et al. (2019) should be interpreted in the context of detection probability of the telemetry array, which consisted of a network of coastal Motus stations each with a detection radius extending from the station to about 15 km offshore (Loring et al. 2019). It is plausible that at least some piping plovers that appeared to be heading south intersected the Maryland Offshore Wind action area but were out of the detection range of the land-based receivers. It is also important to note that tags were deployed in only two nesting areas, and the migration flights of these sampled populations may differ from piping plovers that nest in other parts of the Atlantic Coast range. Therefore, the probability of occurrence in the action area does likely vary for piping plovers breeding in different portions of the range. It is also important to note that very little data on piping plover spring migration movements are available at this time, i.e., only two birds were tracked during partial northbound flights from the Bahamas (Loring et al. 2019). We have no data on the southbound migration patterns of fledged young of the year.

[13] Empirical results of Loring et al. 2019, 2020 supplant earlier efforts to hypothesize migration pathways from land-based observations of piping plovers throughout their annual cycle (e.g., Normandeau 2011, Burger et al. 2011).

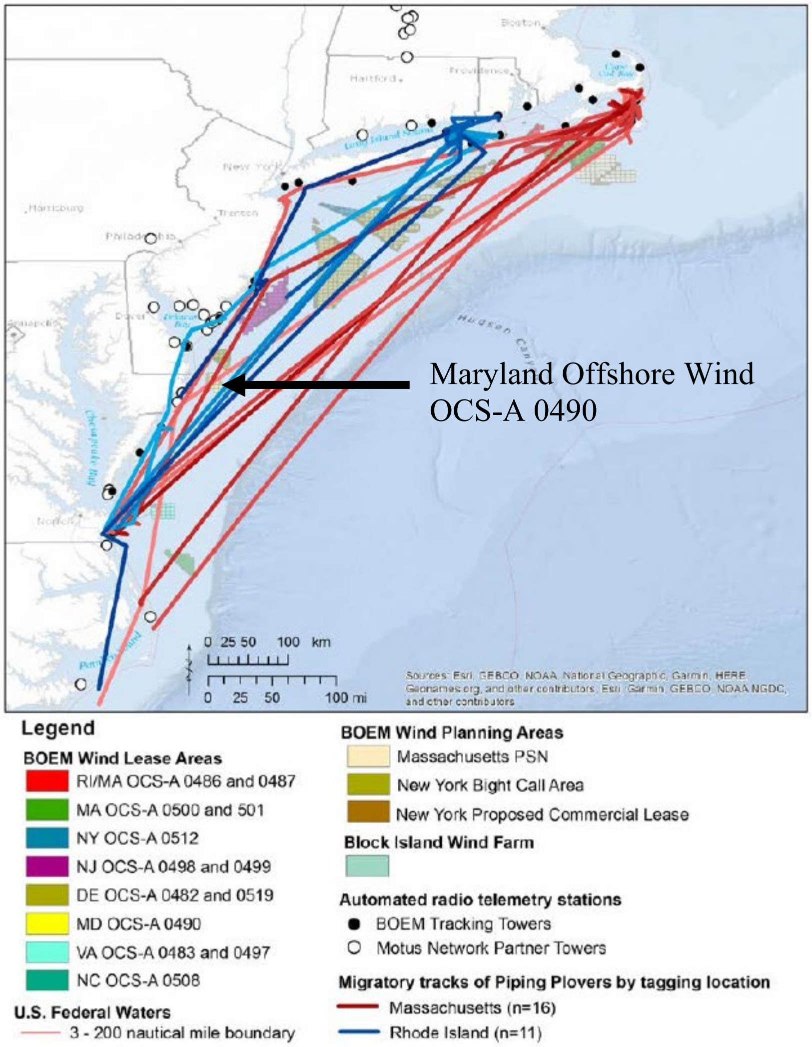

Figure 5. Interpolated migratory flights of piping plovers tagged in 2017 within the vicinity of Lease Area OCS-A 0490 and other WEAs in the Atlantic OCS. Piping plovers were tagged in Massachusetts (red) and Rhode Island (blue). Figure 57, part C, in Loring et al. 2019.

Loring et al. (2019) reported that while most offshore flight altitudes of piping plovers occurred above the study's assumed rotor swept zone (RSZ) (25 to 250 m above sea level), an estimated 21.3 percent of piping plover flights in Federal waters did occur within the study's assumed RSZ. However, the study's assumed RSZ is slightly smaller than the Maryland Offshore Wind RSZ [118 feet (36 m) to 938 feet (286 m) above sea level]. Adams et al. (2023) further analyzed this data set to generate a flight height distribution for collision risk modeling to account for variance across individual piping plovers. The analysis indicates that 30 percent of piping plover flights were within the Maryland Offshore Wind's RSZ.

US Wind, Inc. conducted one year of high-definition aerial avian surveys between May 2022 and May 2023. No piping plovers were identified in the aerial survey imagery; however, of the 2,569 total individual bird identifications, there were 4 shorebirds unidentified to species level and 4 birds unable to be classified (Normandeau Associates 2023). US Wind, Inc. deployed acoustic sensors on a Metocean Buoy within Lease OCS A-0490 between May 2021 and May 2023. The acoustic sensors did not record any piping plovers (Normandeau Associates 2024).

In summary, the action area is located within a migration corridor for piping plovers and its primary value for piping plovers is as a part of a flight corridor. Although a few movements north of breeding sites have been documented (Loring et al. 2022-2023), we suspect that these within season movements hugged the coast, not crossing the action area. Thus, current information indicates that piping plovers cross the action area no more than two times per year, on northward and southward migration flights. Approximately 30 percent of the piping plover crossing the action area are estimated to cross the action area within the Maryland Offshore Wind RSZ. We have very little information on the flight paths or altitudes of spring migrants but presume that spring occurrence in the Maryland Offshore Wind RSZ is similar to fall occurrence. We assume that fledged young of the year migrate south on the same flight paths and altitudes as adults.

Piping plovers from the New England recovery unit are likely to occur in the Maryland Offshore Wind action area during migration. We have no information regarding occurrence of birds from the Eastern Canada, NY-NJ or Southern recovery units within the Maryland Offshore Wind action area or RSZ, but we assume that they are present in the action area, and they would exhibit a similar flight height distribution.

Rufa Red Knot

We expect rufa red knots from all of the recovery units except the Western recovery unit to occur in the action area during many months of the year (Table 8).

Rufa red knots have been documented along the Delaware and Maryland coastline during northward and southward migration and are occasionally observed in the vicinity of at Delaware Seashore State Park in Sussex County, Delaware near the onshore portion of the action area (Ebird 2024); however, during migration, most observations are restricted to locations along the Delaware Bay, Delaware, which is outside of the action area.

We expect rufa red knots to occur in the offshore portion of the Maryland Offshore Wind action area during many months of the year.

Table 8. Expected rufa red knot occurrence by activity and month in the Maryland Offshore Wind action area (Perkins 2023, Ebird 2024).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Offshore												
Northbound Migration					X	X		X				
Southbound Migration	X						X	X	X	X	X	X
Regional Flights	X	X	X	X	X	X	X	X	X	X	X	X
Onshore												
Foraging/ Roosting	X	X	X	X	X	X	X	X	X	X	X	X

The Maryland Offshore Wind action area encompasses Lease Area OCS-A 0490 (see *Action Area* above for more detail). The Lease Area is located within a migration corridor for juvenile and adult rufa red knots and may also be transited by seasonally resident rufa red knots undertaking regional movements across the OCS (Loring et al. 2019). The rufa red knot migration corridor measures 1,529 miles (2,460 km) wide at the latitude of the Maryland Offshore Wind Lease Area. At 11 miles (18 km) wide, the width of the Lease Area occupies less than 1 percent of the width of the rufa red knot migration corridor at this latitude (see *Effects of the Action – Methods for Estimating Numbers of Collisions* below for more detail). Below, we summarize major studies on the presence and behavior of rufa red knots within the vicinity of the offshore portion of the action area.

Perkins (2023) summarized the migration patterns and wintering locations of rufa red knots based on 93 individuals tagged with 100 geolocators (Figure 6). Tags were deployed between 2009 and 2017. All rufa red knot tracks were reviewed and categorized into subpopulations corresponding with recovery units: SEC (31 birds, including 10 that wintered in the Caribbean), NCSA (22 birds), Western (24 birds), and Southern (9 birds). Seven individuals, all tagged in Texas, were unable to be classified confidently to a subpopulation. The location estimates are within an error margin of about 155 miles (250 km) (Perkins 2023).

Rufa red knot from every recovery unit except Western were estimated to be exposed to Lease Area OCS-A 0490. Birds from the NCSA and Southern recovery units were present during spring migration (May and June), and birds from the SEC recovery unit were recorded in during fall migration (August; Perkins 2023). The interpolated tracks from 8 birds (9 percent of tagged birds) were estimated to intersect the Maryland Offshore Wind's action area (blue highlighted lines in Figure 6; see Table 9) (Perkins 2023). It is important to keep in mind the limited accuracy of the geolocators when considering these tracks in relation to the action area.

Table 9. Rufa red knot geolocator tracks intersecting the Maryland Offshore Wind Lease Area.

Location Tagged	Season Tagged	Wintering Location	Recovery Unit
Argentina	Winter	Tierra del Fuego	Southern
Cape Cod, MA	Fall	Venezuela	NCSA
Cape Cod, MA	Fall	Cuba	SEC
Cape Cod, MA	Fall	North Carolina	SEC
Cape Cod, MA	Fall	Virginia	SEC
Delaware Bay, NJ	Spring	Brazil	NCSA
Delaware Bay, NJ	Spring	Tierra del Fuego	Southern
Delaware Bay, NJ	Spring	Brazil	NCSA

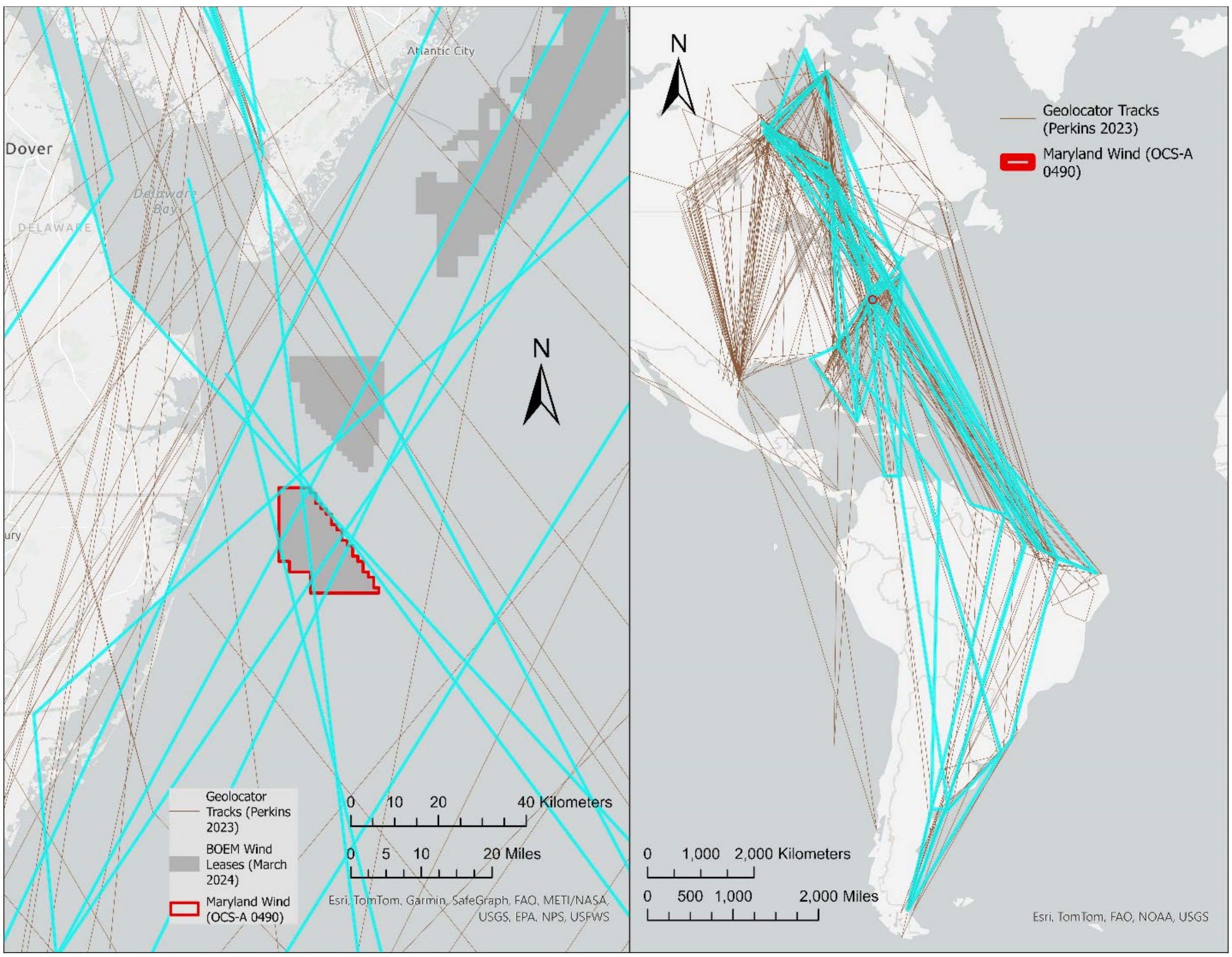

Figure 6. Rufa red knot geolocator tracks in relation to Maryland Offshore Wind Project's Wind Farm Area (Perkins 2023).

An automated radio telemetry study found that 59 of 388 rufa red knots tagged in James Bay and the Mingan Archipelago in Canada, in Massachusetts, and along the Atlantic Coast of New Jersey were detected over Federal waters during southward migration (Loring et al. 2018). Birds tagged at stopover sites in the Mingan Archipelago in Canada had fewer birds estimated to be exposed to WEAs compared to birds tagged at Massachusetts and New Jersey stopover areas. In total, of the 388 tagged birds, 4 were estimated to be exposed to Lease Area OCS-A 0490. However, offshore flights reported in Loring et al. (2018) should be interpreted in the context of detection probability of the telemetry array, which consisted of a network of coastal Motus stations each with a detection radius extending from the station to about 15 miles (24 km) offshore. Because the tracking array likely missed flights that occurred within Atlantic OCS Study Area (due to limited detection ranges from geographically dispersed stations), and because we were unable to account for the loss of the temporary tags utilized by the study, the estimates of exposure to Federal waters and WEAs should be considered a minimum (Loring et al. 2018).

Loring et al. (2018) found that migratory departure flights over the Atlantic OCS Study Area during fall migration occurred primarily at night (80 percent), from 3 hours before local sunset to 1 hour following local sunrise. Flights across WEAs occurred during fair weather, under clear skies (mean visibility greater than 62 feet (19 m) with above-average barometric pressure, mild temperatures, and little to no precipitation). The majority (77 percent) of migratory departure flights across WEAs were estimated to have occurred in the study's RSZ, with a mean altitude of 348 feet (106 m) (range 72 to 2,894 feet (22 m to 882 m)). However, these location estimates were subject to large error bounds and should be interpreted with caution. Further, the RSZ for this study was defined as 66 to 656 feet (20 m to 200 m) above sea level, smaller than the RSZ for Maryland Offshore Wind (Loring et al. 2018). Adams et al. (2022) further analyzed the data set of all altitude points collected over the Atlantic OCS Study Area to generate a flight height distribution for collision risk modeling. The analysis indicates that 54 percent of rufa red knot flights were within the Maryland Offshore Wind's RSZ.

In addition to migration flights, seasonally resident rufa red knots are also known to make regional flights, some of which cross the Atlantic OCS (Burger et al. 2012, Loring et al. 2018) resulting in the potential for increased exposure to the Lease Area.

US Wind, Inc. conducted one year of high-definition aerial avian surveys between May 2022 and May 2023. No rufa red knots were identified in the aerial survey imagery; however, of the 2,569 total individual bird identifications, there were 4 shorebirds unidentified to species level and 4 birds unable to be classified. US Wind, Inc. deployed acoustic sensors on a Metocean Buoy within Lease OCS A-0490 between May 2021 and May 2023. The acoustic sensors did not record any rufa red knots (Normandeau Associates 2024).

In summary, rufa red knots from the SEC, NCSA, and Southern recovery units are known to occur in or near the action area, though it is not yet known if birds from these three regions use the airspace with similar frequency, timing, or altitudes. Far greater numbers of rufa red knots are believed to cross the action area on fall migration flights compared to spring migration flights; however, available tracking data of northbound birds from points south of the action area are very limited. In addition, this species is not limited to migration flights across the OCS; the action area may also be transited by rufa red knots undertaking regional flights offshore during periods of seasonal residence in the mid-Atlantic. Best available information indicates substantial overlap between rufa red knot flight heights and the Maryland Offshore Wind's RSZ.

Roseate Tern

Due to their pelagic nature, roseate terns are usually found offshore. The birds typically breed on small islands but have been documented onshore and are occasionally observed on beaches near 3R's Beach at Delaware Seashore State Park in Sussex County, Delaware. Recent recorded sightings of migrating roseate terns in Delaware include two observed at The Point in Cape Henlopen State Park in July 2020 and one observed at Brockenbridge Gut in May 2023 (S. Robinson,Program Manager – Avian Conservation Wildlife Section, Division of Fish and Wildlife, DNREC, email to S. Deeley, Service, January 22, 2024). In Worcester County, Maryland, roseate terns have been historically and recently observed on a sporadic and occasional basis, primarily during migration (D. Brinker – Natural Heritage Program, Wildlife Heritage Service, Maryland Department of Natural Resources, LaVale Maryland, email to S. Deeley, Service, January 19, 2024) (Maryland Biodiversity Project 2023). Additional sightings of roseate terns have been recorded along coastal bays and shoreline, including the Indian River Inlet, Delaware and Ocean City, Maryland (eBird 2024). While small numbers of nonbreeding adult and juvenile roseate terns may occur in Delaware and Maryland during the nesting season, they do not nest on beaches within these states.

We expect roseate terns to occur in the offshore portion of the action area during many months of the year (Table 10).

Table 10. Expected roseate tern occurrence by activity and month in the Maryland Offshore Wind action area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Offshore												
Northbound Migration	X	X	X	X	X							
Southbound Migration									X	X	X	X
Foraging				X	X	X	X	X	X			
Onshore												
Nesting												

The Maryland Offshore Wind action area encompasses Lease Area OCS-A 0490 (see *Action Area* above for more detail). The Lease Area is located within a migration corridor for juvenile and adult roseate terns and may occasionally support foraging roseate terns. The roseate tern migration corridor measures 449 miles (722 km) wide at the latitude of the Maryland Offshore Wind Lease Area. At 11 miles (18 km) wide, the width of the Lease Area occupies about 2 percent of the width of the roseate tern migration corridor at this latitude (see *Effects of the Action – Methods for Estimating Numbers of Collisions* below for more detail). Below, we summarize major studies on the presence and behavior of roseate terns within the vicinity of the offshore portion of the action area.

Roseate terns migrate offshore (Mostello 2014), primarily following a southern route from Cape Cod, Massachusetts to the Caribbean (Gochfeld and Burger 2020), and therefore are not likely to be detected by land-based Motus stations during the migratory period due to the limited detection range (typically within 15 km) of the stations.

One study fitted 150 roseate terns with digital VHF transmitters at two nesting areas, Buzzards Bay, Massachusetts and Great Gull Island, New York and used an array of land-based Motus stations to monitor signals from tags during the breeding and post-breeding dispersal periods (Loring et al. 2019). No roseate terns were detected in the vicinity of Lease OCS-A 0490. However, there were no receiving stations within detection range of the Lease Area and offshore movement information from these tags is limited to interpolated flights between land-based stations.

US Wind, Inc. conducted one year of high-definition aerial avian surveys between May 2022 and May 2023. No roseate terns were identified in the aerial survey imagery; however, of the 32 *Sterna* terns identified, 21 were not identified to species. Additionally, there were 4 birds unable to be classified from the aerial surveys. US Wind, Inc. deployed acoustic sensors on a Metocean Buoy within Lease OCS A-0490 between May 2021 and May 2023. The acoustic sensors did not record any rufa red knots (Normandeau Associates 2024).

The Mid-Atlantic Baseline Studies Project conducted aerial and boat-based surveys in 2012 and 2013 to document species occurrence within the Mid-Atlantic Wind Energy Areas, which the Maryland Wind Lease Area is located within. The study area was defined as 3.45 miles (5.55 km) offshore of Maryland to the eastern extent of the Wind Energy Areas or the 30 m isobath, whichever was furthest. During 2013 survey efforts, the study area was expanded to include Maryland state waters. The Maryland Extension study area extended inland to the 10 m isobath to include Maryland state waters located west of the Maryland Wind's lease area. One roseate tern was reported approximately 12 miles east of Ocean City, Maryland during a boat survey near or within the action area, confirming at least occasional occurrence of this species at distances off the coast similar to the action area (O'Connell et al. 2009). Additionally, two roseate terns were observed between 1 to 6 miles off the coasts of Delaware and Maryland in mid-May 2013 during a boat survey (Williams 2015).

When crossing Federal waters, roseate terns tracked by Loring et al. (2019) predominantly occurred below the study's RSZ. However, these altitude estimates were derived from Motus data with high levels of uncertainty. An estimated 6.4 percent of roseate tern flights within Federal waters occurred within the study's RSZ. However, the RSZ for this study was defined at 82 to 820 feet (25 to 250 m) above sea level and thus smaller than the Maryland Offshore Wind RSZ. Further, in this study, the flight altitude data were collected during the breeding and post-breeding dispersal period, and thus may not be representative of altitudes for migration flights (Loring et al. 2019). Burger et al. (2011) noted that migratory flight height is poorly known but reported an anecdotal observation of roseate terns presumed to be embarking on migration flying at approximately 400 to 498 feet (122 to 152 m). Based on published reports from other tern species and personal observations of roseate terns (I. Nisbet, email, Service, July 12, 2019), roseate terns are expected to depart on migration flights at an angle of about 1 vertical to 8 horizonal and ascend to heights of 3,280 to 9,843 feet (1,000 to 3,000 m).

Roseate terns tracked via geolocators departing on migration across the ocean toward Puerto Rico flew throughout the first night and made contact with the water frequently during the next day (I. Nisbet, email, Service, July 12, 2019). Data from a study of 10 roseate terns marked with geolocators indicate that during both southbound (fall) and northbound (spring) migration, the roseate terns primarily flew at night and spent time on the water's surface during the day (Oswald 2023). Birds descending to rest on the water and then ascending again to continue migration may represent another layer of complexity in assessing roseate tern exposure to the RSZ.

In summary, we conclude it is likely that roseate terns occasionally occur in the action area. Seasonally, resident birds in Delaware and Maryland (e.g., juveniles, nonbreeding adults during the breeding season, staging birds) may occasionally forage in the Maryland Offshore Wind action area; we have no evidence of this occurring to date, but we also lack any reason to conclude that it does not occur. Although the action area may occasionally support foraging terns during the breeding period, its primary value to roseate terns is as part of a flight corridor during migration and as a foraging area during migration depending on prey availability. To the extent roseate terns utilize the action area, they are more likely to be from the warm water population based on its much larger size and closer proximity to Delaware and Maryland. Flight height distribution of any roseate terns occurring within the Maryland Offshore Wind action area would be expected to overlap the Maryland Offshore Wind RSZ, but only to a low or moderate extent.

Factors Affecting Listed Species in the Action Area

The following discussion describes factors affecting the environment of piping plovers, rufa red knots, and roseate terns within the action area. Such factors may include state, tribal, local, and private actions already affecting the species or that will occur contemporaneously with the consultation in progress. Unrelated Federal actions affecting the same species that have completed formal or informal consultation are also part of the environmental baseline, as are Federal and other actions within the action area that may benefit listed species.

Vessels

The COP (Appendix II-K1 Navigational Safety Risk Assessment, TRC Companies 2024) presents information on vessel traffic specific to the action area. Within a 4.95-mile (7.97 km) radius around the lease area, vessel traffic consists of cargo/tanker (45 percent), recreational (21 percent), fishing (13 percent), other (10 percent), tug (9 percent), and passenger (2 percent). Data collected in 2019 showed vessel traffic was relatively consistent throughout the year for cargo/tanker, fishing, tug and other vessel types, although there were peaks in late summer and early fall for cargo/tanker traffic. Recreational and passenger vessel traffic primarily occurred between late spring and early fall. The average number of transits per day ranges between 5 to 11 with the eastern third of the Lease Area receiving the heaviest vessel traffic. Noise, activity, lighting, and air emissions associated with vessel traffic in the action area could potentially influence the behavior and/or fitness of listed birds.

Birds may occasionally encounter a vessel in the action area. Diurnal encounters will likely cause birds to make a minor course adjustment or be temporarily disoriented by noise or lights, but we conclude such effects are minor and generally do not impact fitness of the affected birds. Avian vessel strikes largely occur during the night or twilight hours when visibility is reduced and birds are exposed to artificial lighting (Black 2005, Merkel 2010). Many bird species are known to be attracted to artificial lighting at night, including many seabird and landbird species (Hüppop et al. 2016, Rodriguez et al. 2017). Poor weather conditions increase the risk of avian collision (Black 2005, Merkel 2010, Ronconi et al. 2015). Nocturnal collision of birds with vessels is likely, especially on nights with poor visibility. Best management for limiting bird exposure to artificial lights are typically implemented on all vessels operating at night. Piping plovers migrate nocturnally (Loring et al. 2020a), as do red knots and roseate terns as part of their multi-day nonstop migration flights (Mostello et al. 2014, Baker et al. 2020).

Carl N. Shuster Jr. Horseshoe Crab Reserve

Horseshoe crab eggs are a critical food resource for shorebirds during migration, including rufa red knots. The Carl N. Shuster Jr. Horseshoe Crab Reserve was created to protect the horseshoe crab population and maintain their egg production in the Delaware Bay region. The reserve spans across an area of approximately 1,593 square miles (4,127 square kilometers) and is closed to horseshoe crab harvest. The southern section of the reserve overlaps with approximately 41.9 square miles (108.6 square kilometers) of the northern half of the Maryland Offshore Wind Lease Area, or 2.6 percent of the total reserve area, where horseshoe crabs have been documented to occur. This area provides overwintering habitat for juvenile and adult horseshoe crabs and serves as a migration corridor when they travel to onshore breeding beaches to spawn. The reserve supports the foraging needs of the rufa red knot as they migrate through the Delaware Bay region.

Offshore structures

Currently, there are two structures in the Maryland Offshore Wind Lease Area, a Floating Light Detection and Ranging (LiDAR) meteorological and oceanographic buoy and a digital acoustic monitoring instrument (DMON) whale monitoring buoy (BOEM 2023a, Woods Hole Oceanographic Institution 2024). The Floating LiDAR buoy measures approximately 13.1 ft (4 m) length and width and approximately 10.2 ft (3.1 m) above sea level (BOEM 2020) and is scheduled to be decommissioned in 2024. The DMON buoy is scheduled to be deployed through at least 2026. Due to the low height and relatively small size, the DMON buoy is not considered a collision hazard. Although the DMON buoy may have potential effects on bird behavior as the result of perching on the buoy, the size of the effects is considered minor.

Climate Change

As described within the Status of the Species, piping plovers, rufa red knots, and roseate terns are likely to face various climate-change driven threats. However, the Environmental Baseline in this Opinion is limited to the boundaries of the action area. We have scarce information to assess the extent to which the three listed avian species may be affected by changing climate in the action area, but best available information is summarized below.

Variation in weather is a natural occurrence and is normally not considered a threat to the survival of species. However, persistent changes in the frequency, intensity, or timing of storms in the action area may impact listed birds using this air space. Storm impacts to birds on migration flights include energetic costs from a longer migration route as birds avoid storms, blowing birds off course, and outright mortality (USFWS 2014). For example, geolocator tracking of rufa red knots found three of four birds likely detoured from normal migration paths to avoid adverse weather during the fall migration. These birds travelled an extra 640 to 1,000 miles (1,030 to 1,609 km) to avoid storms (Niles 2014; Niles et al. 2010). The extra flying represents substantial additional energy expenditure, which on some occasions may lead to mortality (Niles et al. 2010).

In addition to storms, flights of listed birds in the action area may also be impacted by climate-driven changes in weather, for example, shifting average or extreme temperatures or changing wind patterns (Fernández-Alvarez et al. 2023, Simmons 2022). We have little information to assess the extent to which piping plovers, rufa red knots, or roseate terns may be experiencing such shifts in climatic conditions in the action area, or their vulnerability to any such changes.

Roseate terns in the action area may also be affected by changing abundance or composition of forage fish in the action area. As summarized by Cooley et al. (2022), anthropogenic climate change has exposed ocean and coastal ecosystems to conditions that are unprecedented over millennia (high confidence[14]), and this has greatly impacted life in the ocean and along its coasts (very high confidence). Surface warming since the 1950s has shifted marine taxa and communities poleward at an average (mean ± very likely range) of 36.8 ± 9.6 miles (59.2 ± 15.5 km) per decade (high confidence), with substantial variation in responses among taxa and regions that leads to novel assemblages of species and fundamentally altered ecosystems. Ecosystem responses to warming water, fishing pressure, food-web changes, marine heat waves, and sea ice algal populations have been responsible for highly variable or collapsing populations of Northern Hemisphere high-latitude forage fish species including sand lances (*Ammodytes spp.*) and herring (*Clupea spp*.). Declining stocks of forage fish are expected to have detrimental effects on seabirds (medium confidence) (Cooley et al. 2022). We have little information on the extent to which roseate terns forage in the action area, or their vulnerability to any such changes in this part of their range.

EFFECTS OF THE ACTION

In accordance with 50 CFR §402.02, "effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action."

The potential effects of the proposed action to piping plover, rufa red knot, and roseate tern are described in Table 11. Those components of the proposed action determined to result in "no

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[14] Each finding of the International Panel on Climate Change is grounded in an evaluation of underlying evidence and agreement. A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and shown Italics, for example, *medium confidence*. The following terms have been used to indicate the assessed likelihood of an outcome or result: virtually certain 99–100% probability; very likely 90–100%; likely 66–100%; about as likely as not 33–66%; unlikely 0–33%; very unlikely 0–10%; and exceptionally unlikely 0–1%. Additional terms (extremely likely 95–100%; more likely than not >50–100%; and extremely unlikely 0–5%) are also used when appropriate. Assessed likelihood is shown in Italics, for example, *very likely*.

effect” (NE) or to “not likely to adversely affect” (NLAA) the listed species evaluated in this Opinion are described in Table 11 and will not be further discussed in this Opinion. The component of the project that is “likely to adversely” (LAA) affect piping plover, rufa red knot, and roseate tern, collision with WTGs, is described in Table 11 and also in more detail following Table 11.

Table 11. Potential effects of proposed action on piping plover, rufa red knot and roseate tern[1].

Activity	Sub-activity	Environmental Impact or Threat	Stressor	Exposure (resource affected)	Range of Response	Conservation Need Affected	Demographic Consequences	Effect of Sub-activity
Piping Plover/Rufa Red Knot/Roseate Tern								
Construction - Onshore	Tree clearing	N/A	N/A	N/A	N/A	N/A	N/A	NE
	Comments: Tree clearing will occur outside of suitable habitat.							
	HDD	Increase in noise, Increase in artificial lighting	Noise, lighting, disturbance	N/A	N/A	N/A	N/A	NLAA
	Comments: Project work will be confined to previously disturbed areas (parking lot at 3Rs Beach at Delaware Seashore State Park in Sussex County, Delaware) and the exit for the horizontal directional drilling is outside suitable habitat for these species. Therefore, effects to these species are expected to be insignificant.							
	Above ground lines	N/A	N/A	N/A	N/A	N/A	N/A	NE
	Comments: These will be installed outside of suitable habitat.							
Construction - Inshore	HDD	Increase in noise, increase in artificial lighting	Noise, lighting, disturbance	N/A	N/A	N/A	N/A	NLAA
	Comments: The use of barges will introduce noise and artificial lighting but because exposure to the noise and lighting will occur in the inshore environment where birds are expected to be in the area for only brief periods of time, effects to these species are expected to be insignificant.							
	Install energy export cables	Increase in noise, increase in artificial lighting benthic disturbance	Disturbance, avoidance	N/A	N/A	N/A	N/A	NLAA

Activity	Sub-activity	Environmental Impact or Threat	Stressor	Exposure (resource affected)	Range of Response	Conservation Need Affected	Demographic Consequences	Effect of Sub-activity
	Comments: The use of barges will introduce noise and artificial lighting but because exposure to the noise and lighting will occur in the inshore environment where birds are expected to be in the area for only brief periods of time, effects to these species are expected to be insignificant. The installation of export cables using a cable burial tool and dredging in Indian River Bay may affect rufa red knots indirectly. Turbidity, as a result of the cable burial tool, could distress, displace or cause mortality of horseshoe crabs. Dredging could result in a loss of horseshoe crabs and their eggs and larvae as well as their habitat. The impacts to horseshoe crabs in the Indian River Bay could lead to reductions in the spawning population and removal of eggs and larva which would reduce food sources for rufa red knots. Due to the brief duration of the disturbance and the implementation of Conservation Measure 6 (no in-water work in Indian River Bay from March 1 through September 30), effects are expected to be insignificant. The installation of export cables may affect roseate terns indirectly from benthic disturbance to prey habitat (sand lance). Due to the brief duration of the disturbance, effects are expected to be insignificant.							
Construction - Offshore	Install inter-array cables and energy export cables	Increase in noise, benthic disturbance, air pollutants	Disturbance, avoidance	N/A	N/A	N/A	N/A	NLAA
	Comments: The use of a ship will introduce noise and air pollutants, but because exposure will only occur during migration when birds are expected to be in the area for only brief periods of time effects to these species are expected to be insignificant. The use of ships and helicopters may introduce lighting for intermittent, but extended periods of time, but because the project will implement lighting minimization measures and exposure will only occur during migration when birds are expected to be in the area for only brief periods of time, effects to these species are expected to be insignificant. The installation of export cables using a jet plow through the Carl N. Shuster Horseshoe Crab Reserve may affect rufa red knots indirectly. Turbidity, as a result of the cable installation, could distress, displace or cause mortality of horseshoe crabs. Export cable installation will occur over several construction campaigns, each lasting about one year, including the winter months when horseshoe crabs are expected to occur within the Lease Area. The impacts to horseshoe crabs in the reserve could lead to reductions in the spawning population in Delaware Bay and therefore, reduction in food sources for rufa red knots. Due to the brief duration of the disturbance and considering the size of the reserve within the Lease Area (2.6 percent of the reserve), effects are expected to be insignificant. The installation of cables may affect roseate terns indirectly from benthic disturbance and potential loss of prey habitat (sand lance) (Staudinger et al. 2020). Due to the brief duration of the disturbance, effects are expected to be insignificant.							
	WTG, OSS and Met Tower construction	Increase in noise, collision with vessels and lighted stationary structures, air pollutants	Disturbance, avoidance	N/A	N/A	N/A	N/A	NLAA

Activity	Sub-activity	Environmental Impact or Threat	Stressor	Exposure (resource affected)	Range of Response	Conservation Need Affected	Demographic Consequences	Effect of Sub-activity
	Comments: The use of a ship will introduce noise and air pollutants, but because exposure will only occur during migration when birds are expected to be in the area for only brief periods of time, effects to these species are expected to be insignificant. The use of ships and helicopters may introduce lighting for intermittent, but extended periods of time. Because the project will implement lighting minimization measures and exposure will only occur during migration when birds are expected to be in the area for only brief periods of time, effects to these species are expected to be insignificant.							
Operation and Maintenance	WTG Operation	Collision, displacement	Direct mortality	Individuals	Kill	Breeding	Numbers, distribution	LAA
	Comments: The Lease Area is within a migratory route for the listed species and 2 collision risk models predict collisions of both piping plover and rufa red knot will occur during the 35-year lease period. Although collision risk models did not predict collisions of roseate terns, based upon documented presence off the coast of Maryland at distances similar to the Lease Area, the Service anticipates collisions will occur.							
	Lighting	Increase in artificial lighting	Disorientation	N/A	N/A	N/A	N/A	NLAA
	Comments: WTGs, OSSs and the Met Tower have aviation related lighting that only illuminates when aircraft are in the vicinity, given the short duration these lights will be active the likelihood of overlap with migrating birds is expected to be discountable and any effects to these species, should there be an overlap, are expected to be insignificant.							
	Infrastructure maintenance	Increase in noise	Disturbance	N/A	N/A	N/A	N/A	NLAA
	Comments: The use of ships and helicopters will introduce noise; however, these events will be of short duration and listed birds would only potentially be exposed during migration. Given the short duration of the noise the likelihood of overlap with migrating birds is expected to be discountable and any effects to these species, should there be an overlap, are expected to be insignificant.							
	Cable Operation	Increase in EMFs	Reduced prey availability	N/A	N/A	N/A	N/A	NLAA
	Submarine cables that will be installed by the project will emit EMFs (TRC Companies 2024). Best available science has documented responses to EMF by benthic invertebrates, but not specifically horseshoe crabs. Additionally, effects from EMF at intensities utilized by the project have not yet been identified by best available science, and thus the risk of any adverse effects to horseshoe crabs from the EMFs emitted from cables is currently discountable (Hutchinson 2020). If horseshoe crabs are affected by EMFs, it could lead to reductions in the spawning population and removal of eggs and larva which would reduce food sources for rufa red knots. However, there is a lack of research on this topic and we support and appreciate the inclusion of Conservation Measure 12 to research potential effects of EMF on horseshoe crabs.							

[1]"No effect" (NE) rows are green, "not likely to adversely affect" (NLAA) rows are yellow, and "likely to adversely affect" (LAA) rows are orange.

WTG Operation - Collision with WTGs

Background

WTGs are known to present a collision hazard to birds in flight (Drewitt and Langston 2006, Croll et al. 2022). If any listed bird were to collide with any of WTGs, this would result in take under the ESA, by wounding or, more likely, killing the bird. *See* 16 USC §1532(19) (defining "take"). The level of risk is associated with factors such as: the number, location, height, lighting, and operational time of the WTGs; the population size and movement patterns of the bird species in question, its typical flight altitudes, and its ability to avoid collision; the landscape setting (e.g., topography on land, distance offshore); and weather conditions. For most species, collision risk levels vary seasonally and differ between day and night (Drewitt and Langston 2006, Croll et al. 2022). Migratory flights during poor conditions could lead to increased collision risk with offshore WTGs because of impaired visibility, depleted energy reserves, and reduced flight altitudes (Newton 2007). Collision risk levels may change over time as population sizes expand or contract and as bird behaviors, major flyways, or patterns of habitat usage change in response to environmental trends or human-driven factors. For example, over time it is unknown if birds may become acclimated and better able to avoid WTGs. Furthermore, on a local, regional, or flyway scale, additive or synergistic effects on collision risk levels may emerge as various offshore wind projects become operational.

Piping plovers, rufa red knots, and roseate terns may eventually encounter, and be forced to navigate, up to 3,226 total WTGs, as projected upon full build out of currently leased offshore areas in New England and the mid-Atlantic, not including additional areas under consideration for leasing such as the Central Atlantic and Gulf of Maine (S. Vail-Muse, FWS, email to W. Walsh, FWS, April 14, 2023). Additional offshore WEAs are under consideration within the migratory ranges of affected species, including Atlantic Canada, Caribbean, and off the coast of South America. Additive or synergistic effects may also emerge between offshore wind operation and profound ecosystem shifts driven by climate change (e.g., changing assemblages/distribution of prey species; phenological shifts; changing patterns of storm activity).

Meta-analyses performed on 88 bird studies containing information from 93 onshore wind farm sites (Thaxter et al. 2017) related collision rate to species-level traits and WTG characteristics to quantify the potential vulnerability of more than 9,500 bird species globally. Avian collision rate was affected by WTG characteristics, migratory strategy, dispersal distance, and habitat associations. Larger WTG capacity (megawatts) increased collision rates; however, deploying a smaller number of large WTGs with greater energy output reduced total collision risk per unit energy output. Areas with high concentrations of vulnerable species were also identified, including migration corridors. Charadriiformes, the order of birds that includes all three of the species addressed in this Opinion, was identified as vulnerable. However, predicted collision risk within Charadriiformes was relatively low for charadriidae (plovers, including piping plovers) and scolopacidae (sandpipers, including red knots), and relatively high for laridae (seabirds, including roseate terns) (Thaxter et al. 2017 Appendix 6, Figure S9).

Available Collision Risk Models

Technology currently does not exist to reliably detect a collision of a bird with a WTG, and the likelihood of finding a bird carcass in the offshore environment is very low due to wind displacement (Bibby 1981), carcass persistence rate (Ford et al. 1996, Barrientos et al. 2018), and searcher efficiency (Barrientos et al. 2018). A body of literature on avian collision risk at wind farms has developed in recent decades and helps inform risk assessments for piping plovers, rufa red knots, and roseate terns. However, considerable uncertainty remains, in part, because most studies to date have been conducted at wind farms on land and/or in Europe. Thus, until effective collision detection methods are available, we anticipate relying on collision risk modeling to estimate collision rates after construction (see Conservation Measures 3 and 4), as well as for pre-construction analyses including this effects analysis.

Two different models, Band (2012) and SCRAM (Adams et al. 2022), are available to estimate collision risk for piping plovers, rufa red knots, and roseate terns from the Maryland Offshore Wind Project. The BA (BOEM 2023c) provided collision risk estimates utilizing SCRAM v1.0.3 and a Band (2012) model implemented in Excel.

Since the BA was submitted, the SCRAM and Band (2012) collision models have been updated in a collaborative effort by BOEM and the Service. Updates included new movement data from rufa red knots, updated population information, and an updated model structure to more closely align with collision risk models being used in offshore wind assessments in the United Kingdom in coordination with international subject matter experts. In addition, SCRAM v2.0.3 (Gilbert et al. 2022) includes a module that runs a stochastic of the Band (2012) Annex 6 – Migrant Collision Risk. This stochastic version of the Band CRM can be run alongside SCRAM v2.0.3, to help estimate uncertainty in results.

The Service assessed collision risk using newly-available SCRAM v2.0.3 (Gilbert et al. 2022) and Band (2012). We consider the outputs from SCRAM v2.0.3 and the stochastic version of Band (2012) Annex 6 in this analysis of effects and provide a description of the models' methods, limitations, and uncertainty.

Band

Band (2012) is an established method to assess collision risk for offshore wind farms. Band (2012) estimates the number of annual collisions using input data on the target species (e.g., numbers, flight height, avoidance, body size, flight speed) and WTG details (e.g., number, size and rotation speed of blades). The primary limitation of the stochastic Band (2012) Annex 6 model for migrants is that it assumes a uniform distribution of the migrant population across a pre-specified migratory corridor width. While corridor width can change with latitude, the assumption of a uniform distribution over that region is likely inaccurate for most species.

Stochastic Collision Risk Assessment for Movement (SCRAM)

SCRAM builds on the Band (2012) model and introduces stochasticity via repeated model iterations. The wind farm and WTG operational inputs to SCRAM are similar to those used in the Band (2012) model. Unlike Band (2012), however, SCRAM estimates species exposure to a proposed wind farm using bird passage rates based on modeled flight paths of birds fitted with

Motus tags (Adams et al. 2022), which are detected by a network of land-based receiving stations operated in coordination with the Motus network. Future versions of SCRAM will be updated with new tracking data as it becomes available, but the current version of SCRAM, v2.0.3 (Gilbert et al. 2022), is informed by a fixed number of Motus tag detections that were collected from 2015 to 2017 for piping plovers and roseate terns, and in 2016 to 2017 for rufa red knots. SCRAM estimates monthly collision risk for those months when the species-specific tracking data were collected and these monthly collision estimates are summed to produce annual collision estimates reflecting the months evaluated (Adams et al. 2022). It is important to note that SCRAM currently evaluates collision risk only for those months with movement data from Motus (see *Temporal Gaps*, below).

Collection of tracking data during the study periods (2015 to 2017 for piping plover and roseate terns and 2016 to 2017 for rufa red knots) was limited by: 1) tag battery life; 2) temporary tag attachment method/duration (i.e., to minimize risks to tagged individuals); 3) locations of tag deployment; and 4) the detection range of land-based Motus stations (typically less than 9 miles (15 km)), which during the study periods were unevenly distributed along the U.S. Atlantic Coast, with core station coverage at coastal sites from Massachusetts to Virginia.

The first version of SCRAM was only released in early 2023 (with an updated version released in early 2024) and still reflects a number of data gaps and uncertainties. In addition to the limited data available to inform the model parameters, discussed above, there has also been limited validation of the model structure, resulting in substantial uncertainty in model results (Adams et al. 2022). Specific gaps and uncertainties of concern include:

1. *Sample size.* The tracking data sample sizes that underpin the model are relatively small, and do not include all tracks now available (e.g., newer Motus data; any satellite, GPS, or geolocator data).
2. *Accuracy.* All of the flight tracks and altitudes that underpin the model are estimated from geographically dispersed land-based receiving stations and are thus of limited accuracy because offshore bird movements were interpolated rather than measured directly. Model evaluation using a simulated data set suggested that the interpolations were reasonably accurate nearshore (where the majority of the Motus stations are located) but less accurate farther offshore. Even in nearshore areas, movement estimates are biased by the detection range. Estimates of flight altitude from Motus data are currently coarse approximations (Adams et al. 2022).
3. *Detection range.* The detection range of Motus receiving stations varies with altitude of the tagged bird but is typically less than 9 miles (15 km) on average for birds in flight. This is likely a key reason that only one roseate tern migratory track was documented south of Long Island during the tracking studies. The easternmost portions of the Maryland Offshore Wind project are over 36 miles (57.94 km) from the nearest land. Thus, there were gaps in coverage of the Lease Area that could lead to underestimates of collision risk.
4. *Temporal gaps.* Both movement and flight height data are currently limited to those times of year during which the tracking studies were carried out (Table 12). There are no spring data for piping plovers, rufa red knots, or roseate terns in SCRAM due to small sample

sizes of available data (e.g., only two northbound piping plovers tagged in the Bahamas with tracks in the U.S.) and limited tagging locations (e.g., most rufa red knots tagged in spring were in Delaware Bay). Any collision estimates from SCRAM are limited to the time periods listed below. Thus, "annual" SCRAM outputs should be considered only partial estimates of projected collision levels because they reflect summing across only those months for which data are available[15].

Table 12. Months with tracking data available for use in SCRAM to produce collision estimates.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Piping Plover			-	-	X	X	X	X	-	-		
Rufa Red Knot	-	-	-	-	-	-	X	X	X	X	X	-
Roseate Tern				-	-	X	X	X	X	-		

Table 12 **Notes:**
X = Tracking data available for use in SCRAM
- = Tracking data not available for use in SCRAM

<u>Piping plover</u>
1. Collision risk evaluated: mid-incubation period and through fall migratory departure from tagging sites.
2. Collision risk not evaluated: latter portion of fall migratory flights, spring migration and staging.

<u>Rufa red knot</u>
1. Collision risk evaluated: fall migratory departure from tagging sites.
2. Collision risk not evaluated: latter portion of fall migratory flights, spring migration and staging.

<u>Roseate tern</u>
1. Collision risk evaluated: mid-incubation period and to the post-breeding dispersal period.
2. Collision risk not evaluated: fall migration and spring migration to the mid-incubation period.

5. *Spatial bias.* SCRAM assumes that the movement models represent bird airspace use in an unbiased manner. However, it is likely that collision risk outputs from SCRAM are biased by the proximity of an offshore wind lease area to the locations of Motus tag deployment and/or its location relative to the distribution of land-based receiving stations during the tracking study periods (Lamb et al. 2023). As Motus stations are unequally distributed on the landscape, and different numbers of Motus stations were operated each year of the tracking study, the locations of each year's Motus stations inevitably bias resulting estimates of bird use of the offshore airspace (Adams et al. 2022). Thus, SCRAM could underestimate collision risk for projects more distant from the tagging

[15] See *Transparent modeling of collision risk for three federally listed bird species in relation to offshore wind energy development: Final report* (https://espis.boem.gov/Final%20Reports/BOEM_2022-071.pdf) Tables B1, B2, and B3 for months in which data are available for SCRAM collision risk estimates.

areas or more distant from those receiving stations that were in operation during the study periods.

6. *Bias in tagged birds.* Both movement and flight height data are currently limited to those specific tagged populations tracked during the study periods (Adams et al. 2022). It is not yet clear if the bird tracks that underpin the current version of SCRAM are representative of all piping plovers, rufa red knots, and roseate terns utilizing the offshore airspace. Even within the seasons/regions for which tracks are available and incorporated into SCRAM, these tracks represent birds from a relatively small number of sites at which tagging took place. For example, the tracks informing SCRAM for piping plover were all derived from Motus tag deployment at just two nesting areas in New England. No tracks are yet available from the Eastern Canada portion of the piping plover breeding range, which is part of the taxon listed under the ESA. Preliminary results from a separate mark/resight study found that 42 percent of piping plovers marked in Eastern Canada were subsequently detected in New Jersey and 52 percent were detected in North Carolina (J. Rock, Environment and Climate Change Canada, email to W. Walsh, FWS, February 1, 2023). Eastern Canada piping plovers may have significant exposure to offshore wind that is not yet reflected in SCRAM collision risk estimates. Rufa red knot tagging sites covered a greater geographic area but may still not be fully representative of the overall population's use of the offshore airspace.
7. *Variability.* SCRAM cannot yet produce a range of plausible risk levels by varying certain "baked in" assumptions to which the model might be quite sensitive, and which are associated with high uncertainty (e.g., avoidance rate, population size, flight height).

Methods for Estimating Numbers of Collisions

In light of the high uncertainty associated with both Band (2012) and SCRAM, as discussed above, we used collision projections from both models. For SCRAM, we relied on wind farm input data provided by BOEM on September 27, 2023, which included project specifications (e.g., wind farm size, number of WTGs, WTG measurements). As noted above, SCRAM uses estimated flight paths and altitudes of tagged birds, combined with monthly population size estimates, to assess exposure of each species to the RSZ. Compared to Band (2012), SCRAM uses the monthly population estimates in a different way. SCRAM uses movement modeling derived from Motus tracking data to determine monthly occupancy rates within half degree grid cells and then links those values to monthly population estimates to estimate species density across the Atlantic OCS where tracking data were available. SCRAM uses these density estimates at specific flight heights (data also derived from Motus tracking) along with other species and site characteristics (e.g., species-specific flight speeds and number of WTGs in a specified WTG array) to estimate collision risk for locations across a portion of the Atlantic OCS where tracking data are available (Adams et al. 2022).

For Band (2012), we used WTG specifications provided by BOEM (2023) and we utilized the same species-specific flight-height distributions (i.e., derived from Motus radio tracking data) as are used in SCRAM (Adams et al. 2022). We followed the guidance from Band (2012) to develop a best estimate. For all three species, we used Band (2012) Annex 6 – Assessing collision risks for birds on migration. We expect piping plovers in the action area to be limited to birds on migration flights. However, for rufa red knots and roseate terns, use of Annex 6 means omitting from the Band (2012) analysis birds that may be seasonally resident in the mid-Atlantic and present in the action area on non-migration flights (i.e., regional movements for rufa red knots, foraging flights for roseate terns). Although Annex 6 is unable to account for seasonally resident birds, we selected it for the following reasons: (1) Stage B of the Band (2012) basic model (i.e., for resident birds) requires an estimate of observed bird density on an area basis, and this information is unavailable for piping plovers, rufa red knots and roseate terns in the vicinity of the Maryland Offshore Wind Lease Area during any month; and (2) far greater numbers of migrating rufa red knots and roseate terns are present on the mid-Atlantic OCS compared to seasonally resident birds. Thus, we conclude that Annex 6 is the most appropriate application of the Band (2012) model for the Maryland Offshore Wind Project. However, we note that if and when seasonally resident rufa red knots or roseate terns occur offshore, they may spend more time in the action area, and at different flight heights, compared to migrants, and this represents an additional source of collision risk that is not reflected in the Band (2012) outputs presented below.

Under Annex 6, Band (2012) makes the following assumptions:

1. the entire bird population uses a migratory corridor twice each year;
2. the birds are evenly distributed across a migration corridor; and
3. the width of the corridor can be measured at the latitude of the wind farm (i.e., this "migratory front" is an imaginary line passing through the Maryland Offshore Wind Lease Area and extending to the western and eastern edges of the migratory corridor used by each species).

Regarding assumption 1, a few piping plover movements north of the breeding site have been documented (Loring et al. 2022-2023), but we conclude that it generally holds true that piping plovers and roseate terns cross the migratory front only twice per year. However, we know from tracking and resighting data that rufa red knots may engage in reverse migration over regional geographic scales in pursuit of favorable food and other stopover conditions (USFWS 2014). Thus, an unknown number of migrating rufa red knots violate this assumption by crossing the migratory front more than twice per year. Regarding assumption 2, we conclude from tracking data that none of the listed bird species are evenly distributed across their respective migration corridors. However, we still find it appropriate to consider Band (2012) outputs given the known gaps in SCRAM.

We used best available tracking and other data (including range maps) to inform the delineation of the migration corridors (Appendix B) that are included in the stochastic Band (2012) Annex 6 module in SCRAM v2.0.3 web application (Gilbert et al. 2022).

For piping plover, the corridor was based on Motus data for birds departing from Chatham, Massachusetts, several sites in Rhode Island (Loring et al. 2020b Figures 5 and 6), and the known wintering distribution of the Atlantic Coast population (Kirkconnell 2012, Elliott-Smith et al. 2015, Gratto-Trevor et al. 2016, Elliot-Smith and Haig 2020). The piping plover migration corridor measures 131 miles (211 km) wide at the latitude of the Maryland Offshore Wind Lease Area.

For rufa red knot, we delineated a migration corridor based on geolocator tracking data collected from 93 individual birds (with tags deployed across the species range) between 2009 and 2017

(Perkins 2023). Measuring 1,529 miles (2,460 km) across at the latitude of the Maryland Offshore Wind Lease Area, the migration corridor encompasses all rufa red knot geolocator tracks except those that are clearly associated with the Western recovery unit. A considerable number of satellite/GPS tracking devices have been deployed on rufa red knots since 2020. Preliminary data from these satellite tags were evaluated but ultimately not utilized in delineating the migration corridor, because the data are still undergoing quality control and, in many cases, metadata is not yet available. Although not relied upon for this mapping exercise, the preliminary satellite data do show broadly similar geographic patterns to the geolocator data and lend confidence to our delineation of the migration corridor.

A migratory corridor for roseate tern was delineated to include the entirety of their known breeding range and migration range for the northeastern population, from Sable Island, Nova Scotia, south and west through North Carolina and southward to the West Indies (Gochfield and Burger 2020). The roseate tern migration corridor measures 449 miles (722 km) wide at the latitude of the Maryland Offshore Wind Lease Area.

The final input required to run Band (2012), Annex 6, is the number of birds crossing the migratory front each month. Table 13 presents the population data we used for this purpose.

Table 13. Population data inputs to Band (2012), Annex 6.

	Piping Plover	Rufa Red Knot	Roseate Tern
Total northbound (NB)	4,047	59,782	10,866
Young of the year (YOY)	2,632	13,736	5,433
Total southbound (SB)	6,679	73,518	16,299
# of Jan crossings	0	0	0
# of Feb crossings	0	0	0
# of Mar crossings	416 (10% of NB)	0	0
# of Apr crossings	2,482 (60% of NB)	0	3,622 (33% of NB)
# of May crossings	1,244 (30% of NB)	59,782 (100% of NB)	3,622 (33% of NB)
# of Jun crossings	687 (10% of SB)	1,470 (2% of SB)	3,622 (33% of NB)
# of Jul crossings	4,096 (60% of SB)	11,028 (8% of SB)	0
# of Aug crossings	2,050 (30% of SB)	29,407 (40% of SB)	5,433 (33% of SB)
# of Sep crossings	0	14,704 (20% of SB)	5,433 (33% of SB)
# of Oct crossings	0	11,028 (15% of SB)	5,433 (33% of SB)
# of Nov crossings	0	3,676 (5% of SB)	0
# of Dec crossings	0	2,206 (3% of SB)	0

Table 13 Notes:

Piping Plover

1. Population data are from 2021 (USFWS 2024) and exclude an unknown (but likely small) number of nonbreeding birds.
2. The Southern recovery unit population south of Maryland is excluded.
3. Numbers are based on birds Virginia northward, including Atlantic Canada. The southbound (SB) total includes young of the year (YOY), calculated as the unweighted mean 20-year productivity rates (2002 - 2021) times the 2021 breeding pair estimate for each state within the Eastern Canada, New England, and NY-NJ recovery units as well as Delaware and Maryland.
4. The eastern edge of the migration corridor runs southwest parallel to the general orientation of the coast to account for major migration staging areas in North Carolina (Weithman et al. 2018). The eastern edge of the corridor south of Cape Hatteras, North Carolina is also constrained westward to account for much larger numbers of piping plovers wintering in the western Bahamas (however, this has no effect on the width of the corridor at the latitude of the Maryland Offshore Wind Lease Area). Future tagging may reveal some migration pathways to the east of the corridor and/or concentrations within this corridor. The corridor delineated here is based on the limited available data.

Rufa Red Knot:

See Appendix C of the Opinion for details on rufa red knot population data inputs for Band (2012).

Roseate Tern:

1. Migration numbers were generated based on 2021 breeding population numbers and productivity rates from the US and Canada.
2. Spring migration totals were calculated as the number of breeding pairs in each region multiplied by 2 adults per breeding pair.
3. Fall migration totals included all adults from spring migration plus the approximate number of YOY.
4. YOY totals were calculated by multiplying the number of breeding pairs in the US and Canada by the average productivity of these pairs (approximately 1 YOY per pair).
5. Migration months were determined based on peak migration during the spring and fall migration seasons, as reported by Gochfeld and Burger (2020).
6. Number of spring and fall migrants were then assumed to be divided evenly across migration months.

Important Considerations in Estimating Numbers of Collision

Input data

Species-specific input data are critical to obtaining realistic and confident estimates of collision events (Masden and Cook 2016, Kleyheeg-Hartman et al. 2018). Both the Band and SCRAM models require inputs or make assumptions for bird flight height, speed, and populations anticipated to occur within the WTG portion of the action area. Uncertainty and assumptions associated with the species-specific data for these parameters is described in Adams et al. (2022).

SCRAM uses a mean avoidance rate of 0.9295 with a standard deviation of 0.0047 (rounded to 93 percent for the remainder of the Opinion) for all three listed birds (Cook 2021, Adams et al. 2022). Collision risk models are sensitive to the selection of avoidance rates (Chamberlain et al. 2006, Robinson-Willmott et al. 2013, Gordon and Nations 2016, Masden and Cook 2016, Kleyheeg-Hartman et al. 2018). We are not aware of any empirical, species-specific avoidance rates available for the three listed bird species addressed in this Opinion. The selection of a 93 percent avoidance rate for use with piping plover, rufa red knot and roseate tern in SCRAM was based on approximations from data collected on gulls and terns in Europe (Cook 2021). Cook (2021) presents avoidance rates for three tern species for use in the extended Band (2012) model, ranging from 85 to 99 percent; the average of 93 percent is consistent with the avoidance rate used in the SCRAM model. Therefore, we primarily consider the 93 percent avoidance rate in our analysis.

In addition to the lack of species-specific empirical data, we note that blanket application of any avoidance rate does not account for differences among individual birds; acclimation to the wind farm; flocking behavior; flight height or type (e.g., foraging, migratory, regional transit); weather conditions or visibility; time of day; and any behavioral influence of the wind farm on the bird (e.g., displacement, attraction) (May 2015, Gordon and Nations 2016, Masden and Cook 2016, Marques et al. 2021).

Attraction to Wind Turbines

In a literature review of studies examining avian displacement from and attraction to onshore and offshore wind farms, where attraction was defined as an increase in bird density around a wind farm, 15 percent of the studies that were focused on offshore wind farms detected attraction (Marques 2021). Attraction effects were observed in Charadriiformes in 11.6 percent of the studies (Marques 2021). Increased foraging and perching opportunities as well as marine navigation lighting from the wind farm may contribute to species attraction to the wind farms. The collision estimates presented in Tables 14-17 below do not account for any attraction of listed birds to the action area due to the presence of the WTGs.

Foraging and Perching

Offshore WTG foundations may create artificial reef effects that concentrate fish and provide roosting sites (Marques et al. 2021). Roseate terns may be attracted to the action area due to increased prey concentrations. Perching and foraging behavior around offshore WTGs has been associated with increased collision risk (Marques et al. 2021).

Lighting

Studying passerines migrating over the German Wadden Sea, Rebke et al. (2019) found that nocturnally migrating birds at sea were generally attracted by a single light source, and that even relatively weak sources of light (compared to others in the distant surroundings) attract nocturnal migrants flying over the sea. Based on the range of the microphones used to record bird calls in this study, the authors concluded that attracted birds pass close to the light sources.

The results of this study are consistent with the body of literature showing generally stronger avian attraction to artificial light during nights with cloud cover. In this study, no light variant (e.g., color) was constantly avoided by nocturnally migrating passerines crossing the sea. While intensity did not influence the number attracted, birds were drawn towards continuous light more than towards blinking illumination, when stars were not visible. Under cloudy skies, constant red light attracted significantly fewer birds than other hues (i.e., green, blue, and white) (Rebke et al. 2019). The applicability of this study to shorebirds and terns is not yet clear.

Uncertainty

The collision risk estimates are associated with very high uncertainty. We consider these model outputs as one factor relevant to projecting the number of collisions (if any) of each listed bird species that is reasonably certain to occur over the life of the Project. However, we do not restrict our analysis to these numerical outputs due to the model limitations, discussed above. Instead, we consider the model outputs in the context of other relevant quantitative and qualitative information. This approach is consistent with guidance from Band (2012), who concluded, "…given the uncertainties and variability in source data, and the limited firm information on bird avoidance behavior, it seems likely that for many aspects the range of uncertainty may have to be the product of expert judgement, rather than derived from statistical analysis." This approach is also consistent with ESA policy (80 FR 26837), which states, "While relying on the best available scientific and commercial data, the Services will necessarily apply their professional judgment in reaching these determinations and resolving uncertainties or information gaps. Application of the Services' judgment in this manner is consistent with the 'reasonable certainty' standard."

Analysis of Model Outputs and Projected Numbers of Collisions

Table 14. Estimated numbers of collisions over 35 Years of Maryland Offshore Wind WTG operation as projected by Band (2012) and SCRAM models with a 93 percent avoidance rate.

	Piping Plover	**Rufa Red Knot**	**Roseate Tern**
SCRAM v2.0.3[1]			
118-foot (36 m) air gap	**1.01** (0.34 –1.82)	**62.76** (32.10-105.35)	**0** (0 - 0)
Band (2012)			
118-foot (36 m) air gap	**16.26 (13.36 – 21.48)**	**42.18 (36.58 – 48.27)**	**0 (0 – 0)**

[3]The SCRAM results (Appendix D) show the estimate and 95 percent prediction interval.

Complete Band (2012) and SCRAM v2.0.3 (Gilbert et al. 2022) results for the project are located in Appendix D.

Piping Plover

We conclude that piping plovers are reasonably certain to collide with the Maryland Offshore Wind WTGs. Collision will result in injury or death. Piping plover collision estimates over the life of the Maryland Offshore Wind project range from 1.01 to 16.26 (Table 14). Due to the absence of additional information to estimate species-specific avoidance rates, and given other data limitations described above, we considered the full range of collision estimates presented in Table 14. We believe that the best estimate is likely somewhere between the two models' outputs. Therefore, an average of the SCRAM and the Band (2012) estimates is reasonable.

Accordingly, we anticipate that an average of 0.25 piping plovers annually[16], or 8.64 piping plover over the life of the project, would collide with the Maryland Offshore Wind WTGs (Table 15). We note that this estimate is associated with high uncertainty, and we expect that it will be refined over time.

Table 15. Total collision mortality of piping plovers anticipated from Maryland Offshore Wind project.

SCRAM[1]	**Band (2012)**[2]	**Project Life Estimate (Average of SCRAM and Band)**	**Average Annual Estimate**
1.01 plovers	**16.26** plovers	**8.64** plovers	**0.25** plovers/year

[1]All SCRAM outputs should be interpreted in the context of months evaluated. For piping plover, the timeframe includes mid-incubation period through fall migratory departure from tagging sites.
[2]Band outputs apply to spring and fall migration. Band does not use tracking data as inputs.

Rufa Red Knot

We conclude that rufa red knots are reasonably certain to collide with the Maryland Offshore Wind WTGs. Collision will result in injury or death. Rufa red knot collision estimates over the life of the Maryland Offshore Wind project range from 42.18 to 62.76 (Table 14). Due to the absence of additional information to estimate species-specific avoidance rates, and given other data limitations described above, we considered the full range of collision estimates presented in Table 14 and Appendix D. We believe that the best estimate is likely somewhere between the two models' outputs. Therefore, an average of the SCRAM and the Band (2012) estimates is reasonable.

Accordingly, we anticipate that an average of 1.50 red knots annually[17], or 52.47 over the life of the Project, would collide with the Maryland Offshore Wind WTGs (Table 16). We note that this estimate is associated with high uncertainty, and we expect that it will be refined over time. Uncertainty is underscored by the relatively low levels of collisions projected by both models, contrasted with the relatively high number of geolocator tracks crossing the lease. Geolocator tracks are not used in the mechanics of either model and are associated with low spatial

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[16]This annual average estimate based on the modeling suggests that there would be roughly 0.25 piping plover fatality for every year of project operation. Take for the Incidental Take Statement will be measured in whole birds and cumulative take of piping plovers will be tracked over the life of the project.
[17]This annual average estimate based on the modeling suggests that there would be roughly 1.50 rufa red knot fatalities for every year of project operation. Take for the Incidental Take Statement will be measured in whole birds and cumulative take of rufa red knots will be tracked over the life of the project.

precision. But this contrast does speak to the high uncertainty, which will be reduced with accumulation of more and better tracking data over time.

Table 16. Total collision mortality of rufa red knots anticipated from Maryland Offshore Wind project.

SCRAM[1]	**Band (2012)[2]**	**Project Life Estimate (Average of SCRAM and Band)**	**Average Annual Estimate**
62.76 red knots	**42.18** red knots	**52.47** red knots	**1.50** red knots/year

[1]All SCRAM outputs should be interpreted in the context of months evaluated. For rufa red knot, the timeframe includes fall migratory departure from tagging sites.
[2]Band outputs apply to spring and fall migration. Band does not use tracking data as inputs.

Roseate Tern

Both collision risk model outputs presented in Table 14 project 0 roseate tern collisions over the life of the Maryland Offshore Wind project. However, for reasons discussed above, we do not limit our analysis to these outputs for roseate terns. Due to the limited tracking data in SCRAM, and limited flight height data in SCRAM and Band (2012) for roseate terns, we consider these outputs in the context of all best available information, and in the context of Service regulation and policy.

The definition of "effects of the action" includes only those consequences of the proposed action that are "reasonably certain to occur" (50 CFR §402.02). Application of the "reasonable certainty" standard is done in the following sequential manner, in light of the best available scientific and commercial data, to determine if incidental take (would occur due to a collision of a roseate tern with a WTG) is anticipated:

1. a determination is made regarding whether a listed species is present within the action area;
2. if so, then a determination is made regarding whether the listed species would be exposed to stressors caused by the proposed action (e.g., noise, light, ground disturbance); and
3. if so, a determination is made regarding whether the listed species' biological response to that exposure corresponds to the statutory and regulatory definitions of take (i.e., kill, wound, capture, harm, etc.) (80 FR 26832).

Applied in this way, the "reasonable certainty" standard does not require a guarantee that take will result, rather, only that the Service establish a rational basis for a finding of take. While relying on the best available scientific and commercial data, the Service will necessarily apply their professional judgment in reaching these determinations and resolving uncertainties or information gaps. Application of the Service's judgment in this manner is consistent with the "reasonable certainty" standard. The standard is not a high bar and may be readily satisfied (80 FR 26837). Below we consider best available information relevant to each of the sequential steps listed above.

(1) A determination is made regarding whether a listed species is present within the action area;

We conclude that roseate terns at least occasionally occur in the Maryland Offshore Wind project's Lease Area OCS-A 0490 based on the following.

- The project wind farm area is located near or within known migratory routes (Nisbet and Mostello 2015, Loring et al 2019 Appendix J: Common Tern Satellite Telemetry Pilot Study[18]).
- Roseate terns have been documented off the coast of Maryland at a distance greater than to the western boundary of the project's Lease Area (Mid-Atlantic Baseline Study, Northwest Atlantic Seabird Catalog; O'Connell 2009).

(2) If so, then a determination is made regarding whether the listed species would be exposed to stressors caused by the proposed action (e.g., noise, light, ground disturbance); and

When present in the Maryland Offshore Wind Wind Farm Area, we conclude that roseate terns will be at least occasionally exposed to the RSZ and susceptible to collision, based on the following.

- The estimate of 0 collisions output by the Band (2012) model is based on the same flight height distribution that is used in SCRAM, as collected by Loring et al. (2019). However, the flight altitude data collected during this study are limited to flights by breeding and post-breeding dispersal period (i.e., pre-migratory staging) birds (Loring et al. 2019), and thus may not be representative of altitudes for migration flights (I. Nisbet, email, Service, July 12, 2019). In addition, roseate terns were documented in a study to rest on the surface of the ocean during migration transits (Oswald et al. 2023), which could increase exposure to WTG as birds descend and ascend between the ocean surface and flight altitudes.

- Several factors may attract roseate terns to the action area, encourage them to spend more time there, and/or engage in more distracted behaviors while there.
    - Terns are known to perch on oil rigs offshore Brazil (Loring et al. 2023). The addition of new structures, up to 114 WTGs and 4 OSSs, to the action area may result in perching by roseate terns. Birds known to perch or roost around WTGs show increased collision risk (Marques et al. 2021).
    - The new structures may attract terns by concentrating forage fish (Mavraki et al. 2021, Degraer et al. 2020) or increasing water turbulence (Lieber et al. 2021). Birds engaged in foraging or other distracted behavior show increased collision risk (Marques et al. 2021).
    - As discussed above, this species is known to occur offshore at night (I. Nisbet, email, Service, July 12, 2019; Oswald et al. 2023; Gochfeld and Burger 2020), and many bird species are attracted by lighting (Rebke et al. 2019). The extent of effects of marine navigation lighting on roseate terns in unknown.

[18] Due to a lack of satellite data available for roseate terns, the Service considers the migration routes of common terns, a species that shares similar life history characteristics, into its analysis of roseate tern migration.

(3) If so, a determination is made regarding whether the listed species' biological response to that exposure corresponds to the statutory and regulatory definitions of take (i.e., kill, wound, capture, harm, etc.).

Considering all of the above information, we conclude that roseate terns are reasonably certain to collide with the Maryland Offshore Wind WTGs and collision would result in take in the form of wounding or killing. However, we have little information on which to base an estimated level of take (i.e., based on the limitations of available roseate tern data for the collision risk models, discussed above, we have little basis for projecting the number of collisions). Absent more robust information, we compare roseate tern with piping plover to provide a reference point.

Based on absolute numbers, we surmise that roseate terns have more exposure to offshore wind relative to piping plovers. Compared to Atlantic Coast piping plovers, the northeastern roseate tern population size is nearly twice as large (USFWS 2020c, 2022a), which increases the probability of collision risk. However, research indicates that roseate terns utilize migration pathways well east of the Maryland Offshore Wind action area (Gochfeld and Burger 2020, Mostello et al. 2014, Loring et al. 2019). In addition, this species does not breed south of New York. Both of these factors considerably lower collision risk for roseate tern relative to the piping plover. Thus, we conclude that the likely number of roseate tern collisions is lower than for piping plover, based on comparison of the geographic distribution of these two species and our best understanding of how they use the airspace of the OCS, but greater than zero for the reasons discussed above.

Therefore, we project that 1 roseate tern would collide with the WTGs over the life of the project (Table 17). We note that this estimated level of take is associated with high uncertainty, and we expect that it will be refined over time.

Table 17. Total collision mortality of roseate terns anticipated from Maryland Offshore Wind project.

Project Life Estimate (Average of SCRAM and Band)	**Average Annual Estimate**	**Adjusted Project Life Estimate**[1]
0 roseate terns	**0.03** roseate terns/year	**1** roseate tern

[1] The project life estimate has been adjusted to 1 based upon best professional judgment, as described above.

CUMULATIVE EFECTS

Cumulative effects are those "effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area" of the Federal action(s) considered in this Opinion (50 CFR §402.02).

The Service is not aware of any future state, tribal, local, or private actions that are reasonably certain to occur within the onshore or offshore portions of the action area at this time. We do not expect any change in the types or levels of non-project-related vessel traffic in the offshore portion of the action area that would have any appreciable effect on listed birds. For the onshore portion, we expect direct mortality of listed birds from various sources (off-road vehicles, pedestrians) to remain low and continue exerting negligible effects on birds in the action area. It is reasonably certain that human caused climate change will continue into the foreseeable future, although there is large uncertainty around the rate and magnitude of climate change (mostly related to the uncertain trajectory of mitigation actions) (USFWS 2020b). There is also high uncertainty around how climate change may affect usage of the action area by listed birds. Therefore, no cumulative effects are anticipated.

JEOPARDY ANALYSIS

In this section, the Service adds "the effects of the action and cumulative effects to the environmental baseline and in light of the status of the species and critical habitat, formulate[s] the [Service's] opinion as to whether the action is likely to jeopardize the continued existence of listed species" (50 CFR §402.14(g)(4)). "Jeopardize the continued existence of means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR §402.02).

Per the Service's consultation handbook (USFWS and NMFS 1998), survival is defined as "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter."

Per 50 CFR §402.02 and the Service's consultation handbook (USFWS and NMFS 1998), recovery is defined as "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the ESA." The "criteria set out in Section 4(a)(1)" means determining when a species no longer meets the definition of an "endangered species" or a "threatened species" because of any of the following factors:

(A) present or threatened destruction, modification, or curtailment of habitat or range;
(B) overutilization for commercial, recreational, scientific, or educational purposes;
(C) disease or predation;
(D) inadequate existing regulatory mechanisms; or
(E) other natural or manmade factors affecting the species continued existence.

(16 USC §1533(a)(1)).

An endangered species is "in danger of extinction throughout all or a significant portion of its range" (16 USC §1532(6)). A threatened species is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (16 USC §1532(20)).

To analyze whether the Federal action addressed in this Opinion will jeopardize the continued existence of piping plovers, rufa red knots, and roseate terns, we assess project impacts at the individual, population, and species levels.

Individuals
First, we determine how individuals are likely to respond upon exposure to the stressors and/or beneficial actions associated with the proposed action. The response of an individual can be measured by impacts to its breeding, feeding, and/or sheltering. This assessment of effects to individuals provides the basis for the subsequent two steps, in which we determine whether any appreciable reduction of reproduction, numbers, or distribution (RND) is expected at the population or species level.

Impacts to Populations
Because many species are composed of multiple populations and there may be meaningful differences in those populations (e.g., genetics, morphology, size) related to the overall species survival and recovery, it is a logical intermediate step to evaluate the effects of impacts to individuals on the population(s) to which they belong. Specifically, we analyze how the change in breeding, feeding, and/or sheltering at the individual level affects the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. If our analyses indicate that reductions in the condition of the population(s) are not likely to occur, then there can be no appreciable reductions in the RND at a species level and we conclude that the federal action agency has ensured that its action is not likely to jeopardize the continued existence of the species (i.e., not likely to affect the overall species survival and recovery rangewide).

Impacts to Species
If there are reductions in the condition of the impacted population(s), we assess impacts to the species by determining whether the anticipated impacts on the population(s) are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide. To complete this analysis, we evaluate the relative importance of the impacted population(s) within rangewide status of the species (provided in the Status of the Species section) and evaluate the impacts to those populations (positive and negative) from the proposed action.

Piping Plover

Impacts to Individuals
As discussed in the Effects of the Action, individual piping plovers may experience impacts if present within the action area during northward and southward migration. We estimate that an average of 0.25 piping plovers annually and up to 8.64 piping plovers over 35 years, would collide with WTGs in the Maryland Offshore Wind action area. We expect all of these collisions would result in death or, possibly, injury.

Impacts to Populations

Based on current demographic data, we conclude that loss of 0.25 piping plover per year from the Maryland Offshore Wind project – considered in context of take from previously authorized offshore wind projects and considering lost lifetime reproduction of these birds, and also considering the status of piping plover generally – will have no significant effects on survival rates or population sizes of any of the four recovery units.

Current demographic data do not yet reflect projected mortality from offshore wind projects that are the subject of other biological opinions. Projected mortality over the operational life of the Maryland Offshore Wind WTGs (8.64 birds) will be additive to mortality from 8 other offshore wind projects that have completed formal Section 7 consultation (83 birds) (see Appendix A), along with all other threats to piping plovers. The Maryland Offshore Wind project included compensatory mitigation (Conservation Measure 7) which may offset the effects of incidental take of 9 piping plovers. Additionally, the effects of incidental take of 41 piping plovers from at least five of those other offshore wind projects may be offset via compensatory mitigation. However, the Service cannot presently reach any conclusions, with reasonable certainty, regarding the effectiveness of the compensatory mitigation. Therefore, compensatory mitigation to offset take from OSW projects was not considered in our jeopardy analysis.

As aggregate collision mortality continues to increase with each successive offshore wind project, the likelihood of population-level effects increases. This especially pertains to piping plovers breeding in the Eastern Canada recovery unit because of their potential exposure to collision risk from every U.S. Atlantic Coast offshore wind project, as well as that recovery unit's low resilience (which impairs its contributions to the species' redundancy and representation). As described below, the NY-NJ recovery unit is also vulnerable to further impairment of its resiliency. We also note that the survival and productivity rates, carrying capacity of the habitat, and other demographic rates that affect probability of the population's persistence can change over the project life.

Reproduction & Numbers

Reproductive output is expected to decline as a result of direct removal of birds from the population through collision mortality. Thus, our analysis of projected mortality numbers, below, qualitatively considers the loss of any likely offspring that the birds lost to collision would have produced over the balance of their lives. Extinction risk of Atlantic Coast piping plovers is highly sensitive to small changes in adult and/or juvenile survival rates (USFWS 2009). The projected annual mortality from the Maryland Offshore Wind project (0.25 bird per year, on average) represents less than 0.01 percent of the mean population for 2014-2023 of Atlantic Canada, New England, NY-NJ recovery units as well as the Southern recovery unit piping plovers that nest in Delaware and Maryland (3,598 bird; USFWS 2024).

To assess population-level effects of the Maryland Offshore Wind project, we must consider differences across the four recovery units that occur in the action area. To date, tracking data are only available for birds from two nesting areas within the New England recovery unit. Lacking additional data, we must make some assumptions to assess differential effects by recovery unit.

For purposes of this analysis, we assume that the Maryland Offshore Wind collision mortalities will be spread across the four units proportional to the units' population size (Table 18). This assumption does not account for the possibility that exposure to offshore WTGs differs among the four recovery units (i.e., that prevailing migration routes vary by nesting region).

Table 18. Presumed distribution of Maryland Offshore Wind piping plover mortality across recovery units.

Recovery Unit	% of Population Total Across All 4 Units (3,598 birds)[1]	Presumed Collision Maryland Offshore Wind Mortality for 35-Year Lease Term	Presumed Average Collision Frequency
Eastern Canada	10 %	0.86	1 plover per every 40.71 years
New England	59%	5.10	1 plover per every 6.86 years
NY-NJ	29 %	2.47	1 plover per every 14.15 years
Southern[1]	2 %	0.21	1 plover per every 169.48 years
Total	100%	8.64	

[1] The analysis for impacts to populations for the Southern Recovery Unit only includes the mean population 2012-2021 for Delaware and Maryland.

Even if the *level* of collision mortality is confirmed to be proportional to population size in each recovery unit, the *effect* of that mortality on the viability of each unit is disproportional. Loss of birds from the units that are farthest from recovery goals (i.e., that are the least resilient) will cause the largest incremental increase in the vulnerability of that unit and its ability to provide redundancy and representation to the coastwide population.

- We presume that most of the collision losses from Maryland Offshore Wind will be from the New England unit. The large and increasing size of this unit make it the least vulnerable to demographic effects. We conclude that loss of 5.10 birds from the New England unit, spread out over 35 years, is not likely to reduce appreciably survival rates or population size of the New England unit.
- As discussed above, the NY-NJ recovery unit is tenuously stable. Loss of individuals from this unit has the potential to negatively impact its stability. However, we conclude that loss of 2.47 birds from the NY-NJ unit is not likely to reduce appreciably survival rates or population size of the NY-NJ unit. This conclusion is based on the time horizon for the projected take (35 years), and the assumption that most of these birds will be from New York based on its larger population size. From a demographic perspective, the New York population has typically been more robust than the New Jersey population.
- The Eastern Canada recovery unit is the most sensitive to the loss of individuals, with a long-term average of only 179 pairs (358 birds) and a long-term declining population trend. Loss of individuals could exacerbate the decline. However, with projected loss of 0.86 bird over the project lease term, we conclude that the Maryland Offshore Wind project is not likely to reduce appreciably survival rates or population size of the Eastern Canada unit. We note that available information suggests birds from the Eastern Canada unit may have significant exposure to collision risk as these birds traverse all of the projects listed in Appendix A during migration and based on sightings data of marked

birds using migration stopovers along the Atlantic Coast (J. Rock, Environment and Climate Change Canada, email to W. Walsh, FWS, February 1, 2023).

- The Southern recovery unit has experienced low productivity since 2016, the cause of which has not been determined. The abundance of Southern recovery unit breeding pairs declined 40 percent between 2016 and 2023, and preliminary results indicate a further decline of 14 percent between 2021 and 2023 (A. Hecht, email, Service, March 15, 2023; USFWS 2024). Loss of individuals as a result of the proposed project could further exacerbate this decline in breeding abundance and, in turn, lost productivity. However, with projected loss of 0.21 birds spread out over 35 years, we conclude that the Maryland Offshore Wind project is not likely to reduce appreciably survival rates or population size of the Southern recovery unit.

Distribution
The proposed action would not have an appreciable effect on piping plover numbers and would not reduce habitat for feeding, breeding, and sheltering. Therefore, the proposed action would not reduce the distribution of the piping plover.

Impacts to Species
As we have concluded that the Atlantic Coast population (and its Eastern Canada, New England, NY-NJ, and Southern recovery units) of piping plovers is unlikely to experience reductions in breeding, feeding and sheltering, there will be no appreciable reduction in RND on the species as a whole.

Recovery
Because the New England recovery unit has the largest population size, it may experience the highest number of piping plover collision mortalities, 5.10 birds over 35 years, from Maryland Offshore Wind. However, based on its size, the New England recovery unit is the least vulnerable to demographic effects from loss of these birds. The Eastern Canada recovery unit is much more sensitive to loss of individuals, with a long-term average of only 179 pairs (358 individuals). However, the numerical odds suggest few of the projected collisions would come from the unit with the smallest population size and the loss of 0.86 birds over 35 years for the Eastern Canada recovery unit would not reduce appreciably the likelihood of recovery in the Eastern Canada unit. The NY-NJ and Southern recovery units would be intermediate in sensitivity between the Eastern Canada compared to the New England recovery unit, and, therefore, the proposed action would not reduce appreciably the likelihood of recovery in all of these units.

Rufa Red Knot

Impacts to Individuals
As discussed in the Effects of the Action, individual rufa red knots may experience impacts if present within the action area during spring and fall migration or throughout the year for seasonally resident rufa red knots. We estimate that an average of 1.50 rufa red knots annually, and up to 52.47 rufa red knots over 35 years, would collide with WTGs in the Maryland Offshore Wind action area. We expect all of these collisions would result in death or, possibly, injury.

Impacts to Populations

We estimate that 52.47 rufa red knots will be killed by WTG collisions over the 35-year life of the Maryland Offshore Wind project. It is possible that multiple birds will be killed during a single migration event because rufa red knots are known to migrate in flocks. We assume even temporal distribution of about 1.50 birds per year, which does allow for the possibility of multi-bird collision events in any particular year. The best available population size estimate across the SEC, NCSA, and Southern recovery units combined is 61,049 birds (see Table 5). That abundance level, and current demographic trends, do not yet reflect projected mortality from offshore wind projects that are the subject of other biological opinions but not yet built. Projected mortality over the operational life of the Maryland Offshore Wind WTGs (52.47 birds) will be additive to mortality from 8 other offshore wind projects that have completed formal Section 7 consultation (2,100 birds) (see Appendix A), along with all other threats to rufa red knots. The Maryland Offshore Wind project included compensatory mitigation (Conservation Measure 7) which may offset the effects of incidental take of 53 rufa red knots. Additionally, the effects of incidental take of 804 rufa red knots from at least five of those other offshore wind projects may be offset via compensatory mitigation. However, the Service cannot presently reach any conclusions, with reasonable certainty, regarding the effectiveness of the compensatory mitigation. Therefore, compensatory mitigation to offset take from OSW projects was not considered in our jeopardy analysis.

Reproduction and Numbers

We consider the loss of 52.47 individuals and any likely young they would have produced over the balance of their life when evaluating the potential impact to reproduction and numbers. There is very little information on rufa red knot reproductive rate. Pairs are not successful at producing an adult bird every year (A. Smith, pers. comm., 2023). Hypothetically, if half of the individuals taken were female, typically recruiting 0.5 chicks into the adult population each year, total annual loss to reproduction and numbers could be 65.59 birds (26.24 males, 26.24 females, 13.12 young not produced annually). Over an average 6-year reproductive life span (breeding at age 2, 7-year average life), the lost reproductive potential of up to 26.24 females could be around 78.72 young. This is a coarse approximation with many assumptions. Although this is not a trivial reproductive loss, within the context of the current numbers of rufa red knots, and largely stable populations, the expected loss of rufa red knots would not have a substantial impact on reproduction and numbers.

Based on a current population size of 61,049 birds, projected annual mortality from the Maryland Offshore Wind project (1.50 birds per year, on average) represents less than 0.002 percent of total birds. However, to assess population-level effects, we must consider differences across the three recovery units that occur in the action area. With available data, we are unable to quantify the proportion of individuals that are likely to be killed by collision across the three recovery units. Thus, we must make some assumptions to assess differential effects by recovery unit.

For purposes of this analysis, we assume that the Maryland Offshore Wind collision mortalities will be spread across the three units and proportional to the population size of each (Table 19). This assumption does not account for the possibility that exposure to offshore WTGs differs among the three recovery units (i.e., that prevailing migration routes vary by wintering region) because to date most tracking data has not been correlated with the wintering destination due to limits of the tracking technology.

Table 19. Presumed distribution of Maryland Offshore Wind rufa red knot mortality across recovery units.

Recovery Unit	% of Population Total Across All 3 Units (61,049 birds)	Presumed Collision Maryland Offshore Wind Mortality for 35-Year Lease Term	Presumed Average Collision Frequency
SEC	25%	13.32	Every 2.63 years
NCSA	51%	26.70	Every 1.31 years
Southern	24%	12.45	Every 2.81 years
Total	100%	52.47	

Even if the *level* of collision mortality is confirmed to be proportional to population size in each recovery unit, the *effect* of that mortality on the viability of each unit is disproportional. Loss of birds from the units that are farthest from recovery goals will cause the largest incremental increase in the vulnerability of that unit and its ability to provide representation to the rangewide population.

- We presume that most of the collision losses from Maryland Offshore Wind will be from the NCSA unit. The large and stable size of this unit make it the least vulnerable to demographic effects. We conclude that loss of 26.70 birds from the NCSA, spread out over 35 years, is not likely to reduce appreciably overall survival rates or population size.

- The SEC recovery unit is estimated at only about half the size of the NCSA unit but is believed to be stable over recent decades. We conclude that loss of 13.32 birds from the SEC unit is not likely to reduce appreciably survival rates or population size. This conclusion is based on the time horizon for the projected take (35 years), and the apparent resiliency of this unit to date. We note that available information suggests birds from the SEC unit may have significant exposure to collision risk with the Maryland Offshore Wind WTGs (Perkins 2023), which has not yet been assessed and which may supersede the assumption that underpins Table 19 (i.e., that collision levels will be proportional to population size).

- The Southern recovery unit is the most sensitive to the loss of individuals, with the population size hovering around only 25 percent of its historic (1980s) level since 2011. The vulnerability of the Southern unit is based not only on its smaller size, but also the challenges that these birds face on their very long migrations (USFWS 2020b). Loss of individuals could potentially slow recovery of this unit, but available demographic data are not adequate to characterize what level of direct mortality from human causes would be reasonably expected to appreciably affect the population's trajectory. We conclude that collision mortality is not likely to reduce appreciably survival rates or population size, based on collisions of 0.36 birds per year with the Maryland Offshore Wind Project, in the context of total incidental take from offshore wind projects on the Atlantic Coast

OCS, along with all other threats to the Southern recovery unit. This conclusion is based on the assumption that collision mortality is proportional to recovery unit size.

Distribution
The proposed action would have a minor effect on rufa red knot numbers and would not reduce habitat for feeding, breeding, and sheltering. Therefore, the proposed action would not reduce the distribution of the rufa red knot.

Impacts to Species
As we have concluded that NCSA, SEC, and Southern wintering populations of rufa red knot are unlikely to experience reductions in breeding, feeding and sheltering, there will be no appreciable reduction in RND on the species as a whole.

Recovery
The Southern unit would be far more sensitive to loss of individuals (USFWS 2020b) than other recovery units. However, based on its smaller population size, and results from Perkins (2023) that suggest birds from the Southern unit are less likely to be exposed to the Maryland Offshore Wind project than birds from the SEC and NCSA units, we conclude it is likely that few of the projected collisions would come from the Southern unit. The majority of the collisions likely would come from the more populous SEC and NCSA units. Recovery criteria 3 (stability of the SEC and NCSA units) and 10 (juvenile survival and recruitment) are particularly applicable to this analysis and the potential effects of the Project (USFWS 2023b). Based on current demographic data, and potential effects of the Project, we conclude that the anticipated effects of the Project would not reduce appreciably the likelihood of recovery of the rufa red knot.

Roseate Tern

Impacts to Individuals
As discussed in the Effects of the Action, individual roseate terns may experience impacts if present within the action area during spring and fall migration. We estimate that an average of less than one roseate tern annually, and up to one roseate tern over 35 years, would collide with WTGs in the Maryland Offshore Wind action area. We expect these collisions would result in death or, possibly, injury.

Impacts to Populations
Current demographic conditions are such that roseate tern populations are sensitive to changes in adult mortality. The 10-year (2010 to 2019) average population size of northeastern roseate terns was 3,755 pairs, or 7,510 birds (USFWS 2020c). Given this current abundance level and long-term population trajectory, we conclude that loss of 1 bird will have no appreciable effect on survival rates. That abundance level, and current demographic trends, do not yet reflect projected mortality from offshore wind projects that are the subject of other biological opinions. Projected mortality over the operational life of the Maryland Offshore Wind WTGs (1 bird) will be additive to mortality from two other offshore wind projects that have completed formal Section 7 consultation (2 birds; see Appendix A), along with all other threats to roseate terns. The Maryland Offshore Wind project included compensatory mitigation (Conservation Measure 7) which may offset the effects of incidental take of 1 roseate tern. Additionally, the effects of

incidental take of 1 roseate tern from at least one of those other offshore wind projects may be offset via compensatory mitigation. However, the Service cannot presently reach any conclusions, with reasonable certainty, regarding the effectiveness of the compensatory mitigation. Therefore, compensatory mitigation to offset take from OSW projects was not considered in our jeopardy analysis.

Reproduction and Numbers
The expected loss of roseate terns likely would be indistinguishable from normal population variation and would not have an appreciable effect on roseate tern numbers and reproduction.

Distribution
The proposed action would not have an appreciable effect on roseate tern numbers and would not reduce habitat for feeding, breeding, and sheltering. Therefore, the proposed action would not reduce the distribution of the roseate tern.

<u>Impacts to Species</u>
As we have concluded that the northeastern population of roseate terns is unlikely to experience reductions in breeding, feeding and sheltering, there will be no reduction in RND on the species as a whole.

<u>Recovery</u>
The cold water subregion group is the most sensitive to loss of an individual, with a long-term average of only 54 pairs (108 birds). However, we conclude it is unlikely that the 1 projected collision would come from the cold water subregion group, simply based on the much larger size (68 times larger) of the warm water unit. Based on current demographic data, we conclude that loss of 1 northeastern roseate tern over 35 years will have no appreciable effects on roseate tern populations. This conclusion assumes that the affected bird is from the warm water unit, as that is the impact that is likely to occur. Demographic rates are associated with uncertainty and can change over the 35-year project life. Based on current demographic data, and potential effects of the Project, we conclude that the anticipated effects of the Project would not reduce appreciably the likelihood of recovery of the roseate tern.

Conclusion

We considered the current overall rangewide status of the piping plover, rufa red knot, and roseate tern and the status of the species in the action area. We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. We do not anticipate appreciable reduction in the reproduction, numbers, or distribution of these species as a result of the proposed action. The Service's Opinion is that construction, operation, and decommissioning of the Maryland Offshore Wind project, as proposed, is not likely to jeopardize the continued existence of the piping plover, rufa red knot, or roseate tern.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened wildlife species, respectively, without a special exemption.

Take is defined in Section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Incidental take is defined as "takings that result from but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant." (50 CFR §402.02.) Under the terms of Section 7(b)(4) and Section 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement (ITS).

Amount or Extent of Take Anticipated

The Service expects the operation of the Maryland Offshore Wind project would cause take of piping plovers, rufa red knots, and roseate terns by wounding and killing (Table 20). This take would result from birds colliding with WTGs in the Maryland Offshore Wind Lease Area OCS-A 0490 over the 35-year life of the Project.

Table 20. Anticipated incidental take summary for Maryland Offshore Wind project.

Species	Exempted Take	Life Stage When Take is Anticipated	Type of Take	Effects of Action Anticipated to Cause Take
Piping plover	9	Adults, juveniles	Wound, Kill	Collision with WTGs
Rufa red knot	53	Adults, juveniles	Wound, Kill	Collision with WTGs
Roseate tern	1	Adults, juveniles	Wound, Kill	Collision with WTGs

Reasonable and Prudent Measures

The measures described below are nondiscretionary and must be undertaken by BOEM so that they become binding conditions of any grant or permit issued to Lessee, as appropriate, for the exemption in Section 7(o)(2) to apply. BOEM, or another Federal agency (e.g., BSEE) under a transition of oversight responsibility, has a continuing duty to regulate the activity covered by this ITS. If BOEM: (1) fails to assume and implement the terms and conditions or (2) fails to require Lessee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of Section 7(o)(2) may lapse.

As discussed under Effects of the Action, above, the physical and operational parameters of WTGs are known to influence the risk of wildlife collision. At this time, the Service is not aware of any specific physical or operational WTG adjustments that would be reasonably likely to appreciably reduce collisions of listed birds in the offshore environment. However, technology and research in this area are advancing rapidly, and new methods for reducing collisions may become available over the long operational life of the Maryland Offshore Wind project. Therefore, the Service believes the following reasonable and prudent measure (RPM) is necessary and appropriate to minimize take of piping plovers, rufa red knots, and roseate terns.

1. Periodically review current technologies and methods for minimizing collision risk of migratory birds with WTGs, including but not limited to: WTG coloration/marking, lighting, avian deterrents, remote sensing such as radar and thermal cameras, and limited WTG operational changes[19].

The Service also believes the following RPM is necessary and appropriate to minimize take of piping plovers, rufa red knots and roseate terns.

2. Ensure that all individuals performing work offshore (i.e., Maryland Offshore Wind staff, concessioners, contractors) are familiar with the piping plover, rufa red knot, and roseate tern and their respective habitats and are aware of all protection measures required as part of the proposed action and in this ITS.

Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, BOEM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. ***Periodically review current technologies and methods for minimizing collision risk of listed birds.***

a) BOEM must periodically review current technologies and methods for minimizing collision risk of migratory birds with WTGs, including but not limited to: WTG coloration/marking, lighting, avian deterrents, remote sensing such as radar and thermal cameras, and limited WTG operational changes.

b) Prior to the start of WTG operations at Maryland Offshore Wind, BOEM must extract from existing project documentation (e.g., the BA, other consultation documents, the final Environmental Impact Statement, the COP) a stand-alone summary of technologies and methods that were evaluated by BOEM to reduce or minimize bird collisions at the Maryland Offshore Wind WTGs.

c) Within 5 years of the start of WTG operation, and then every 5 years for the life of the project, BOEM must prepare a Collision Minimization Report, reviewing best available scientific and commercial data on technologies and methods that have been implemented, or are being studied, to reduce or minimize bird collisions at WTGs. The review must be global in scope and include both offshore and onshore WTGs.

d) BOEM must distribute a draft Collision Minimization Report to the Service, BSEE, Lessee, appropriate state agencies for a 60-day review period. BOEM must address all comments received during the review period and issue the final report within 60 days of the close of the review period.

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[19] Operational changes may include, but are not limited to, feathering, which involves adjusting the angle of the blades to slow or stop them from turning under certain conditions.

e) Following issuance of the final Collision Minimization Report, the Service may request a meeting. Within 60 days of receiving the request, BOEM must convene a meeting with the Service, BSEE, and Lessee to discuss the Collision Minimization Report and seek consensus on whether implementation of any technologies/methods is warranted.

2. Ensure that all individuals performing work offshore are familiar with piping plover, rufa red knot and roseate tern.

a) BOEM must provide annual training to all individuals directly or indirectly responsible for implementing and/or overseeing actions described in the BA. The training will review the protection measures outlined in the BA and Conservation Measures outlined in the Opinion and may be modified as agreed upon by BOEM and the Service.

Monitoring and Reporting Requirements

To monitor the impact of incidental take, BOEM must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(4)].

1. Notification of injured or dead listed species will be made by Lessee to Service Law Enforcement and Chesapeake Bay Field Office. Additionally, reporting of injured or dead listed species will be recorded in the Injury & Mortality Reporting (IMR) system[20]. Exercise care in handling any specimens to preserve biological material in the best possible state. In conjunction with the preservation of any specimens, Lessee responsible for ensuring that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. Finding dead or non-viable specimens does not imply enforcement proceedings pursuant to the ESA. Reporting dead specimens is required for the Service to determine if take occurred, whether the take limit is reached or exceeded, and to ensure that the terms and conditions are appropriate and effective.

   Upon locating a dead piping plover, rufa red knot, roseate tern, or other listed species, initial notification must be made to the following Service offices or to alternate Service contacts provided by Service in the future:

   Eric W. Marek
   Assistant Special Agent in Charge
   United States Fish and Wildlife Service
   Office of Law Enforcement
   300 WESTGATE CENTER DRIVE
   HADLEY, MA 01035
   Eric_marek@fws.gov
   (413) 253-8274

[20] https://ecos.fws.gov/imr/welcome

and

U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, Maryland 21401
cbfoprojectreview@fws.gov

Per the Conservation Measure 6, Lessee will report any occurrence of a dead piping plover, rufa red knot, roseate tern, or other ESA-listed species to BOEM and the Service as soon as practicable (taking into account crew and vessel safety), ideally within 24 hours and no more than two business days after the sighting. If practicable, Lessee will carefully collect the dead specimen and preserve in the best possible state, contingent on the acquisition of the any necessary wildlife permits and compliance with Maryland Offshore Wind health and safety standards. Data to be recorded include the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information.

2. BOEM must provide updated model runs, associated input data, and output reports (per Conservation Measure 4 guidelines) from both SCRAM and Band (2012) for piping plover, rufa red knot, and roseate tern using the best available information on each species. BOEM must submit a report containing this information by December 31 of the years specified in Conservation Measure 4.

Coordination of Incidental Take Statement with other Laws, Regulations and Policies

The Service will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 USC §703-712), if such take is in compliance with the Terms and Conditions specified herein. Take resulting from activities that are not in conformance with this Opinion (e.g., deliberate harassment of wildlife) are not considered part of the proposed action and are not covered by this Incidental Take Statement and may be subject to enforcement action against the individual responsible for the act.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Recommendation 1: Establish an Offshore Wind Adaptive Monitoring and Impact Minimization Framework to guide and coordinate monitoring, research, and avian impacts coastwide.

To address Service concerns related to potential effects of WTG operation on listed species and other species of concern, at both the project and coastwide scales, we recommend that BOEM develop and adopt an Offshore Wind Adaptive Monitoring and Impact Minimization Framework

(Framework) for flying wildlife. Here we provide some basic principles for establishment, adoption, and operation of the Framework.

1. Establish a Framework Principals Group to consist of representatives from BOEM, BSEE, the Service, state natural resource agencies responsible for flying wildlife, and offshore wind energy developers/operators.
2. Develop and adopt a written Framework foundational document specifying:
    a. the governance structure of the Principals Group;
    b. the geographic coverage of the Framework (at a minimum, Federal waters from Maine to Florida—optionally also state waters);
    c. the species covered by the Framework (at a minimum, federally listed, proposed, and candidate bird and bat species likely to occur in the offshore environment—optionally also other flying species of concern in the offshore environment such as certain Bird Species of Conservation Concern, At-Risk species, State-listed species, and Species of Greatest Conservation Need as identified in State Wildlife Action Plans); and
    d. the duration of the Framework (at a minimum, the entire length of time that any offshore wind energy generation is operational or until all members of the Principals Group are in agreement that a robust weight of scientific evidence indicates that flying wildlife are not impacted by offshore WTG operation).
3. Establish an annual operating budget for the Framework to be funded by offshore wind energy developers/operators.
4. Arrange for the Principals Group to meet at least annually, and for the Framework foundational document to be updated at least every 5 years.
5. Provide for experts (both internal and external to the Principals Group) to regularly assess new and improved technologies and methods for estimating collision risk of covered species and measuring or detecting collisions. Adopt and deploy such methods deemed most promising by the Principals Group.
6. Coordinate monitoring and research across wind energy projects. Share and pool data and research results coastwide.
7. Provide for experts (both internal and external to the Principals Group) to regularly assess new and improved technologies and methods for minimizing collision risk of covered species, including but not limited to WTG coloration/marking, lighting, avian/bat deterrents, and limited WTG operational changes that would not unduly impact energy production. At local, regional, and coastwide scales, adopt and deploy such technologies/methods deemed most promising by the Principals Group.
8. Provide for experts (both internal and external to the Principals Group) to periodically assess new and improved technologies and methods for evaluating indirect effects to covered species from WTG avoidance behaviors (e.g., impacts to time and energy budgets).
9. Periodically assess the level and type of compensatory mitigation necessary to offset any unavoidable direct and indirect effects of WTG operation on covered species. Adopt and deploy such levels and types of mitigation deemed appropriate by the Principals Group.
10. Consider partnering with other stakeholders or cross-sector organizations, such as the

Regional Wildlife Science Collaborative for Offshore Wind[21], to provide administrative, institutional, and technical support to the Principals Group.

Recommendation 2: Conduct a coastwide buildout analysis that considers all existing, proposed, and future offshore wind energy development on the Atlantic OCS.

The definition of "cumulative effects" at 50 CFR §402.02 excludes future Federal actions because such actions will be subject to their own consultations under Section 7 of the ESA. Further, the analysis of environmental baseline conditions for each subsequent consultation would be limited to the action area of that particular project. This creates a situation where the effects analysis for each individual offshore wind energy project cannot fully take into account the possible additive and/or synergistic effects that may occur at full build-out of offshore wind infrastructure along the U.S. Atlantic Coast. Besides the 4 existing offshore wind energy facilities, the Service understands there are approximately 25 additional projects in various stages of development offshore the U.S. Atlantic Coast. There are approximately 28 projects offshore from Maine to South Carolina. As the Department of Interior continues moving toward the national goal of deploying 30 gigawatts of offshore wind by 2030, we anticipate more projects beyond those already in development (e.g., within the New York Bight, Central Atlantic, and Gulf of Maine).

While a thorough and robust assessment of potential direct effects (collision) and indirect effects (behavioral change) will be completed for each individual offshore wind project, coastwide analysis may indicate or suggest additive and/or synergistic effects among projects. Therefore, the Service recommends that BOEM analyze potential aggregate effects from WTG operation at a coastwide scale. A coastwide analysis will work in concert with the Offshore Wind Adaptive Monitoring and Impact Minimization Framework to comprehensively assess, monitor, and manage avian impacts from wind energy development along the U.S. Atlantic Coast. (Programmatic consultation for wind energy development in the New York Bight is already underway and could set the stage for a full coastwide analysis.) Ultimately, a coastwide programmatic Opinion may emerge as the most effective and efficient mechanism for assessing, monitoring, minimizing, and offsetting effects to listed birds from WTG operation on the OCS.

Recommendation 3: Future Studies

Roseate Tern Migratory Flight Heights
To better understand collision risk for migration flights through offshore wind projects, the Service recommends that BOEM work with the Service to implement and carry out studies on migratory flight heights for roseate terns. Research has been conducted on primarily staging flight heights, but the SCRAM and Band models require migratory flight heights to more accurately estimate collision risk.

Cryptic Mortality
Finding a piping plover, rufa red knot, roseate tern, or other listed species killed or injured by collision with a WTG, is highly unlikely given factors that may impede discovery such as drift

[21] https://rwsc.org/

rate from wind displacement (Bibby 1981), carcass persistence rate (Ford et al 1996, Barrientos et al 2018) and searcher efficiency (Barrientos et al. 2018). Due to a lack of research on bird carcass recovery in an open ocean environment, the Service recommends that BOEM work with the Service to implement and carry out studies on cryptic mortality[22].

Curtailment in the Offshore Environment
To better understand avian collision risk and potential mitigation strategies, the Service recommends that BOEM work with the Service to implement and carry out studies on curtailment in the offshore environment.

Behavioral Effects
To better understand behavioral effects to listed avian species from offshore wind farms, the FWS recommends that BOEM work with the Service to implement and carry out studies on attraction, avoidance and displacement in the offshore environment

We request BOEM notify the Service of the implementation of any of these conservation recommendations to keep the Service informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in BOEM's request for consultation on the Maryland Offshore Wind Project. As provided in 50 CFR §402.16, reinitiation of consultation is required and shall be requested by the Federal action agency where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) the amount or extent of incidental take specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

In instances where the amount or extent of incidental take is exceeded, the exemption issued pursuant to Section 7(o)(2) may have lapsed and any further take could be a violation of Section 4(d) or 9. Consequently, we recommend that any activity causing such take cease pending reinitiation. For example, the discovery of 1 dead piping plover, rufa red knot, or roseate tern in the Maryland Offshore Wind action area or an increase in the Band or SCRAM collision risk model outputs (including updated versions), could indicate that our anticipated amount of take was reached for the respective species, and BOEM must contact the Chesapeake Bay Field Office immediately to determine if reinitiation of formal consultation is necessary.

Thank you for consulting with the Service on this project. If you have any questions regarding

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[22] Cryptic mortality was first defined in the context of fisheries management as post-release mortality of fish (Coggins et al. 2007) but has been applied more recently to animals killed in the marine environment whose carcasses are never observed (Pace et al. 2021).

the Opinion, our response to your concurrence requests, or our respective responsibilities under the ESA, please contact Julie Thompson-Slacum and Sabrina Deeley (cbfoprojectrecview@fws.gov) of the Chesapeake Bay Field Office.

Sincerely,

GENEVIEVE PULLIS

Digitally signed by GENEVIEVE PULLIS
Date: 2024.05.31 14:24:56 -04'00'

Genevieve LaRouche
Field Supervisor

Literature Cited

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Consultation History

In addition to the consultation history listed below, BOEM and the Service coordinated regularly via email, telephone, and meetings since 2023.

- September 27, 2023: BOEM provided inputs used for SCRAM v1.0.3 model to the FWS.
- September 29, 2023: BOEM submitted a draft BA, dated October 2023, to the FWS.
- November 6, 2023: The Service provided comments on the draft BA to BOEM.
- December 18, 2023: BOEM submitted a final BA, dated December 2023, to the Service which requested initiation of formal consultation under Section 7 of the ESA for the Maryland Offshore Wind Project.
- January 10, 2024: The Service acknowledged to BOEM that the consultation packet is complete.
- April 19, 2024: The Service requested comments from BOEM on the draft Biological Opinion.
- May 6, 2024: BOEM provided comments to the Service from US Wind, Inc. on the draft Biological Opinion and submitted a revised Construction and Operations Plan which included a Conservation Measure for compensatory mitigation.
- May 8, 2024: BOEM provided comments to the Service on the draft Biological Opinion.
- May 13, 2024: BOEM provided comments to the Service from US Wind, Inc. on the draft Biological Opinion. May 28, 2024: BOEM, the Service and US Wind, Inc. discussed and implemented revisions to the Conservation Measure for compensatory mitigaton.

Appendix A. Offshore Wind Incidental Take Summary

Table A1. Summary of anticipated piping plover, rufa red knot and roseate tern incidental take for Atlantic Coast offshore wind energy projects that have completed formal consultation with the Service[1, 2]. Values indicate individual birds.

Date of Opinion Issuance	Project Name	Project Duration	Compensatory Mitigation[4]	Piping plover		Rufa red knot		Roseate tern	
				Anticipated Take (Annual)	Anticipated Take (Project Duration)	Anticipated Take (Annual)	Anticipated Take (Project Duration)	Anticipated Take (Annual)	Anticipated Take (Project Duration)
5/12/2023	Ocean Wind 1[3]	35 years	Conservation Measure	<1 (0.14)	5	1	35	0	1
5/30/2023	Revolution Wind	35 years	Conservation Measure	<1 (0.09)	3	18	630	0	0
6/22/2023	Empire Wind 1 & 2	35 years	Conservation Measure	<1 (0.06)	2	>1 (1.06)	37	0	0
6/29/2023 10/04/2023 (amended)	Sunrise Wind	35 years	Conservation Measure	<1 (0.06)	2	<1 (0.89)	31	0	0
8/31/2023	CVOW-C	33 years	Conservation Recommendation & COP Approval Condition	~1 (0.88)	29	>2 (2.15)	71	0	0
9/1/2023	SouthCoast Wind	35 years	Conservation Recommendation	<1 (0.17)	6	<2 (1.91)	67	0	0
9/28/2023	New England Wind	33 years	Conservation Recommendation	<1 (0.39)	13	>1 (1.24)	41	0	0

12/1/2023	Atlantic Shores Offshore Wind South	30 years	Conservation Recommendation	1 (0.77)	23	~40 (39.6)	1,188	0	1
Exempted Take					**83**		**2100**		**2**
Exempted Take Subject to Compensatory Mitigation					**41**		**804**		**1**
Exempted Take Not Subject to Compensatory Mitigation					**71**		**1,367**		**1**

[1] For the first four projects, compensatory mitigation with a minimum 1:1 ratio was included as a conservation measure. Compensatory mitigation plans are to be developed before the start of WTG operation for those projects, the tangible commitments are to be in place concurrent with the start of operations. Geographic considerations may include but are not limited to: (a) any listed species recovery unit(s) or other management unit(s) determined to be disproportionally affected by or vulnerable to collision mortality; and/or (b) those portions of a species' range where compensatory mitigation is most likely to be effective in offsetting collision mortality.

[2] USFWS 2023d

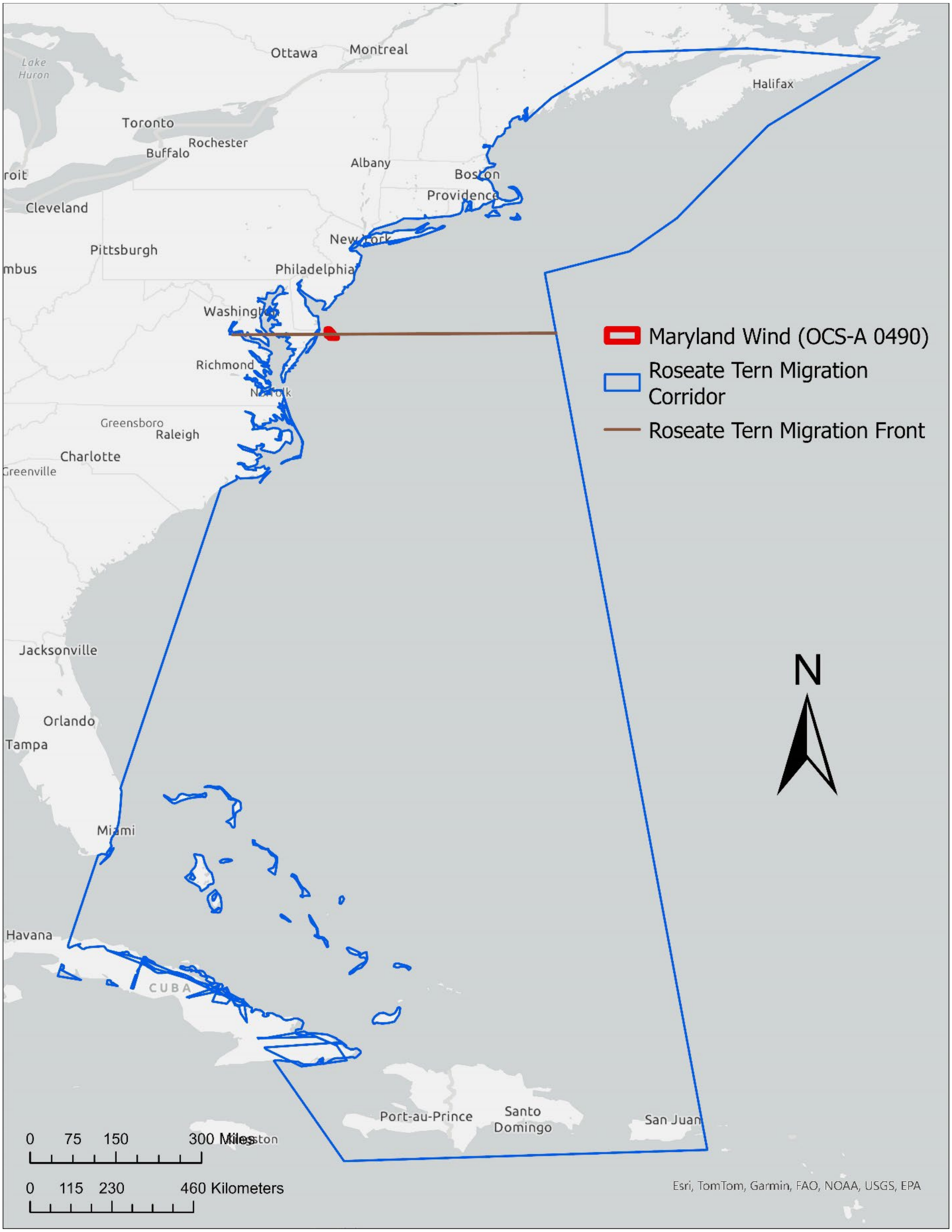
[3] On January 19, 2024, Ocean Wind LLC submitted a request for suspension of the operations term of commercial lease OCS-A 0498. BOEM approved a two-year suspension of the operations term, until February 28, 2026, subject to terms described in the approval letter. We continue to consider take exempted in the Ocean Wind 1 Opinion as part of the Status of the Species in this Opinion.

[4]Conservation measures are actions to benefit or promote the recovery of listed species that are included by the Federal agency as an integral part of the proposed action. These actions will be taken by the Federal agency or applicant, and serve to minimize or compensate for, project effects on the species under review. Conservation recommendations are the FWS' non-binding suggestions resulting from formal or informal consultation. Conservation recommendations (which may be provided at the end of the consultation package) are discretionary suggestions made by the FWS for consideration by the agency or applicant.

Appendix B. Migration Corridors


Piping Plover Migration Front
Maryland Wind (OCS-A 0490)
Atlantic Coast Piping Plover Migration Corridor
N
0 50 100 200 Miles
0 100 200 400 Kilometers
Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS
Toronto
Rochester
Buffalo
Albany
Boston
Providence
Halifax
Cleveland
Pittsburgh
New York
Philadelphia
Washington
Richmond
Norfolk
Greensboro
Raleigh
Charlotte
Greenville
Jacksonville
Orlando
Tampa
Miami
Havana
CUBA


Davis Strait
Hudson Bay
Labrador Sea
Lake Superior
Ottawa
Toronto
Chicago
Detroit
Boston
New York
Washington
St. Louis
Atlanta
ston
Miami
Havana
CUBA
Port-au-Prince
Caribbean Sea
Guatemala
Caracas
VENEZUELA
Georgetown
Paramaribo
GUYANA
Bogotá
COLOMBIA
Quito
ECUADOR
Manaus
Belém
Fortaleza
PERÚ
Recife
BRAZIL
Lima
Salvador
North Atlantic Ocean
Rufa Red Knot Migration Front
Maryland Wind (OCS-A 0490)
Rufa Red Knot Migration Corridor
N
0 200 400 800 Miles
0 300 600 1,200 Kilometers
Esri, TomTom, Garmin, FAO, NOAA, USGS


Maryland Wind (OCS-A 0490)
Roseate Tern Migration Corridor
Roseate Tern Migration Front
N
0 75 150 300 Miles
0 115 230 460 Kilometers
Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA

Appendix C. Rufa Red Knot Population Data Input for Band (2012)

Estimated Monthly Numbers of Rufa Red Knots Crossing "Migration Fronts" in the Mid-Atlantic (Massachusetts to Virginia)

This document lays out the biological basis for use of the Band (2012) model by the U.S. Fish and Wildlife Service (Service) to estimate collision risk of the federally listed (threatened) rufa red knot (*Calidris canutus rufa*) for proposed wind energy development on the Outer Continental Shelf (OCS) offshore the mid-Atlantic States from Massachusetts to Virginia. As shown in Table C1, this assessment considers birds from three of the four rufa red knot recovery units: Southeast U.S./Caribbean (SEC), Northern Coast of South America (NCSA), and Southern. See USFWS (2014, 2020, 2023) for the geographic range of these populations and background information on the species and offshore wind.

Model Assumptions

Band (2012) does not contemplate a species that may be resident in the wind farm area in some seasons and migrating through in other seasons. Stage B of the Band basic model (i.e., for resident birds) requires an estimate of observed bird density on an area basis. This information is currently unavailable for rufa red knots in the mid-Atlantic OCS during any month. In addition, far greater numbers of rufa red knots are present in the mid-Atlantic during the migration seasons than during winter or summer. For these reasons, we use Band Annex 6, for birds on migration. Under Annex 6, Band (2012) assumes that the entire bird population passes through a migratory corridor exactly twice each year. Annex 6 involves measuring the width of the corridor at the latitude of the wind farm (i.e., along a "migratory front," which is an imaginary line passing through the wind development area and extending to the western and eastern edges of the migratory corridor used by the species). Our application of the Band (2012) model was reviewed by an independent expert who concurred with our approach (A. Cook, email, Service, June 6, 2023). However, there are several significant caveats associated with use of Annex C, as discussed below.

Consistent with Annex C, our model inputs are deliberately calibrated to count each bird only once during the northbound (NB) and once during the southbound (SB) migration seasons. However, in addition to migration flights, seasonally resident rufa red knots are also known to make regional flights, some of which cross the OCS. Seasonally resident birds occurring in the mid-Atlantic may include nonbreeding adults during the breeding season, juveniles at any time of year, birds on extended stopover or staging visits, and birds during the early part of the wintering season (see USFWS 2023b). Rufa red knots have also been documented making regional flights opposite the main migration trajectory (i.e., south in spring, north in fall), a phenomenon known as reverse migration that is likely an attempt to find optimal food or other conditions for the stopover period (USFWS 2014, C. Hunter, email, Service, July 6, 2022); F.

Sanders, email, Service, August 9, 2023;, Perkins 2023). The prevalence of regional movements is reflected in available tracking data, summarized by USFWS (2023b).

Rufa red knots are known to move considerable distances within their wintering regions during the core winter months and may also depart the mid-Atlantic on late-season migration flights toward wintering destinations farther south (Burger et al. 2012, USFWS 2014, Perkins 2023). As shown in Table C2, Ebird data from the past 10 years from Massachusetts to Virginia average 42 rufa red knot records (>311 birds) in December and 52 records (>397 birds) in January per year. In addition, rufa red knots occur along the mid-Atlantic in June, with an average of 139 records (>1,710 birds) per year, which includes late-migrating breeding birds, as well as over-summering juveniles and nonbreeding adults. Due to the limitations associated with Ebird data, the actual number of rufa red knots wintering or summering in the mid-Atlantic is highly uncertain, and we have little information on the frequency with which these seasonally resident birds may cross the OCS.

Conversely, the majority of NB rufa red knots are likely to cross the migration front over land and not over the OCS. A growing body of evidence indicates that a substantial portion of NB rufa red knots depart from the U.S. Atlantic Coast (Florida to Delaware Bay) on a northwest trajectory to their final stopover areas along Hudson Bay in Canada. Some birds do continue along the Atlantic Coast north of Delaware Bay, and some of those birds may cross the OCS. However, the overland route does appear to be the predominant flyway for this leg of the northbound migration (USFWS 2014, USFWS 2021, Loring et al. 2021, Perkins 2023, unpublished satellite data) and this route entirely avoids the OCS.

In summary, the assumptions necessary to use Band (2012), Annex C, cannot account for: (1) more than two crossings of the migratory front per year by migrating birds (e.g., as may be associated with juveniles or instances of reverse migration); (2) crossings of the migratory front by birds summering or wintering in the mid-Atlantic; or (3) avoidance of the OCS by the majority of NB migrants.

Reproductive Output and Nonbreeding Birds

Research has documented a variety of behaviors among juveniles and nonbreeding adults.

- All juveniles of the Tierra del Fuego wintering area are thought to remain in the Southern Hemisphere during their first year of life, possibly moving to northern South America (Niles et al. 2008). (Tierra del Fuego supports the vast majority of the Southern recovery unit during the winter months (USFWS 2020b; Castellino and González, pers. comm., 2023).

- Some nonbreeding birds of both age classes remain south of the mid-Atlantic (USFWS, 2014, Martínez-Curci et al. 2020, Perkins 2023).
- Some nonbreeding birds may pass through the mid-Atlantic once in spring and spend the breeding season on (adults) or just south of (juveniles) the breeding grounds (USFWS 2014; A. Smith, pers. comm., 2023; Perkins 2023).
- Some birds may remain resident in the mid-Atlantic for prolonged periods (Burger et al. 2012, Loring et al. 2018, Perkins 2023) and may make multiple regional flights.

Given high uncertainty around the use of the OCS airspace by nonbreeding birds, we include them in our migration passage population estimates *except* for juveniles from the Southern population. For the rest, we assume they all cross the mid-Atlantic once during the NB migration window and once during the SB migration window. All of these assumptions are associated with high uncertainty.

Table C3 shows information and assumptions underpinning our estimation of the number of breeding birds and the addition of young of the year (YOY) to the SB migration population. Modeling by Schwarzer (2011) found that the Florida population was stable at around 8.75 percent juveniles among wintering birds. Available data suggest the three populations considered in this analysis are currently stable. Thus, we assume 8.75 percent of the total wintering birds are juveniles. We have no estimate of the number of nonbreeding adults in a typical year, or their distribution across the species' nonbreeding range. To account for nonbreeding adults, we round our estimate of nonbreeding birds up to 10 percent and exclude all these nonbreeding birds (juveniles and adults) from our calculation of chicks fledged per pair. Because all three rufa red knot populations are apparently stable, we assume annual mortality balances reproduction and we do not add any YOY to the wintering population totals.

Table C1. Current estimates of rufa red knot abundance by recovery unit

Recovery Unit	Abundance Estimate	Certainty	Basis	Source
SEC[1]	15,500	Moderate	mark/resight model (2011 data) + stable isotope analysis	Lyons *et al.* 2017
NCSA	31,065	Moderate	2019 aerial count	Mizrahi 2020
Southern[2]	14,484	High	2021-23 average count	Castellino and González pers. comm. 2023, Castellino 2023, Norambuena et al. 2023, Norambuena et al. 2022, Matus 2021
Subtotal	***61,049***			
Western[3]	5,500	Low	best professional estimate	D. Newstead, emails, Service, October 2, 2019, March 6 and June 3, 2020
Total	**66,549**			

[1] Includes an estimated 10,400 birds in the Southeastern U.S. and 5,100 birds in the Caribbean.
[2] The 2022 and 23 estimates include ground surveys of Patagonia, which varied in geographic coverage and methodology, and which were not conducted in 2021.
[3] Birds from the Western unit are known to occur in the mid-Atlantic during migration, but the predominant flyway for these birds is through the midcontinent (Newstead et al. 2013, Perkins 2023). Thus, we consider them discountable in our assessment of wind energy development on the OCS and omit them from further calculations.

Table C2. Ebird data by State* and month, June 2013 through May 2023

	MA	RI	CT	NY	NJ	DE	MD	VA	
cumulative total # of birds									% of total
Jan	112	0	0	2,188	1,184	9	47	425	0.2%
Feb	11	0	12	418	147	0	1	72	0.0%
Mar	0	4	0	180	79	7	0	24	0.0%
Apr	2	7	0	110	897	88	2	241	0.1%
May	3,320	807	281	21,133	825,966	401,589	2,380	22,831	77.5%
Jun	1,204	520	120	5,784	3,298	1,880	702	3,596	1.0%
Jul	22,844	277	28	3,655	8,177	756	195	5,514	2.5%
Aug	86,546	1,452	193	13,237	40,856	551	394	13,537	9.5%
Sep	46,514	1,089	97	7,908	19,244	340	159	2,567	4.7%
Oct	10,969	118	17	4,165	32,048	21	120	997	2.9%
Nov	3,011	25	6	4,298	11,917	9	51	130	1.2%
Dec	12	3	2	1,292	1,329	0	20	449	0.2%
annual average # of birds									total
Jan	11	0	0	219	118	1	5	43	397
Feb	1	0	1	42	15	0	0	7	66
Mar	0	0	0	18	8	1	0	2	29
Apr	0	1	0	11	90	9	0	24	135
May	332	81	28	2,113	82,597	40,159	238	2,283	127,831
Jun	120	52	12	578	330	188	70	360	1,710
Jul	2,284	28	3	366	818	76	20	551	4,145
Aug	8,655	145	19	1,324	4,086	55	39	1,354	15,677
Sep	4,651	109	10	791	1,924	34	16	257	7,792
Oct	1,097	12	2	417	3,205	2	12	100	4,846
Nov	301	3	1	430	1,192	1	5	13	1,945
Dec	1	0	0	129	133	0	2	45	311
total	17,455	430	76	6,437	94,514	40,525	407	5,038	164,882

	MA	RI	CT	NY	NJ	DE	MD	VA	
cumulative total # of records*									% of total
Jan	6	0	0	294	128	3	47	37	1.8%
Feb	6	0	12	113	36	0	1	23	0.7%
Mar	0	4	0	47	23	4	0	10	0.3%
Apr	1	7	0	48	113	19	1	28	0.8%
May	384	145	104	1,232	5,594	2,458	281	857	38.4%
Jun	152	100	34	534	237	136	74	125	4.8%
Jul	743	100	7	501	256	160	63	133	6.8%
Aug	2,385	300	138	1,044	962	96	73	389	18.7%
Sep	1,995	225	70	698	864	71	53	259	14.7%
Oct	471	46	9	461	1,295	12	43	73	8.4%
Nov	70	13	6	429	315	2	22	44	3.1%
Dec	11	3	2	203	128	0	20	52	1.5%
annual average # of records*									total
Jan	1	0	0	29	13	0	5	4	52
Feb	1	0	1	11	4	0	0	2	19
Mar	0	0	0	5	2	0	0	1	9
Apr	0	1	0	5	11	2	0	3	22
May	38	15	10	123	559	246	28	86	1,106
Jun	15	10	3	53	24	14	7	13	139
Jul	74	10	1	50	26	16	6	13	196
Aug	239	30	14	104	96	10	7	39	539
Sep	200	23	7	70	86	7	5	26	424
Oct	47	5	1	46	130	1	4	7	241
Nov	7	1	1	43	32	0	2	4	90
Dec	1	0	0	20	13	0	2	5	42
total	622	94	38	560	995	296	68	203	2,877

*Only records falling within the Study Area defined by Adams et al. (2022), Figure 2 are included.
**Bird numbers exclude 1,075 records for which the number of rufa red knots was not recorded.
***Numbers of both birds and records likely include duplicate reports of the same birds. Conversely, these data reflect those times and places that bird watchers were active, which does not cover all times and places rufa red knots occur.

Table C3. Data sources and assumptions to estimate the southbound population size

Population Segment	Method/Assumptions	Value	Sources
# of Southern juveniles	8.75% of Southern population *[14,484 * 0.0875]*	1,267	Table 1, Schwarzer 2011
# of NB birds expected to occur in the mid-Atlantic	(SEC + NCSA + Southern) – Southern juveniles *[61,049 - 1,267]*	59,782	Table 1, Niles et al. 2008, USFWS 2014, Perkins 2023
# of breeding birds expected to produce offspring that will migrate south through the mid-Atlantic	90% of (SEC + NCSA + Southern) *[61,049 * 0.9]*	54,944 (27,472 breeding pairs)	A. Smith pers. comm. 2023, Perkins 2023, Martínez-Curci *et al*. 2020, Schwarzer 2011
Annual # of YOY expected to migrate south through the mid-Atlantic	0.5 chicks per pair *[27,472 * 0.5]*	13,736	A. Smith pers. comm. 2023 and considering ASMFC 2022, Tucker 2019, Wilson and Morrison 2018
Total # of southbound birds expected to occur in the mid-Atlantic	NB migrants + YOY *[59,782 + 13,736]*	73,518	

Table C4. Numbers of rufa red knot mid-Atlantic crossings,* by month, for input to Band (2012), Annex 6

Month	# Crossings	Basis
January	0	
February	0	
March	0	
April	0	
May	59,782	100% of NB. (Any NB flights in April and June are attributed to May.)
June	1,470	2% of SB.
July	11,028	15% of SB.
August	29,407	40% of SB.
September	14,704	20% of SB.
October	11,028	15% of SB.
November	3,676	5% of SB.
December	2,206	3% of SB. (Any SB flights in January are attributed to December.)

*Annex C considers only two migratory flights per year (i.e., one NB and one SB). Allocations of the NB and SB population totals across the months are based on consideration of Ebird 2023; Perkins 2023; and Barrett and Harkness 2023.

Appendix D. Band (2012) and SCRAM Outputs for Maryland Offshore Wind.

Estimated number (95 perc. prediction intervals) of collisions reported by SCRAM v2.0.3 (Gilbert et al. 2022). Results include only months that have movement data and should be considered partial estimates of annual and operational collision risk. Operational risk calculated for 35-year period.

	Mean	Lower	Upper
PIPL			
Annual	0.02884	0.00964	0.05203
Operational	1.0094	0.3374	1.82105
REKN			
Annual	1.793	0.9171	3.01
Operational	62.755	32.0985	105.35
ROST			
Annual	0	0	0
Operational	0	0	0

Estimated number of collisions reported by Band 2012 (Annex 6) during migration calculated for 35-year operational period and assuming 93% avoidance rate.

	Mean	Lower	Upper
PIPL			
Annual	0.4645	0.3816	0.6136
Operational	16.2575	13.356	21.476
REKN			
Annual	1.205	1.045	1.379
Operational	42.175	36.575	48.265
ROST			
Annual	0	0	0
Operational	0	0	0