United States Department of the Interior

FISH AND WILDLIFE SERVICE

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May 30, 2023

Katherine Segarra
Bureau of Ocean Energy Management
Gulf of Mexico Regional Office
New Orleans, LA

Re: Biological opinion for the Revolution Wind offshore wind energy project
Project code: 2022-0023298

Dear Katherine Segarra:

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, and decommissioning of the Revolution Wind offshore wind energy project (Project). Revolution Wind is being developed by the energy companies Orsted and Eversource. The biological opinion considers the potential adverse effects of operating the Project on the federally threatened piping plover (*Charadrius melodus*) and rufa red knot (*Calidris canutus rufa*). The BOEM also requested our concurrence with the BOEM's determination that the proposed action may affect, but is not likely to adversely affect, the federally endangered northern long eared bat (*Myotis septentrionalis*) and roseate tern (*Sterna dougallii dougallii*). We received the BOEM's request for formal consultation, dated April 13, 2023, on the same day via email from David Bigger. Your request and our response are made in accordance with section 7 of the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA).

May Affect, Not Likely to Adversely Affect Determinations

Northern long-eared bat

The BOEM determined that the proposed action may affect, but is not likely to adversely affect, the northern long-eared bat. The species occurs in coastal New York and New England and could be affected by onshore and offshore components of the project. The onshore components of the Project may affect the northern long-eared bat through habitat disturbance from tree removal. In addition, noise, exhaust, vehicle presence and movement, etc. during construction could cause direct or indirect effects to the species. Offshore impacts are dependent on collision risk. There are many examples of bats being killed by barotrauma or collision with onshore wind turbines, and northern long-eared bats encountering offshore turbines could be killed as well. Bat species have been detected offshore including in the South Fork Wind (SFW) project area, which shares a lease area with Revolution Wind. In 2017, 896 bat calls were detected and identified to species in the SFW project area. Over 30 of these calls off Montauk Point on Long Island were attributed to the northern long-eared bat, but only one call was attributed to the species in or near the wind turbine lease area (as reported in Stantec 2018). In contrast, no northern long-eared bats were detected in over 2,600 calls recorded at the Block Island Wind project (Peterson and Pelletier 2016, and as reported in Stantec 2018), and no northern long-eared bats were detected foraging offshore of Martha's Vineyard in 2016 (Dowling et al. 2017).

The biological assessment (BA) for the Project (BOEM 2022a) is unclear about the measures the BOEM would implement to avoid adverse effects to the northern long-eared bat from the proposed Project. Regardless, we concur with the BOEM's determination that the proposed Project may affect, but is not likely to adversely affect, the northern long-eared bat because the best available information indicates the likelihood of the species occurring in the project area is discountable. This concurrence is based upon the following:

1. The Service's current understanding of the species' distribution indicates the northern long-eared bat no longer occurs in or near the onshore components of the Project[1].
2. While northern long-eared bats have been detected offshore, only one was detected near the project area out of thousands of recorded bat calls. Nearly all offshore northern long-eared bat calls were detected near Long Island, New York, which still supports a substantial population of northern long-eared bats.

<u>Roseate tern</u>

The BOEM determined that the proposed action may affect, but is not likely to adversely affect, the roseate tern. Islands in New York and New England support roseate tern breeding colonies, and Loring et al. (2019) documented roseate tern flight paths through the Revolution Wind lease area. We expect roseate terns to occur in the action area annually during migratory flights and during foraging flights from the closest breeding colonies. However, we concur with the BOEM's determination because:

- We do not expect any adverse effects during Project construction from noise, and indirect effects of habitat disturbance (e.g., from vessels, aircraft, pile driving, cable laying) would be insignificant. The likelihood of roseate terns colliding with stationary structures or vessels in the offshore environment is discountable. Turbine installation and cable laying would disturb the ocean floor, and these areas could be suitable habitat for roseate tern forage fish. However, most of the disturbance is temporary and would occur over an insignificant area relative to the surrounding available habitat.
- The best available information on roseate tern flight heights indicates the species generally would fly below the rotor-swept zone (RSZ), defined as 82 ft to 820 ft (25 m to 250 m), during foraging and transit flights (Hatch and Kerlinger 2004, Perkins et al.

[1] Information for Planning and Consultation website (https://ipac.ecosphere.fws.gov/), accessed 08 May 2023.

2004, Loring et al. 2019) and above the RSZ during migration (Alerstam 1985, Veit and Petersen 1993). In addition, both collision risk models (Band 2012, Gilbert et al. 2022) used to evaluate potential effects of the Project showed no predicted collisions over the life of the Project. Therefore, we expect the risk of roseate terns colliding with operating wind turbine generators would be discountable.

- The likelihood of roseate terns being attracted to lighting on the WTGs is discountable and any effects would be insignificant because (1) the aircraft detection lighting system (ADLS) would be active for a few minutes monthly, and (2) any birds that are attracted/disoriented by the ADLS are likely to be affected for only a few minutes.

Consultation History

In addition to the consultation history listed below, the BOEM and the Service coordinated regularly via email, telephone, and meetings since 2020.

- April 25, 2022: The BOEM submitted a draft BA, dated April 15, 2022, to the Service.
- June 24, 2022: The Service provided comments on the draft BA to the BOEM.
- June 28, 2022: The Service provided additional comments on the draft BA to the BOEM.
- August 29, 2022: The BOEM submitted a second version of the BA, dated August 29, 2022, to the Service.
- October 31, 2022: The Service provided comments on the August 29 BA to the BOEM.
- November 17, 2022: The BOEM submitted a final BA, dated November 16, 2022 (BOEM 2022a), to the Service and requested initiation of informal consultation under section 7 of the ESA for the Revolution Wind Project.
- November 25, 2022: The Service acknowledged to the BOEM that the consultation packet is complete.
- January 16, 2023: The BOEM provided the Service with an addendum (BOEM 2023a), dated January 12, 2023, to the November 2022 BA. The addendum primarily included additional details on the proposed action and collision risk model inputs.
- April 13, 2023: The BOEM provided the Service with a second addendum (BOEM 2023b), dated April 13, 2023, to the November 2022 BA. The addendum included outputs from a collision risk assessment based on revisions to the SCRAM collision risk model. The addendum described new information indicating likely adverse effects on the rufa red knot as a result of the proposed action. The BOEM revised its effects determination, implying a request for formal consultation.
- May 24, 2023: The BOEM submitted additional conservation measures for the Description of the Proposed Action.

We based the following Opinion on information provided in your request for consultation; the BOEM's final BA for the Project (BOEM 2022a); the BOEM's January 2023 and April 2023 addenda to the 2022 BA; the BOEM's draft environmental impact statement (BOEM 2022b); the 2022 construction and operations plan (COP) for the Project (VHB 2022); correspondence between Service and BOEM staff; and other sources of information. We can make a complete administrative record of this consultation available at the Service's New England Field Office in Concord, New Hampshire.

If you have any questions regarding this Opinion, please contact David Simmons at david_simmons@fws.gov or 603-333-5440 or me at audrey_mayer@fws.gov or 603-496-5181.

Sincerely yours,

AUDREY MAYER

Digitally signed by AUDREY MAYER
Date: 2023.05.30 18:32:49 -04'00'

Audrey Mayer
Supervisor
New England Field Office

BIOLOGICAL OPINION

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 following is a summary of the proposed action. Additional details are located in the BA, BA addenda, and the COP for the Project.

The BOEM proposes to approve a COP for construction, operation and maintenance (O&M), and eventual decommissioning of Revolution Wind, an offshore wind energy facility within the BOEM Renewable Energy Lease Area OCS-A 0486 (Lease Area). The Lease Area is located on the outer continental shelf (OCS) approximately 15 nautical miles south of Rhode Island (figure 1). The Project shares the Lease Area with South Fork Wind but occupies the majority of the Lease Area.

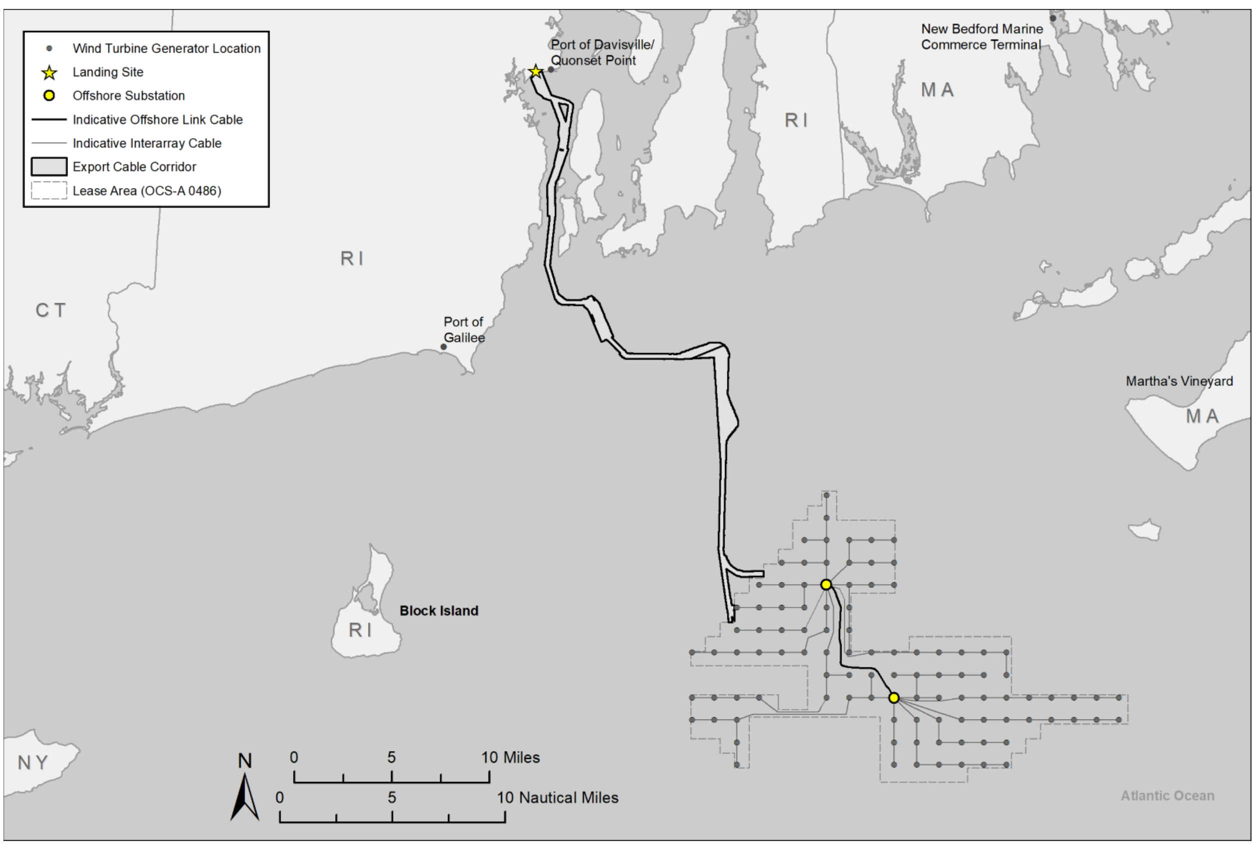

Figure 1. Map of project area copied from figure 1.1 of the BA

The offshore components of the Project would include:

- up to seventy-nine (79) 11-megawatt wind turbine generators (WTGs)
- up to two offshore substations (OSSs)
- inter-array cables linking the individual WTGs to the OSSs
- substation interconnector cables linking the OSSs to each other, and
- export cables, including connecting the OSSs to the onshore/offshore transition point. The transition point would be constructed in nearshore waters using a cofferdam and connected onshore through horizontal directional drilling.

The onshore components of the Project would include:

- an onshore substation (OnSS) and interconnection facility totaling approximately 11.1 acres, adjacent to an existing substation where the Project would connect to the electrical grid, and
- an underground cable duct bank connecting the offshore transition point to the OnSS/interconnection facility.

Piping plovers and rufa red knots are not likely to be adversely affected by onshore portions of the Project because suitable habitat is not present. Similarly, we expect the construction phase of the offshore components to avoid adverse effects because these species would occur in the offshore space of the action area only briefly during migration and would not be present on, or in, the water. We do not expect adverse effects from collision with any stationary structures in the offshore environment during construction (whether above or below the ocean surface) or behavioral changes (e.g., displacement, attraction) that the birds may exhibit as a result of wind turbine operation. Thus, this Opinion addresses only the risk that individuals of these species will collide with any of the WTGs over the operational life of the Project.

The WTGs would be arranged in a grid with 1 nautical mile between turbines. Table 4 of the January 2023 BA addendum (BOEM 2023a) and Attachment A of the April 2023 addendum (BOEM 2023b) display pertinent WTG dimensions and operational information. Total turbine height would be approximately 787 feet (240 meters (m)) above mean sea level (AMSL), hub height would be approximately 459 feet (140m) AMSL, and the air gap would be approximately 130 feet (40m) AMSL. The BOEM assumes that the proposed project would have an operating period of 35 years. Revolution Wind's lease with the BOEM has an operations term of 25 years that commences on the date of COP approval. While Revolution Wind would need to request and be granted an extension of its operations term, the BA assumes the project would operate for a longer period to avoid underestimating any potential effects to listed species (BOEM 2022a).

Conservation Measures

Section 7.2 of the 2022 BA contains a list of environmental protection measures Revolution Wind would implement to avoid or minimize impacts on the piping plover and rufa red knot during operation of the Project. We summarize those measures as follows:

- Design lighting to avoid and minimize attracting birds or altering their behavior. This would include using red flashing avian obstruction lights, hooded/down-shielded lights when possible, and the Aircraft Detection Lighting System.
- In coordination with the BOEM and the Service, finalize and implement a bird and bat post-construction monitoring plan, including installing technology to monitor use of, and estimate exposure to, the lease area by piping plovers and rufa red knots, other migratory birds, and bats.
- Install bird perching deterrents on turbines and OSSs.
- Implement a protocol for reporting any dead birds and bats detected in the project area.

On May 24, 2023, BOEM provided additional, and complementary, detailed conservation measures for inclusion in the project description. These are listed in Appendix B.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATION

"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). In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on 4 components: (1) Status of the Species, which evaluates the rangewide condition of the red knot and piping plover, the factors responsible for that condition, and the species' survival and recovery needs; (2) Environmental Baseline, which evaluates the status of the red knot and piping plover in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action on the red knot and piping plover; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the red knot and piping plover. The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of the listed species and the role of the action area in providing for those needs. Within this context we evaluate the significance of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination (see 50 CFR 402.14(g)).

To conduct this analysis, we begin by assessing whether there are effects to any individuals of the species of interest (as discussed in the effects analysis section below). If we are able to show that individuals are likely to experience reductions in their reproductive success or survival likelihood, we are required to assess how those effects are or are not anticipated to result in an appreciable reduction in the likelihood of both the survival and recovery of the species.

Because many species are composed of multiple populations and there may be meaningful differences in those populations (e.g., genetics, morphology, size) 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) they are associated with. If our analyses indicate that reductions in the reproduction, numbers, and distribution of the population(s) are not likely to occur, then there can be no appreciable reductions in reproduction, numbers, or distribution at a species level and we conclude that the agency has ensured that their action is not likely to jeopardize the continued existence of the species. If there are reductions in the reproduction, numbers, and distribution of the population(s) impacted, we then assess whether those changes affect the overall species survival and recovery rangewide based on the importance of the population(s) for species level representation, resiliency and redundancy, the level of impact, and the status of the species.

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 is a summary of the species' general life history drawn primarily from Service assessment, listing, and recovery documents.

Piping Plover

<u>Listing and Life History</u>
Piping plovers breed in three discrete areas—the Atlantic Coast, the Great Lakes, and the Northern Great Plains of the United States and Canada. The Atlantic Coast and Northern Great Plains populations are listed under the ESA as threatened, while the Great Lakes population is listed as endangered. All three populations winter along the U.S. coast from North Carolina to Texas, as well as in Mexico and the Caribbean (USFWS 2020a). The two inland breeding populations are not considered in this BO. The Atlantic Coast piping plover 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). The Bahamas is a particularly important wintering area (USFWS 2020a).

The Service listed the Atlantic Coast population as threatened in 1986 (50 FR 50726). The Service designated critical habitat for wintering piping plovers of all three populations in 2001 (66 FR 36038) and revised the designation in 2008 (73 FR 62816). The critical habitat extends along the coast from North Carolina through Texas (USFWS 2020a). The critical habitat does not overlap the action area, and there is no proposed or designated critical habitat within the breeding range of the Atlantic Coast population. Therefore, critical habitat for this species is not considered in this Opinion. The Service completed recovery plans for each breeding population.

The piping plover is a small shorebird approximately 7 inches long with a wingspan of about 15 inches. Piping plovers are present on New England beaches during the breeding season, generally between April 1 and August 31, though migrants may be present into October. These territorial birds nest above the high tide line, usually on sandy ocean beaches and barrier islands, but also on gently sloping foredunes, blowout areas behind primary dunes, washover areas cut into or between dunes, the ends of sandspits, 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. Surviving chicks fledge after about 25 to 35 days. Piping plover adults and chicks feed on marine macroinvertebrates such as worms, fly larvae, beetles, and crustaceans (USFWS 1996).

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, and oil spills are a continuing moderate threat (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 that breeding Atlantic Coast piping plovers rely on. Threats from human disturbance and predation remain ubiquitous along the Atlantic Coast. Human disturbance of nesting birds includes foot traffic, kites, 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). The best available information indicates that disease, environmental contaminants, and overutilization are not current threats to Atlantic Coast piping plovers (USFWS 2020a).

Two new threats have been identified in recent Service reviews. Climate change (especially sea level rise) and wind turbines 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 activities. Although threats from WTGs are foreseeable, the magnitude is poorly understood. As the BOEM's offshore wind leasing and review of projects has advanced, there is an increasing degree of certainty about the likely locations of future projects; however, the timing and extent of full coastwide buildout of WTGs on the OCS is still unknown, and any effects of the turbines on migrating birds (*e.g.*, collision, behavioral effects) are even more difficult to study and characterize offshore than on land.

New information demonstrates the important effect of wintering site conditions on annual survival rates, a factor to which piping plover populations are highly sensitive as discussed below. 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, including habitat degradation and increasing human disturbance (USFWS 2020a).

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). Most birds breed each year if mates are available (Elliot-Smith and Haig 2020). Although piping plovers have been documented to live more than 11 years, 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). There is currently no information regarding the distribution of mortality across the annual cycle of Atlantic Coast piping plovers. 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 2021 Atlantic Coast piping plover population estimate of 2,289 pairs was almost 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 1). The largest population increase between 1989 and 2021 occurred in New England (514 percent), and the NY-NJ recovery unit experienced a net increase of 81 percent between 1989 and 2021. However, the NY-NJ population declined sharply from a peak of 586 pairs in 2007 to 378 pairs in 2014, before rebounding to 576 pairs in 2021. Net growth in the Southern recovery unit population was 35 percent between 1989 and 2021, but the Southern population decreased 30 percent between 2016 and 2021. In Atlantic Canada, where increases have been short-lived, the population posted a net 23 percent decline between 1989 and 2021. 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 2021a).

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 2018 was 1.25 fledged chicks per pair. The overall U.S. Atlantic Coast productivity estimate was 1.38 fledged chicks per pair in 2019, 1.25 in 2020, and 1.09 in 2021—the fifth lowest since

1989 (USFWS 2021a).

In summary, the overall status of the Atlantic Coast piping plover is improving, though unevenly. The Atlantic Canada recovery unit is declining sharply, the New England recovery unit is increasing sharply, and the NY-NJ recovery unit is tenuously stable.

Table 1. Estimated numbers of pairs* of Atlantic Coast piping plovers, 2012-2021 (USFWS 2021a)

	Atlantic Canada	**New England**	**NY-NJ**	**Southern**	**Total**
2012	179	865	463	377	1,884
2013	184	854	397	358	1,793
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
average	179	945	476	335	1,935

*Recovery criteria: Eastern Canada=400. New England=625. NY-NJ=575. Southern=400. Total=2,000

<u>Recovery</u>

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). Accordingly, the recovery plan (USFWS 1996) delineates four recovery units: Atlantic Canada, New England, New York-New Jersey (NY-NJ) and Southern (Delaware, Maryland, Virginia, and North Carolina). 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 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). The Southern recovery unit is not addressed in this BO, as these birds spend their entire life cycle south of the action area. Some number of birds from each of the other three recovery units are expected to occur in the action area during spring and fall migration.

As described in the recovery plan (USFWS 1996), the recovery criteria, which reflect the conservation tenets of representation, redundancy, and resiliency (3Rs), 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 Atlantic 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
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.

Recent Biological Opinions

May 2023: biological opinion for the Ocean Wind 1 project anticipates less than 1 piping plover killed annually and 5 over the life of the project (USFWS 2023c)

Rufa red knot

Listing and Life History

The Service listed the rufa red knot as threatened under the ESA in 2015 (79 FR 73705). The Service published a proposed rule to designate critical habitat for the rufa red knot in 2021 (86 FR 37410) and published a revised proposed rule in April 2023 (88 FR 22530). The proposed critical habitat does not overlap with the action area; therefore, we do not consider critical habitat for this species in this Opinion.

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; (3) northern Brazil and extending west along the northern 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. This subspecies shows very high fidelity to wintering region, with habitat, diet, and phenology varying appreciably among birds from different regions (USFWS 2014).

Some rufa red knots migrate more than 9,300 miles, one of the longest migrations of any animal. Migrating rufa red knots can complete non-stop flights of 1,500 miles or more, converging on vital stopover areas to rest and refuel along the way. The single most important spring staging area is along the shores of Delaware Bay in Delaware and New Jersey, where rufa red knots 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. In addition to staging areas, rufa red knots also use other stopover habitats in smaller numbers and/or for shorter durations.

Large and small groups of rufa red knots, sometimes numbering in the thousands, may occur in suitable habitats from the southern tip of South America to Central Canada during the migration seasons. The timing of spring and fall migration varies across the range (USFWS 2014).

Coastal habitats used by rufa red knots in migration and wintering areas are similar in character—generally coastal marine and estuarine habitats with large areas of exposed intertidal sediments. Migration and wintering habitats 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. In many wintering and stopover areas, quality high-tide 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 nonbreeding areas, rufa red knots require sparse vegetation to avoid predation. Unimproved tidal inlets are preferred nonbreeding habitats. Along the Atlantic Coast, dynamic and ephemeral features are important rufa red knot habitats, including sand spits, islets, shoals, and sandbars, and other features often associated with inlets.

In coastal nonbreeding areas, rufa red knots feed in the intertidal zone by probing for invertebrate prey, especially small clams, mussels, and snails, but also crustaceans, and marine worms. Horseshoe crab eggs are a preferred food wherever they occur. On the breeding grounds rufa red knots mainly eat insects. The timing of food resources (*e.g.*, insect prey on the breeding grounds, horseshoe crab eggs or mollusks at stopover areas) with the species' migratory lifecycle is a critical need (USFWS 2014).

<u>Threats</u>
The Service completed a Species Status Assessment (SSA) (USFWS 2020b) that classified 24 threats to the rufa red knot. Threats that are driving the rufa red knot's status as a threatened species under the ESA are classified as High Severity in the SSA, and include loss of breeding and nonbreeding habitat due to sea level rise, coastal engineering/stabilization, coastal development, and Arctic ecosystem change; likely effects related to disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies in the timing of the species' annual migratory cycle relative to favorable food and weather conditions. Threats classified as Moderate Severity in the SSA cause additive mortality that cumulatively exacerbate the effects of the High Severity threats. Moderate Severity threats include hunting; predation in nonbreeding areas (*e.g.*, by peregrine falcons (*Falco peregrinus*)); harmful algal blooms; human disturbance; oil spills; and wind energy development, especially near the coasts. Threats

classified as Low Severity in the SSA were evaluated in the final listing rule, but the Service concluded they are not contributing to the rufa red knot's threatened status under the ESA. These include beach cleaning, agriculture, research activities, and disease (USFWS 2020b). 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, we consider goose overpopulation a Moderate Severity threat, but recognize high uncertainty around how geese may be impacting rufa red knot reproductive rates (USFWS 2021b).

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 forgo 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 and whether it varies spatially or temporally. 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).

Based on best available information, the current total rangewide abundance estimate is just under 64,800 rufa red knots, distributed across the four recovery units (Table 2). We conclude with moderate confidence that the North Coast of South America (NCSA) and the Southeast United States/Caribbean (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 wintering population (*i.e.*, birds wintering in Argentina and Chile) 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).

The decline of the Southern population, which had been the largest in the 1980s, 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 2. Current estimates of rufa red knot abundance by recovery unit*

Wintering Population	Current Abundance Estimate	Certainty	Source
Southern (mean 2020-2022)	12,704	High	Norambuena *et al.* 2022, Matus 2021, WHSRN 2020
North Coast of South America	31,065	Moderate	Mizrahi 2020
Southeast U.S./Caribbean	15,500	Moderate	Lyons *et al.* 2017
Western**	5,500	Low	Newstead pers. comm. 2019, 2020
Total	**64,769**		

*Recovery criteria: Southern=35,000, Western=10,000
**Presented for context but not considered in this BO.

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

<u>Recovery</u>
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. The Service has delineated four recovery units corresponding to the four wintering populations listed above. Conservation of each recovery unit contributes to each of the 3Rs and is essential for the recovery of the entire subspecies. The recovery plan establishes population targets for each recovery unit, based on 10-year average abundance. The recovery plan also 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). Although rufa red knots from the Western Gulf of Mexico/Central America/Pacific South America (Western) recovery unit are

known to occasionally occur in the Atlantic Coast (USFWS 2014), we consider the likelihood that they will be affected by the proposed project discountable. Therefore, the proposed action would not affect recovery of the Western unit. Some rufa red knots from each of the other three recovery units may occur in the action area during spring and fall migrations.

The rufa red knot recovery plan includes ten recovery criteria that address the 3Rs for each recovery unit.

Recent Biological Opinions

- January 2023: up to 6 rufa red knots per year injured or killed incidental to research activities over the next 5 years (30 birds total) (USFWS 2023d).
- May 2023: biological opinion for the Ocean Wind 1 project anticipates 1 rufa red knot killed annually and 35 over the life of the project (USFWS 2023c)

ACTION AREA

The implementing regulations for section 7(a)(2) of the ESA define the "action area" as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for the entire Project is considerably larger than the action area considered in this Opinion. The action area for the complete Project includes surface and subsurface portions of the offshore environment, as well as nearshore and terrestrial areas affected by onshore project components (Figure 1). However, as discussed above, this Opinion addresses only the areas where one or more piping plovers or rufa red knots are reasonably certain to collide with any of the Revolution Wind WTGs occur over the operational life of the Project. Thus, this Opinion addresses affected areas limited to the offshore airspace within the wind turbine area, extending from the ocean surface to the maximum height of the turbine blade tip.

The wind turbine area is an irregularly-shaped polygon (Figure 1) that is approximately 22 miles wide. The closest land is Nomans Land Island approximately 7.5 nautical miles to the northeast. It is located 10 to 12.5 nautical miles south of other points in Massachusetts and Rhode Island.

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 consequences to listed species or designated critical habitat from ongoing agency activities or existing 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 OCS by the piping plover and rufa red knot has been growing over the last 10 to 15 years, our understanding of the species' presence in the OCS is still limited. We use all conceptual, qualitative, quantitative, and other relevant information to anticipate and describe the status of the species in the action area.

As discussed above, the action area covered by this Opinion is limited to the airspace of the Revolution Wind portion of lease area OCS-A-0486. The action area is located within a migration corridor for both species, and its primary value to piping plovers and rufa red knots is as part of a flight corridor. Based on the widths of the migration corridors we used for the Band (2012) collision risk model, discussed below, the Wind Farm Area occupies about 13 percent of the width of the piping plover migration corridor (approximately 164 miles (264 kilometers (km))) and 1.5 to 9.5 percent of the rufa red knot wide (1,407 miles (2,264 km)) and narrow (232 miles (373 km)) migration corridors, respectively. We focus our assessment on the WTG's rotor swept zone (RSZ), which is between 131 feet (40m) and 787 feet (240m) AMSL.

In a literature review regarding collision risk, Burger et al. (2011) concluded that (1) the primary risk to piping plovers occurs during spring and fall migration, with risk decreasing with WTG distance from land; and (2) risk exposure of rufa red knots occurs during migratory flights, especially when flying across the OCS (rather than along the coast).

In a synthetic data analysis of the Atlantic coast and OCS distributions of roseate tern, piping plover, and rufa red knot, Normandeau (2011) identified potential migratory flight paths these species might use to cross the OCS rather than following the coast. Both piping plovers and rufa red knots probably "shortcut" across the OCS using long-distance flights instead of following the coastline, although some individual birds likely choose to complete multiple shorter-distance flights along the coast. Accordingly, both species would be exposed to WTGs on the OCS during spring and fall migrations, especially between Cape Cod and the mid-Atlantic U.S. Typical northbound migration patterns for rufa red knots result in less exposure to the action area in the spring. However, both species stage for fall migration on Cape Cod and use habitats in the mid-Atlantic, and we expect some individuals will pass through the action area on long-distance, cross-OCS, southward migration flights.

In recent years, emerging geospatial tracking technology has provided more specific and useful information than past methods; however, this technology requires receiving stations that currently do not exist offshore. As tagged birds move farther from receiving stations installed onshore, they eventually lose connection with receivers altogether until they again are within range of a receiver. Therefore, uncertainty about exact flight path, flight height, etc. grows dramatically in areas lacking receivers.

Tracking data used to assess the number and behavior of listed birds in the action area has been collected 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. Based on the 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 piping plover and rufa red knot use of the action area relative to the surrounding OCS and adjacent coastline, but we do not have enough information to discern any differences in use of the action area that may exist along latitudinal or longitudinal gradients.

Piping Plover

Most of our knowledge of migratory trajectories for Atlantic coast piping plovers is derived from Loring *et al.* (2019). From 2015-2017, this study fitted 150 piping plovers at breeding grounds in Massachusetts and Rhode Island with digital Very High Frequency (VHF) radio transmitters. An array of automated VHF telemetry towers established from Cape Cod, Massachusetts, to southern Virginia tracked the movements of tagged piping plovers, capturing the most data in late July and early August. The telemetry array detected 82 percent of the 150 tagged individuals, on average for 46 days per individual; 25 percent of the tagged individuals dropped their transmitters on the breeding grounds. Due to low detection probabilities, only about half (70 of 150) of the fitted birds had sufficient detection data to model fall migration of piping plovers.

The initiation of a migration event was determined when a tagged individual was tracked by two or more towers in the telemetry array south of their breeding grounds. Piping plovers used primarily offshore routes from their breeding grounds to stopover areas in the Mid-Atlantic. Of the 70 tracked individuals, 27 percent (19 birds) had estimated exposure to Wind Energy Areas (WEA) during migration, including lease area OCS-A 0486 (Figure 2). Along these routes, individual birds crossed through up to four WEAs while flying across the mid-Atlantic Bight. Estimated exposure to WEAs was higher for tagged birds from breeding grounds in Massachusetts than from Rhode Island. Flights across Federal waters and WEAs were strongly correlated with southwesterly winds, which reduce energy expenditure during post-breeding migration. Peak estimated WEA exposure occurred within four hours of local sunset (19:00 hours) for 22 birds from the Massachusetts breeding grounds; 64 percent (14 birds) crossed WEAs pre-sunset, and 36 percent (8 birds) crossed WEAs post-sunset.

With respect to offshore flight altitudes of piping plovers, Loring *et al.* (2019) found that while most birds migrated at altitudes above the RSZ (where RSZ was considered to be 25 to 250m above sea level, a lower air gap and larger RSZ than Revolution Wind), 21 percent of piping plover flights in Federal waters occurred within the RSZ. Using the same dataset, Loring *et al.*

(2020a) found that roughly 30 percent of the 17 individual migratory flights across the mid-Atlantic Bight occurred within the RSZ.

The data from Loring *et al.* (2019) have important limitations that must be taken into account. First, the land-based telemetry tower array has limited detection probability further from shore. Some of the tagged birds heading south may have crossed the action area, outside of the detection array of the telemetry towers. Second, all tagged piping plovers originated from only two breeding areas (Massachusetts and Rhode Island), and birds in other breeding areas along the Atlantic Coast range may take migration paths that are substantially different. Indeed, a recent mark/resight study following piping plovers banded in Atlantic Canata (rather than using VHF transmitters) resighted 42 percent of banded birds in New Jersey and 52 percent in North Carolina (Rock pers comm. 2023). Piping plovers migrating from Atlantic Canada to these areas of the United States could be crossing through one or more WEAs if their fall migration occurs offshore, and their exposure to offshore wind has not yet been assessed. Loring *et al* (2019) note several differences in the migratory flights of birds tagged in Massachusetts versus Rhode Island, indicating that probability of occurrence in the action area does likely vary for piping plovers breeding in different portions of the range. Finally, the two studies reviewed here were focused on fall migration; few data are available on piping plover spring migration movements at this time (only two birds were tracked during partial northbound flights from the Bahamas; Loring *et al.* 2019).

In summary, based on the results above, piping plovers from the New England recovery unit are likely occur in the Revolution Wind WEA annually. Individuals are likely to cross the action area one or two times per year, on spring and fall migration fights. Approximately one third of these birds may cross the action area within the RSZ. We have no information regarding occurrence of birds from the Eastern Canada recovery unit, but our analysis assumes they may also be present in the action area and that they would exhibit a similar flight height distribution. We have very little information on the flight paths or altitudes of spring migrants, but we presume that these are similar to fall flights.

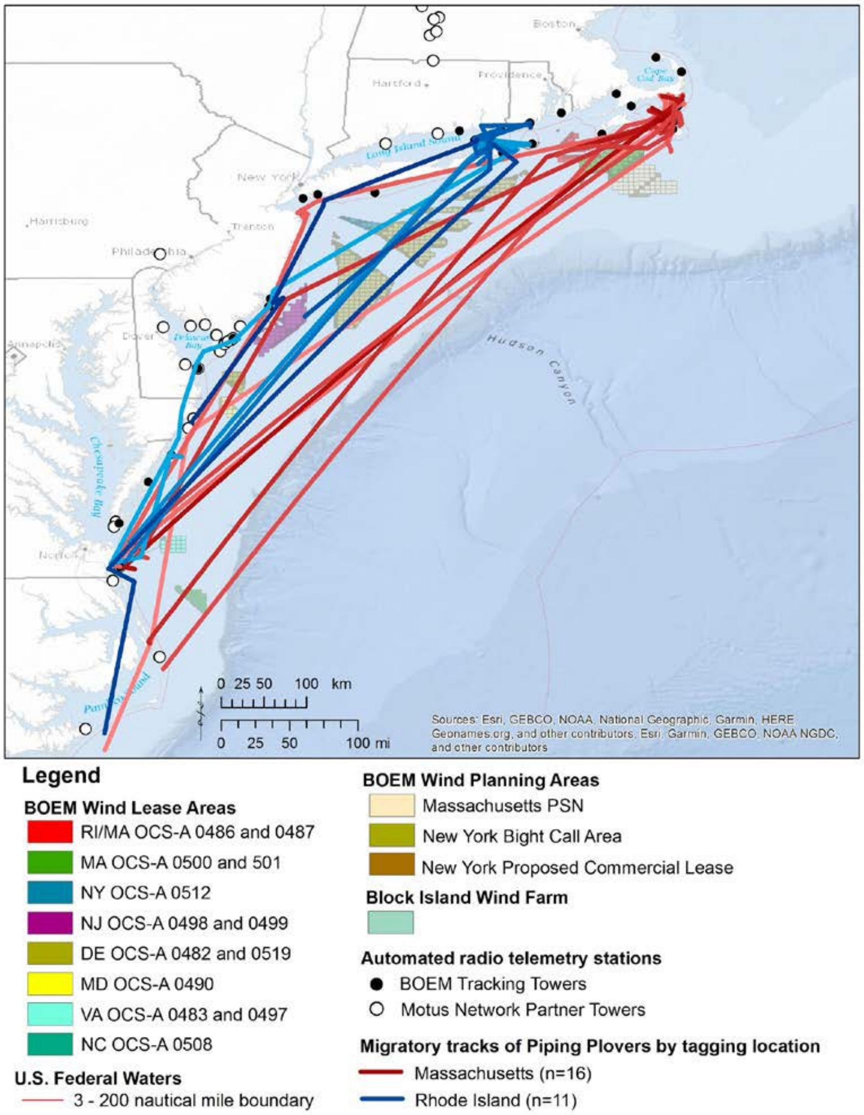

Figure 2. Figure 57, part C, in Loring et al. (2019), illustrating piping plover migratory flights intersecting the action area and other offshore wind lease areas.

Rufa Red Knot

Below, we compile the major results from studies on the breeding, nonbreeding, and migration patterns of rufa red knot by Perkins (2023), Smith *et al.* (2023), Loring *et al.* (2018 and 2020b), and Burger *et al.* (2012).

Based on data from 93 individual rufa red knots and 100 geolocators, Perkins (2023) determined the migration patterns and wintering areas for all recovery units except the Western unit (Figure

3) using data from 2009 to 2017. Rufa red knot flight paths were categorized into subpopulations using expert elicitation and draft recovery plan maps, and individuals were assigned to the following categories: Southeast U.S./Caribbean (SEC) (31 birds, 10 of which wintered in the Caribbean); North Coast of South America (NCSA) (22 birds), Western Gulf of Mexico/Central America (Western) (24 birds), and Southern (9 birds). Seven individuals that were tagged in Texas were not classified. Location estimates were accurate to within 155 miles (250 km). Tagged individuals from the SEC recovery unit were detected in Massachusetts in May through September; and individuals from the NCSA unit were detected in Connecticut in May and in Massachusetts from July through September, during fall migration. Perkins (2023) did not detect individuals from the Southern unit stopping in Massachusetts, although some flight paths crossed southwest New England. Given the potential 155-mile error in accuracy, it is possible that any of the birds detected in, or flying over, New England could have flown through the Revolution Wind action area.

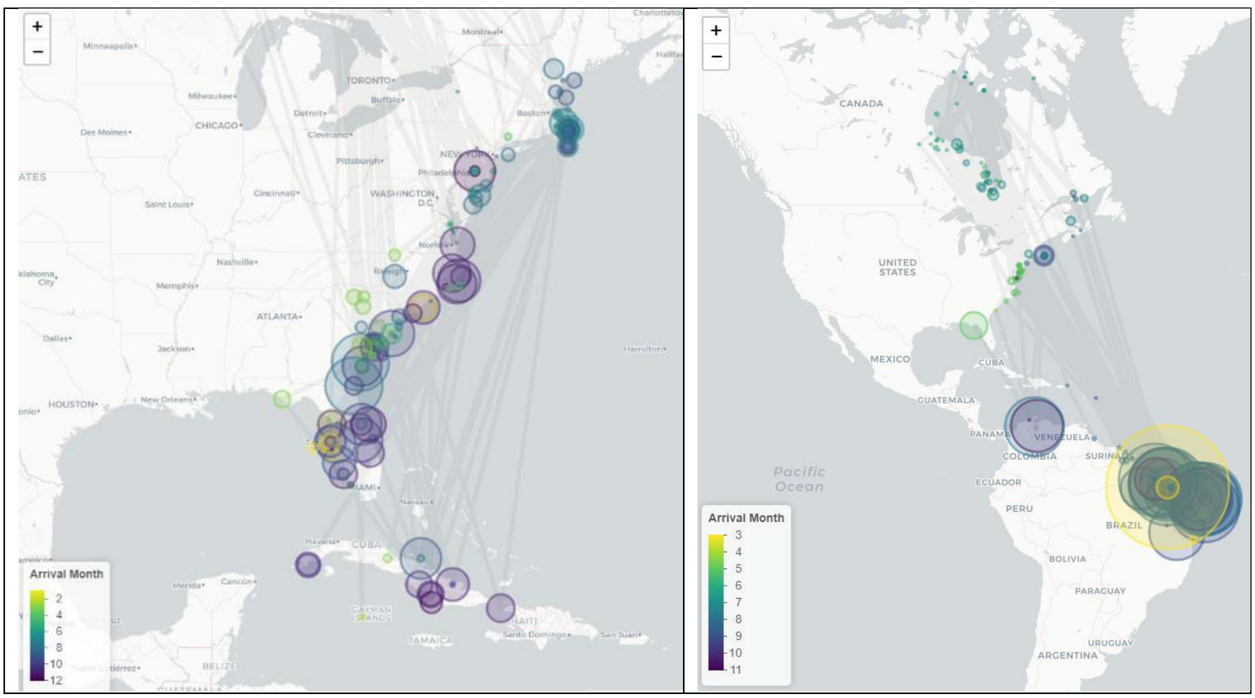

Figure 3. Figures 5b (left) and 6a (right), in Perkins (2023), illustrating rufa red knot migratory flights. Some flights are long-distance across the OCS and appear to intersect the action area.

Using digital VHF transmitters and a Motus network of land-based receiving stations, Smith *et al.* (2023), tagged 96 northbound rufa red knots in South Carolina from 2017-2019, and 12 northbound rufa red knots in 2019, to determine whether these birds used Delaware Bay as stopover habitat. Of the 108 tagged birds, 33 were detected by the Motus network, and of those 33 birds, 9 (27 percent) were detected in Delaware Bay. Smith *et al.* (2023) found similar northward migratory pathways from the southeastern U.S. as reported in Perkins (2023), although the data in Smith *et al.* (2023) do not provide information on offshore flight paths of rufa red knots departing from the southeast and mid-Atlantic, since most tend to fly overland directly to their breeding grounds in the Arctic.

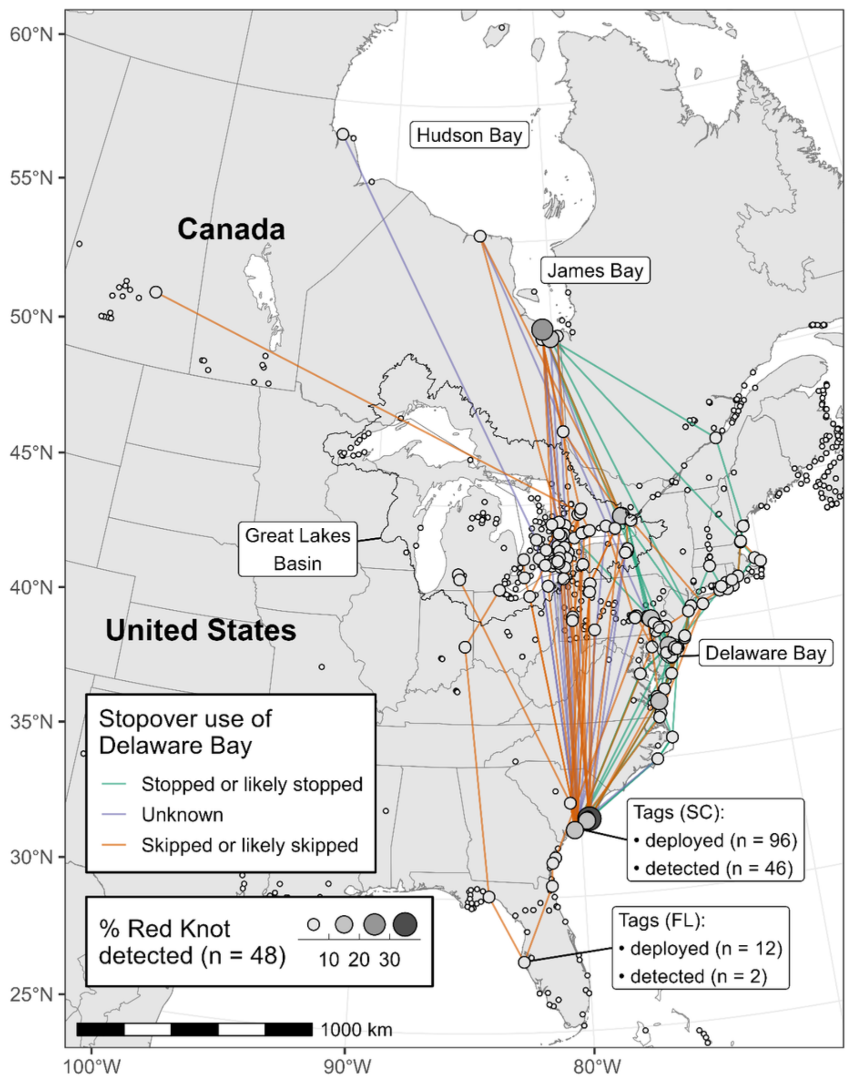

Figure 4. Figure 2, in Smith et al. (2023), illustrating rufa red knot northbound migratory flights.

To identify critical southbound stopover sites and migratory pathways in Canada and the Northeastern United States, Loring *et al.* (2018) attached digital VHF transmitters to 388 rufa red knots in 2016 in four areas; James Bay and the Mingan Archipelago in Canada, in Massachusetts, and along the Atlantic Coast of New Jersey. An array of automated telemetry stations along the U.S. Atlantic coast from Cape Cod, Massachusetts to Back Bay, Virgina tracked a total of 59 of the 388 tagged birds as they migrated over Federal waters. Tag loss and failure were low, as more than 75% of the tagged birds were detected at least once by the array. However, only 3 to 22 percent of the Canadian tagged birds were detected in the array off the

U.S. coast; of those, 2 tagged birds were likely exposed to WEAs while migrating through the study area. Of the birds tagged in Massachusetts and New Jersey, 54 percent were detected while passing through Federal waters along the U.S. coast, and 11 percent of those were likely exposed to one or more WEAs, either during short-distance flights on staging grounds or longer-distance migration flights. The majority (77 percent) of these flights occurred in the RSZ (mean altitude 348 feet (106m), range 72-2894 feet (22-882m); where the RSZ defined in this study was lower and smaller than the Revolution Wind RSZ), however there was a large error associated with these altitude data. Offshore departures for migratory flights primarily occurred within several hours of dusk; 80 percent of flights detected within the WEA occurred at night, from 3 hours before local sunset to 1 hour after sunrise. These flights occurred during fair weather: clear skies (mean visibility greater than 62 feet (19m)); above-average barometric pressure; mild temperatures; and little to no precipitation.

While only 3 of the 388 tagged rufa red knots in the study were detected crossing Leases OCS-A 0498 and/or 0499, the tracking array likely missed some to many individuals flying within the array detection area, due to the limited detection ranges of the transmitters or due to stations that were intermittently offline. Therefore, these exposure estimates to Federal waters and WEAs should be assumed to be an underestimate (Loring *et al.* 2018).

Appendix F in Loring et al. (2018) contains 26 maps of estimated flight paths of tracked rufa red knots between Virginia and Massachusetts. Several flight paths intersect the action area or adjacent lease areas.

In a second migration study, Loring *et al.* (2020b) aggregated data from 3,955 individuals across 17 shorebird species that had been tagged with VHF transmitters between 2014 and 2017 at sites in North and South America. Transmitters were tracked during spring and fall migrations by an automated Motus radio telemetry network with stations across eastern North America, and at several sites from Arctic Canada to South America. This study used data from the telemetry stations extending from Cape Cod, Massachusetts, to Back Bay, Virginia (the same study area as Loring *et al.* 2018). These telemetry stations had an effective detection radius of roughly 12 miles (20 km), yielding a total detection area from 12 miles inland of the array to 12 miles offshore of it. Tracking data included detections of individuals that were tagged at least 31 miles (50 km) from their tagging site and within 18 miles (30 km) of the Atlantic Coast telemetry array. Among the 17 species detected, rufa red knots had the highest number of tagged individuals (1,175) and also represented the majority of detections (86 percent) by the array in the study area.

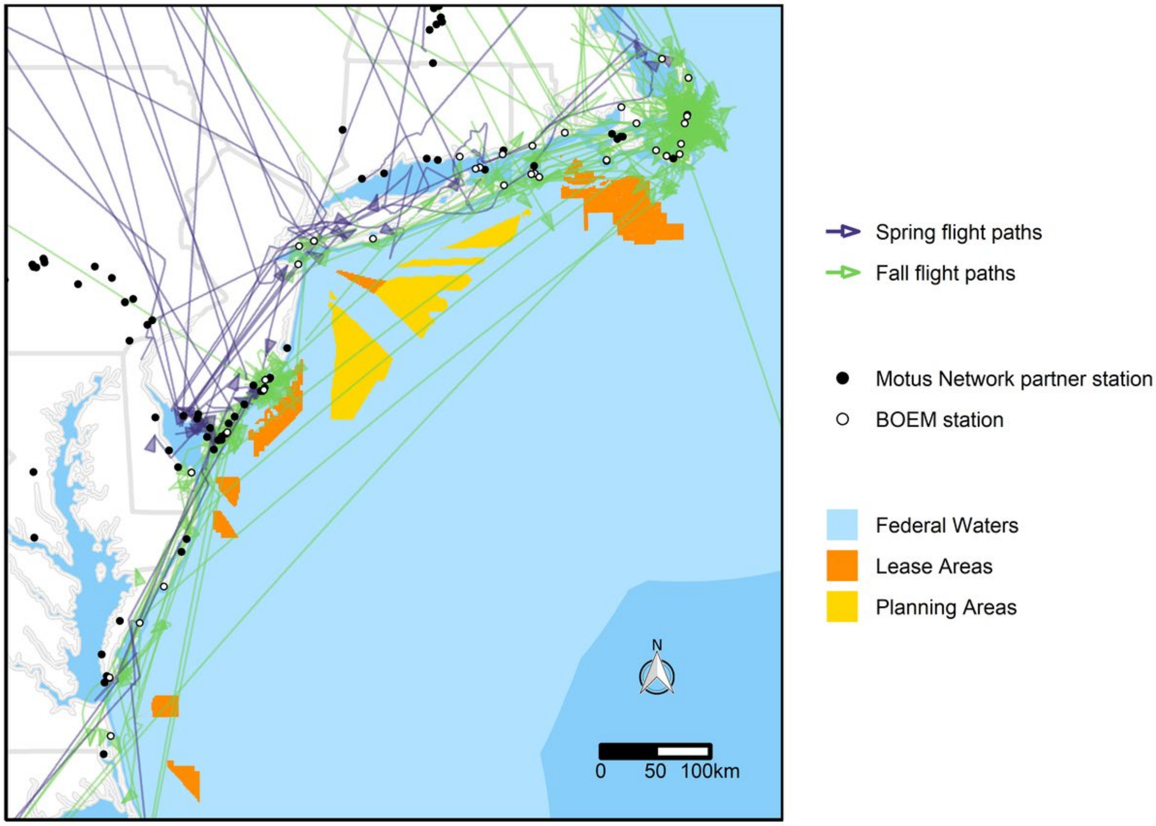

Figure 5. Figure 14 in Loring et al. (2020b), illustrating red knot migratory flights.

This growing body of evidence indicates that a substantial portion of northbound rufa red knots fly overland 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 Revolution Wind action area. However, the overland route appears to be the predominant flyway for this leg of the northbound migration (USFWS 2014, Loring *et al.* 2020b, USFWS 2021b, Perkins 2023), and this route entirely avoids the OCS.

The prevalence of regional movements is reflected in available tracking data. Burger *et al.* (2012) found that rufa red knots outfitted with geolocators and recaptured in Massachusetts spent over half the year migrating, at stopovers, and wintering along the Atlantic Coast. While birds in this study crossed the OCS at least twice during long-distance flights, individuals crossed even more often on shorter flights (Burger *et al.* 2012). As described above, Loring *et al.* (2018) found that 17 percent (17 of 99) rufa red knots tagged in Massachusetts moved through Federal waters when staging or utilizing stopover areas during fall migration. Northbound migration movements were concentrated near Delaware Bay and western Long Island, and tagged individuals were detected by the tracking array moving between staging areas (Loring *et al*. 2020b). Some tagged birds also crossed Federal waters while flying between staging and stopover sites before continuing north to breeding grounds.

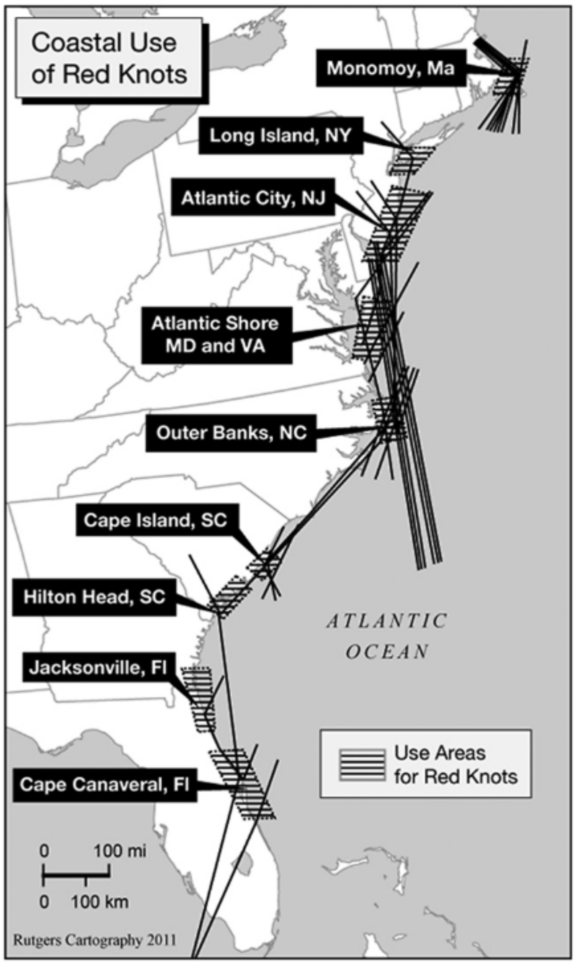

Figure 6. Figure 3 in Burger et al. (2012), illustrating areas used by rufa red knots on the Atlantic Coast.

In summary, rufa red knots from the SEC, NCSA, and Southern recovery units are known to occur in the action area, though we do not know if birds from these three regions use the airspace with similar frequency, timing, or altitudes. The available information indicates far greater numbers of rufa red knots cross the OCS on fall migration flights compared to spring migration flights. Best available information indicates substantial overlap between rufa red knot flight heights and the Revolution Wind RSZ.

<u>Summary</u>

The available tracking data shows both species using flight paths through or over the action area. We expect both species will fly through or over the action area annually during migrations, although likely numbers and flight paths will vary seasonally and annually. The Band (2012) and SCRAM (Gilbert et al. 2022) collision risk models have to make assumptions about likely numbers/density and likely flight paths or occupancy probability.

Factors Affecting the Species within the Action Area

Vessels

Commercial, military, recreational, and other vessels already frequent the waters in and around the action area. The COP (Volume I, Section 4.6.6) presents information on vessel traffic specific to the action area and reports that data collected by the Automatic Identification System show relatively low vessel density in the WTG area. The primary travel routes through the WTG area have an average of fewer than 10 transits per day. Routes with higher vessel traffic do not intersect the Lease Area.

Compared to WTGs, most vessels do not extend very high above the ocean surface and move at relatively slow speeds. Thus, we conclude that vessels do not present a collision hazard to listed birds in the action area. 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. Any such influences are likely greater on seasonally resident birds making lower-altitude movements within or across the OCS, compared to the typically higher-altitude migration flights.

Piping plovers and rufa red knots are not known to occur on the OCS with the exception of migration flights, and their exposure to vessels in the action area is limited. For these reasons, we conclude that vessel traffic in the action area has an insignificant effect on these species.

Climate Change

Variation in weather is a natural occurrence and is normally not considered a threat to native 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). However, the Environmental Baseline in this Opinion is limited to the boundaries of the action area, and we have insufficient information to assess the extent to which piping plovers and rufa red knots may be affected by changing climate in the action area.

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. 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. Indirect effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

Beneficial Effects

As discussed above, piping plovers and rufa red knots may be affected by climate change to varying degrees. Offshore wind energy projects may contribute to global efforts to slow and limit climate change, providing an indirect benefit to these species. However, we do not consider those benefits in our analysis of project effects. A 2008 Department of the Interior Solicitor's Opinion (M-37017)[2] cites a U.S. Geological Survey (USGS) finding that, "It is currently beyond the scope of existing science to identify a specific source of [carbon dioxide] emissions and designate it as the cause of specific climate impacts at an exact location." The Solicitor's Opinion went on to say, "Based on the USGS statement, and its continued scientific validity, we conclude that where the effect at issue is climate change in the form of increased temperatures, a proposed action that will involve the emission of greenhouse gas (GHG) cannot pass the "may affect" test and is not subject to consultation under the ESA and its implementing regulations." In formulating this biological opinion, we conclude that because it is inappropriate to consider effects from new or increased GHG emissions (in a Section 7 context), it is likewise inappropriate to consider potential beneficial effects to listed species from reduced or avoided GHG emissions.

Collision with Wind Turbine Generators

The only adverse effect evaluated in this Opinion is collision of listed birds with the Revolution Wind turbines. If a piping plover or rufa red knot collides with any of the WTGs, the individual likely would be injured or killed and take[3] would have occurred. Thus, this analysis focuses on the probability of collision occurring, and, if we anticipate collision, the likely number of affected birds. If we anticipate take, we will issue an incidental take statement (ITS) following this Opinion. The Service's standard for issuance of an ITS is "reasonable certainty" that take will occur (50 CFR 402.14(g)(7)). A conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available (50 CFR 402.17).

<u>Background</u>
Wind turbines are known to present a collision hazard to birds in flight (Drewitt and Langston 2006, Croll *et al.* 2022). The level of risk is associated with factors such as (1) the number, location, height, lighting, and operational time of the WTGs; (2) the population size and movement patterns of the bird species in question, its typical flight altitudes, and its ability to avoid collision; (3) the landscape setting (*e.g.*, topography on land, distance offshore); and (4)

[2] https://www.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/M-37017.pdf
[3] Section 3(19) of the ESA defines take as "…to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

weather conditions. For most species, collision risk levels vary seasonally and differ between day and night (Drewitt and Langston 2006, Croll *et al.* 2022). Collision risk levels may change over time as population sizes expand or contract and as prevalent bird behaviors, major flyways, or patterns of habitat usage change in response to environmental trends or human-driven factors. For example, over time birds may become acclimated and better able to avoid WTGs. Conversely, on a local or regional scale, additive or synergistic effects on collision risk levels may emerge as various offshore wind projects go into operation.

Piping plovers and rufa red knots eventually may encounter, and be forced to negotiate, up to 3,092 total WTGs 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 (Hildreth pers. comm. 2023). 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).

Avian collision rate is affected by turbine characteristics, migratory strategy, dispersal distance and habitat associations (Thaxter *et al.* 2017). Larger turbine capacity (megawatts) increased collision rates; however, deploying a smaller number of large turbines 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. Predicted collision rates were highest for Accipitriformes (most diurnal birds of prey, but not falcons). Thaxter *et al*. (2017 Appendix 6, Figure S9) identified order Charadriiformes as vulnerable but predicted collision risk within Charadriiformes as relatively low for charadriidae (plovers) and scolopacidae, which includes red knots.

<u>Available Collision Risk Models</u>

Technology currently does not exist to detect a collision of a bird with a WTG, and the likelihood of finding a bird carcass in the offshore environment is remote. Thus, until effective collision detection methods are available, we anticipate relying on collision risk modeling to estimate collision rates after construction (see Conservation Measures 4 and 7), as well as for pre-construction assessments including this effects analysis. A body of literature has developed and helps inform risk assessments for bird species. However, considerable uncertainty remains, in part, because most studies to date have been conducted at wind farms on land and/or in Europe. In the BA, the BOEM (2022a) presents results from two different models in order to estimate collision risk for listed birds from the Project. The second BA addendum (BOEM 2023b) provided updated collision risk estimates. The two models are Band (2012) and the SCRAM (Gilbert et al. 2022). We consider the outputs from both models in this analysis of effects and provide a description of the models' methods, limitations, and uncertainty in Appendix A.

Table 3. Estimated numbers of collisions over 35 Years of Revolution Wind WTG operation as projected by two different collision risk models. The SCRAM results show the estimate and 95 percent confidence interval. The air gap is measured between the water and lowest point of the WTG RSZ.

	Piping Plover	Rufa Red Knot
SCRAM 1.0.3		
131-foot (40 m) air gap	0.1 (0.0 – 0.3)	1,134 (927.5 – 1,368.5)
Band (2012)		
0.9297 avoidance rate		
131-foot (40 m) air gap	5	Wide corridor: 36 Narrow corridor: 125
0.980 avoidance rate		
131-foot (40 m) air gap	1	Wide corridor: 10 Narrow corridor: 36

The collision estimates presented in Table 3 do not account for any attraction of listed birds to the action area by marine navigation 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. Conservation Measure 2 provides for reassessment of collision projections for listed birds following approval of the maritime navigation lighting plan by the USCG.

<u>Piping Plover</u>

Table 3 presents a range of 0 to 5 piping plover collisions over the life of the Revolution Wind project. We conclude that the SCRAM estimates likely are too low based on the lack of spring data, the limited detection range of land-based receivers, and the limited tag deployment sites that were restricted to only one of the three recovery units covered by this Opinion.

Several factors suggest the possibility of a piping plover avoidance rate greater than 92.97 percent (Table 3). First, unlike the species studied by Cook (2021), piping plovers are not pelagic feeders. Hence, they will not be distracted by foraging activities during migration. Second, there is evidence of good nocturnal vision inferred by nocturnal foraging behavior (Staine and Burger 1994, Stantial and Cohen 2022) and nocturnal flights during the breeding season (Sherfy *et al*. 2012). Charadriidae (plovers) have specialized visual receptors and are known to possess excellent visual acuity with the ability to routinely forage during poor light conditions (del Hoyo *et al*. 2011), although other species with exceptional visual acuity (e.g., raptors) regularly collide with onshore WTGs. Third, agility of adult plovers has been observed in distraction displays, including abrupt flights to escape potential predators during broken-wing displays (Hecht pers. comm. 2023). How this agility translates to avoidance at the scale of a single WTG or a wind farm is unknown. Finally, preliminary data suggest that piping plovers favor high-visibility conditions when crossing the OCS. Loring *et al*. (2020a) found that visibility was high during their sample of southbound offshore piping plover flights (mean: 11 miles, range: 9 to 12 miles), although data from 2 birds tagged in the Bahamas and tracked during a portion of their northbound offshore flights included periods of low visibility and precipitation (Loring *et al.* 2019, Appendix I). Loring *et al*. (2020a) shows a range of southward migratory departure times and dates from Massachusetts and Rhode Island. Birds that departed on the same day often had variable flight durations to cover the similar distances. However, the overland route appears to be the predominant flyway. This information is consistent with informal observations of staggered arrivals and departures during both northward and southward migration and, in turn, reduces concerns that a large proportion of the plover population could simultaneously encounter weather conditions (*e.g.*, dense fog) that would impair visibility, exerting a large effect on the average avoidance rate (Hecht pers. comm. 2023).

We conclude that Atlantic Coast piping plovers are reasonably certain to collide with the Revolution Wind WTGs. Collision would result in injury or death. Absent additional information to estimate more precise avoidance rates, and given other data limitations described in Appendix A, we considered the full range of collision estimates presented in Table 3. However, considering the likely over- and underestimates of the models and the disparity between the model estimates, the best estimate is likely somewhere between the two models' outputs. We determined an average of the SCRAM estimate and the highest Band (2012) estimate would be reasonable. Accordingly, we anticipate that up to 3 piping plovers will collide with the turbines over the life of the Project. We note that this estimate is associated with high uncertainty, and we expect that it will be refined over time.

<u>Rufa Red Knot</u>
Table 3 presents a range of 10 to 1,134 rufa red knot collisions over the life of the Revolution Wind project. Several factors suggest a collision estimate on the higher end of this range is appropriate:

- Data gaps (*e.g*., lack of spring data, limited deployment areas, limited detection range of land-based receivers) bias SCRAM to underestimate collision.
- The Band (2012) estimates consider only two migration flights per bird per year, omitting regional flights over the OCS which are known to occur with some regularity. This would cause underestimation of collision risk.
- Between the wide and narrow Band (2012) corridors, we feel narrow is more scientifically sound, as it attempts to account for uneven distribution of birds across the migratory front.
- Gordon and Nations (2016) used an avoidance rate of 93 percent in good weather and 75 percent in poor weather. As discussed above, rufa red knot migration flights are typically

associated with fair weather (Loring *et al.* 2018), but birds have been known to encounter storms on their long flights (Niles *et al.* 2010, Niles 2014).

However, other factors suggest a collision estimate on the lower end of the range is appropriate.

- While Band (2012) assumes even distribution of birds across the migratory front, SCRAM accounts for the known spatial heterogeneity in rufa red knot tracks.
- While Band (2012) assumes each bird crosses the migratory front twice each year, SCRAM accounts for regional flights by seasonally resident birds, as it is informed by the full data set reported by Loring *et al.* (2018).
- Although important gaps still need to be addressed in the radio tracking data underpinning SCRAM, the sample sizes and distribution of tagging locations are far more robust for rufa red knots than for the other two listed birds, lending more weight to the SCRAM estimates.
- The lack of spring data in SCRAM is less consequential for rufa red knots than for the other two species, because a substantial fraction of birds fly overland in spring from the Atlantic Coast (Florida to Delaware Bay) directly to Hudson Bay in Canada.
- Certain aspects of SCRAM's methods for calculating occupancy probability and daily exposure to WTGs can result in higher collision numbers.

We conclude that rufa red knots are reasonably certain to collide with the Revolution Wind WTGs. Collision would result in injury or death. Absent additional information to estimate more precise avoidance rates, and given other data limitations described in Appendix A, we considered the full range of collision estimates presented in Table 3. However, considering the likely over- and under-estimates of the models and the disparity between the model estimates, the best estimate is likely somewhere between the two models' outputs. We determined an average of the SCRAM estimate and the highest Band (2012) estimate would be reasonable. Accordingly, we anticipate that up to 18 rufa red knots annually, and 630 over the life of the Project, would collide with the WTGs. We note that this estimate is associated with high uncertainty, and we expect that it will be refined over time.

CUMULATIVE EFFECTS

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 subject to consultation (50 CFR 402.02). We do not consider future Federal actions that are unrelated to the proposed action in this section because they require separate consultation pursuant to section 7 of the ESA.

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 action area that would have any appreciable effect on listed birds. We expect direct mortality of listed birds 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 pace 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. Moreover, emission of GHGs is generally not considered an action (in this case a State or private action) based only on its contribution to climate change, per the Department of the Interior Solicitor's Opinion M-37017. Therefore, we do not anticipate any cumulative effects.

JEOPARDY ANALYSIS

Section 7(a)(2) of the ESA requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. "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). Therefore, we have used those three aspects of the status of the piping plover and rufa red knot as the basis to assess the overall effect of the proposed action on the species.

Piping Plover

Individual Effects

We estimate that less than one piping plover annually, and up to 5 piping plovers over 35 years, would collide with WTGs in the Revolution Wind action area. We expect all of these collisions would result in death.

Population Effects

Extinction risk of Atlantic Coast piping plovers is highly sensitive to small changes in adult and/or juvenile survival rates (USFWS 2009). However, the 10-year (2012 to 2021) average population size across the Eastern Canada, New England, and NY-NJ recovery units combined was 1,600 pairs, or 3,200 birds (USFWS 2021a). Given this current abundance and long-term, increasing population trajectory, we conclude that loss of less than 1 individual annually and up to 3 birds over 35 years would be difficult to discern from natural population variation and would have an insignificant effect on the Atlantic Coast piping plover.

Reproduction and Numbers

The expected loss of piping plovers likely would be indistinguishable from normal population variation and would have an insignificant, if any, effect on piping plover numbers and reproduction.

Distribution
The proposed action would have an insignificant 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.

Recovery
Piping plover collisions at Revolution Wind may be most likely to affect the New England recovery unit, which, based its size, 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). The numerical odds suggest most of the projected collisions would come from the New England unit, and the loss of 3 birds over 35 years would not preclude recovery in this unit. However, even if all the plovers that collide with WTGs in Revolution wind are from the Eastern Canada unit, the average of 1 bird per decade would have an insignificant effect on the unit's population size and demographics and would not preclude recovery in the Eastern Canada unit. The NY-NJ unit would be intermediate in sensitivity between the Eastern Canada and New England recovery units, and, therefore, the proposed action would not preclude recover in this unit.

Rufa Red Knot

Individual Effects
We estimate that up to 18 rufa red knots annually, and up to 630 rufa red knots over 35 years, would collide with WTGs in the Revolution Wind action area. We expect all of these collisions would result in death.

Population Effects
Given the population abundance estimates shown in Table 2, and apparent population stability (USFWS 2014), we conclude that loss of 18 rufa red knots per year would have an insignificant effect on the rufa red knot. The southern wintering population is the smallest of the populations that may occur in the action area. Eighteen is 0.14 percent of this population, so even if all rufa red knots that collided with WTGs in the Project were from the southern population, the population-level effect would be insignificant. This hypothetical scenario is unlikely, and the impacts likely would be distributed across multiple populations.

Reproduction and Numbers
We consider the loss of 18 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 recruitment rate. ASMFS (2022) estimated that pairs are not successful at producing an adult bird every year. 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 23 birds (9 males, 9 females, 4.5 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 9 females could be around 27 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 (over 59,000 excluding western birds), and largely stable populations, the expected loss of rufa red knots would not have a substantial impact on reproduction and numbers.

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.

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 Revolution 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. Based on current demographic data, and potential effects of the Project, we conclude that the anticipated effects of the Project would not preclude recovery of the rufa red knot.

CONCLUSION

We considered the current overall rangewide status of the piping plover and rufa red knot 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 significant reduction in the reproduction, numbers, or distribution of these species. The Service's Opinion is that construction, operation, and decommissioning of the Revolution Wind offshore wind energy project, as proposed, is not likely to jeopardize the continued existence of the Atlantic Coast piping plover or the rufa red knot.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation 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. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering (50 CFR § 17.3). Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), 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 Revolution Wind project would cause take of piping plovers and rufa red knots by wounding and killing. This take would result from birds colliding with WTGs in the Revolution Wind portion of Renewable Energy Lease Area OCS-A 0486 over the 35-year life of the Project.

Based on likely collisions predicted by the two collision risk models, we anticipate:

1. up to 3 piping plovers would be wounded or killed due to collision mortality over 35 years; and
2. up to 18 rufa red knots annually, and 630 over the life of the Project, would be wounded or killed due to collision mortality over 35 years.

Absent additional information to estimate avoidance rates more precisely; account for limitations of the models; and, ultimately, determine the likely number of collisions; we considered and adopted the full range of collision estimates from Band (2012) and SCRAM. In the Effects of the Action section of the Opinion, we attempted to account for likely model estimate error, reconcile the disparate estimates of the two models, and develop a single number of likely collisions annually and over the life of the Project. These take numbers are associated with high uncertainty, and we expect the BOEM and the Service will refine them over time. However, they are our best estimates based on the best available information at this time.

Finding a dead or injured piping plover or rufa red knot is highly unlikely given the large area over which collisions could occur and the brief time carcasses would be available for discovery. Nevertheless, we must provide a level at which formal consultation would have to be reinitiated. Discovery of 1 dead piping plover and 7 dead rufa red knots for which the cause of death can be attributed to collision with a WTG at the Revolution Wind project would indicate that our anticipated amount of take was reached for the respective species, and the BOEM must contact our office immediately to determine if reinitiation of formal consultation is necessary. With better technology/methods to more efficiently detect collisions, it may be reasonable to revise these reinitiation triggers higher in the future.

REASONABLE AND PRUDENT MEASURES

The measures described below are nondiscretionary and must be undertaken by the BOEM so that they become binding conditions of any grant, permit, or other approval issued to Revolution

Wind (i.e., Orsted and Eversource), as appropriate, for the exemption in Section 7(o)(2) to apply. The BOEM, or other Federal agency (e.g., Bureau of Safety and Environmental Enforcement) under a transition of oversight responsibility, has a continuing duty to regulate the activity covered by this incidental take statement. If the BOEM (1) fails to assume and implement the terms and conditions, or (2) fails to require Revolution Wind 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. To monitor the impact of incidental take, the BOEM and/or Revolution Wind 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)(3)].

At this time, the Service is not aware of any specific physical 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 Revolution Wind project. Successful implementation of these RPMs could reduce the mitigation obligation outlined in the Description of the Proposed Action section of the accompanying Opinion.

The Service believes the following RPMs are necessary and appropriate to minimize take of piping plovers and rufa red knots.

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;[4] and

2. Implement those technologies and methods deemed reasonable and prudent to minimize collision risk.[5]

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the ESA, the BOEM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

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[4] 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.

[5] Reasonable and prudent minimization measures will include only actions that occur within the action area, involve only minor changes to the project, and reduce the projected level of take. Measures are reasonable and prudent when they (and their implementing terms and conditions) are consistent with the project's basic design, location, scope, duration, and timing (50 CFR 402.14(i)(2)). The reasonableness determination will consider both technical and economic factors; the test for reasonableness is whether the proposed measure would cause more than a minor change to the project. The prudency determination will consider the likelihood, based on best available information, of successfully and appreciably reducing bird collisions relative to the cost and technical difficulty of the measure. The BOEM and the Service will ensure that any reasonable and prudent measures and terms and conditions are within the legal authority and jurisdiction of the BOEM and Revolution Wind to carry out.

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

   a. Prior to the start of WTG operations at Revolution Wind, the BOEM must compile, from existing project documentation (*e.g.*, the BA, other consultation documents, the final EIS, the COP), a stand-alone summary of technologies and methods that the BOEM evaluated to reduce or minimize bird collisions at the Revolution Wind WTGs.

   b. Within 5 years of the start of WTG operation, and then every 5 years for the life of the project, the BOEM must prepare a Collision Minimization Report (CMR), 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 offshore and onshore WTGs. The review must be global in scope.

   c. The BOEM must distribute a draft CMR to the Service, Revolution Wind, and appropriate state agencies for a 60-day review period. The 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.

   d. Within 60 days of issuing the final CMR, the BOEM must convene a meeting with the Service, Revolution Wind, and appropriate state agencies to discuss the report and whether implementation of any technologies/methods are reasonable and prudent. The BOEM and the Service will consider input from the meeting participants and make the final determination of whether any measures are reasonable and prudent and should be implemented under RPM 2.

2. Implement those technologies and methods deemed reasonable and prudent to minimize collision risk.

   a. The BOEM will require Revolution Wind to adopt and deploy reasonable and prudent technologies and methods to avoid or minimize take of the piping plover and rufa red knot. Additional technology and methods would be required only if they are likely to appreciably reduce take of the piping plover and rufa red knot, in accordance with 50 CFR 402.14(i)(2). The BOEM will specify the Service-approved timeframe in which any required minimization measure(s) must be implemented, as well as any requirements to monitor, maintain, or adapt the measure(s) over time.

   b. The BOEM will require Revolution Wind to provide periodic reporting on the implementation of any minimization measure(s) according to a schedule developed by the BOEM and approved by the Service.

MONITORING AND REPORTING REQUIREMENTS

Pursuant to 50 CFR 402.14(i)(3), the BOEM must report the progress of the action and its impact on the species to the Service as specified in this ITS.

1. The BOEM or Revolution Wind shall monitor the action area for piping plovers and rufa red knots. As effective technology and methods become available, the BOEM should include monitoring for piping plovers and rufa red knots that may have collided with a WTG during migration. The monitoring method(s) should be informed by the best available information and technology and could include boat-based monitoring, Motus stations, remote sensing, cameras, microphones, Doppler and NEXRAD radar, eDNA, etc. The monitoring should occur during the time(s) of year when collisions are most likely. Initially, monitoring will proceed according to Revolution Wind's Avian and Bat Post-Construction Monitoring Framework and be operational for the first piping plover and rufa red knot migratory seasons after the WTGs are operational. Subsequently, consideration of new methods and timing will occur on the same timeline as the CMR described in the Terms and Conditions above unless the BOEM and the Service agree to a different schedule.

2. The BOEM shall notify the Service within two business days if an injured or dead piping plover or rufa red knot is identified in or within 1 mile of the Revolution Wind lease area.

3. The BOEM or Revolution Wind shall provide a report to the Service annually summarizing monitoring efforts, methods, and results; observations of injured or dead piping plovers and rufa red knots; observations of any listed species perching on Revolution Wind infrastructure (including offshore substations); implementation and effectiveness of avoidance and minimization measures; and any other relevant activity and information related to the proposed action and potential impacts to listed species. The BOEM will submit the report to the Service by the end of each calendar year or at another time agreed to by the two agencies. This report can be part of a larger, more comprehensive offshore wind report submitted to the Service annually.

4. Reports and notifications will be submitted to:

Field Supervisor
New England Field Office
U.S. Fish and Wildlife Service
70 Commercial Street, Suite 300
Concord, NH 03301
newengland@fws.gov
603-223-2541

Although finding a dead or injured piping plover or rufa red knot is unlikely, care must be taken in handling any dead specimens of listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead or injured specimen, notify the Service's New England Field Office at newengland@fws.gov and 603-223-2541.

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. Pursuant to 50 CFR 402.14(j), 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: Adopt compensatory mitigation ratios greater than 1:1.

As discussed throughout this Opinion, estimated levels of collision mortality are associated with high uncertainty. Future advancements in SCRAM are expected to substantially reduce, but not eliminate, uncertainty. In addition, compensatory mitigation actions will likely be associated with their own levels of uncertainty (*e.g.*, probability of success, actual number of bird mortalities offset), and may occur later in time that the project-induced mortality. Thus, we recommend a compensatory mitigation ratio greater than 1:1, particularly given the extent of full buildout of WTGs anticipated on the OCS.

Recommendation 2: Establish an Offshore Wind Adaptive Monitoring and Impact Minimization Framework to guide and coordinate monitoring, research, and avian impacts assessment coastwide.

To address Service concerns related to potential effects of WTG operation on listed and other species of concern, at both the project and coastwide scales, we recommend that the BOEM develop and adopt an Offshore Wind Adaptive Monitoring and Impact Minimization Framework (Framework) for flying wildlife. Many details will need to be worked out, but 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 the BOEM, the BSEE, the Service, State natural resource agencies responsible for management of birds, bats, and insect, 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;
   c. the species covered by the Framework; and
   d. the duration of the Framework.

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. 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 require the levels and types of mitigation deemed appropriate by the Principals Group.

10. Consider partnering with other stakeholders or cross-sector organizations to provide administrative, institutional, and technical support to the Principals Group.

Recommendation 3: 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. While we can use the Status of the Species section of a biological opinion to capture the anticipated effects of completed consultations, we cannot consider additive effects of concurrent, ongoing consultations. Even this creates a situation where the effects analysis for each individual offshore wind energy project cannot fully account for synergistic effects that may occur with nearby projects and especially not full build-out of offshore wind infrastructure along the coast.

Besides the two existing offshore wind energy facilities (Block Island Wind offshore Rhode Island and Coastal Virginia Offshore Wind), we understand there are 26 additional projects in various stages of development offshore the U.S. coast from Maine to Virginia. As the Department of the Interior continues moving toward the national goal of deploying 30 gigawatts of offshore wind by 2030, we anticipate still more projects beyond those 26 (*e.g.*, within the New York Bight, Central Atlantic, and Gulf of Maine). While the Service will complete a thorough assessment of potential direct and indirect effects for each individual offshore wind project, a coastwide analysis may indicate or suggest additive and/or synergistic effects among projects. Therefore, the Service recommends that the 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. A 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.

We request the BOEM notify us of the implementation of these conservation recommendations, so we are kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats.

REINITIATION NOTICE

This concludes formal consultation on the proposed construction, operation, and decommissioning of the Revolution Wind project. As provided in 50 CFR 402.16(a), reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of taking 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 previously considered; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion…; or (4) a new species is listed or critical habitat designated that may be affected by the identified 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.

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Appendix A. Collision Risk Models

Available Collision Risk Models
Technology currently does not exist to detect a collision of a bird with a wind turbine generator (WTG), and the likelihood of finding a bird carcass in the offshore environment is negligible. Thus, we anticipate relying on collision risk modeling to estimate collision rates after construction, as well as for pre-construction assessments including this effects analysis. The biological assessment (BOEM 2022a) presents results from two different models to estimate collision risk for listed birds from the Project. The two models are Band (2012) and the Stochastic Collision Risk Assessment for Movement (SCRAM).

Band (2012)

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 turbine details (*e.g.*, number, size, and rotation speed of blades). Band (2012) is an established method to assess collision risk for offshore wind farms. However, the Band (2012) model has several known limitations, summarized here from Masden (2015) and Masden and Cook (2016):

1. **Limited transparency.** The Excel spreadsheet that underpins the Band (2012) model does not allow for easy reproducibility or review of underlying code and data, thus hindering independent verification of results.
2. **Unable to account for variability, thus cannot reflect the inherent heterogeneity of the environment.** The Band (2012) model does not consider the natural variability of certain input parameters, such as bird flight speed and turbine rotor speed, which likely results in added uncertainty surrounding collision estimates.
3. **Deterministic.** Band (2012) is not a stochastic model, so it does not account for the stochasticity present in natural systems.
4. **Limited ability to quantify uncertainty.** Recent versions of the Band (2012) model guidance provide an approach under which uncertainty can be expressed, but its use is limited to cases in which sources of variability are independent of one another. Properly accounting for uncertainty becomes increasingly important as collision risk estimates are extrapolated over time, such as the 35-year lifespan of the Revolution Wind Project.

Stochastic Collision Risk Assessment for Movement (SCRAM)

The SCRAM builds on Band (2012) 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 (Gilbert *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 is informed by a fixed number of Motus tag detections that were collected from 2015 to 2017 for piping plovers and in

2016 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.* in prep). It is important to note that SCRAM currently evaluates collision risk only for those months with movement data from Motus.

Collection of movement data during the study periods 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 12 miles), 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 Service appreciates BOEM's past and ongoing support for the development of SCRAM and inclusion of Conservation Measure 3, above. We continue to support the development and refinement of SCRAM as a scientifically sound method for integrating best available information to assess collision risk for migratory birds. However, the first version of SCRAM was only released in early 2023 and still reflects consequential gaps and uncertainties. In addition to the limited data available to inform the model parameters, there has been limited validation of the model structure, resulting in substantial uncertainty in model results (Adams *et al.* in prep). 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 land-based receiving stations and are thus of limited accuracy because offshore bird movements were interpolated rather than measured directly. When evaluated via modeling, accuracy seems to improve the closer to shore and, in turn, the closer to most Motus stations; however, the detection range of receiving stations influence all movement estimates, nearshore and farther offshore. Estimates of flight altitude from Motus data are currently coarse approximations (Adams *et al.* in prep).
3. **Detection range.** The detection range of Motus receiving stations varies with altitude of the tagged bird but is typically less than 12 miles on average for birds in flight. Portions of the Revolution Wind lease area are well over the detection range from land-based receiving stations. Thus, there are gaps in coverage of the action area that could lead to inaccuracies in collision risk estimates.
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 (Adams *et al.* in prep). There are no spring data for piping plover or rufa red knot 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.

a. Piping plovers:
    i. Collision risk evaluated: mid-incubation period and through fall migratory departure from tagging sites
    ii. Collision risk NOT evaluated: latter portion of fall migratory flights, spring migration and staging
b. Red knots:
    i. Collision risk evaluated: fall migratory departure from tagging sites
    ii. Collision risk NOT evaluated: latter portion of fall migratory flights, spring migration and staging

5. **Spatial bias.** SCRAM assumes that modeled bird airspace use is unbiased. However, it is likely that collision risk outputs from SCRAM are biased by the proximity of a 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.* 2022). Variability in the location and operational status of Motus stations over the tracking study's timeframe resulted in biased estimates of bird use of the offshore airspace (Adams *et al.* in prep). Thus, SCRAM could inaccurately estimate collision risk for projects more distant from the tagging 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.* in prep). It is not yet clear if the bird tracks that underpin the current version of SCRAM are representative of all piping plovers and rufa red knots 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 two nesting areas in New England. No tracks from the Atlantic Canada portion of the piping plover breeding range, which is part of the taxon listed under the ESA and fully protected when they are in the U.S., are available yet. Preliminary results from a previous mark/resight study found that 42 percent of piping plovers marked in Atlantic Canada were subsequently detected in New Jersey, and 52 percent were detected in North Carolina (Rock pers comm. 2023). These Canadian nesters could have significant exposure to offshore wind that is not yet reflected in SCRAM collision risk estimates. Rufa red knot trapping sites covered a greater geographic area but still may not be fully representative of the overall population's use of the offshore airspace.
7. **Variability**. SCRAM cannot produce a range of plausible risk levels by varying certain "baked in" assumptions (*e.g.*, avoidance rate, population size, flight height) to which the model might be quite sensitive, and which are associated with high uncertainty.

We appreciate BOEM's cooperative efforts to work with the Service on the development of SCRAM with the goal of reducing uncertainty around collision risk estimates. We expect that many of the above-listed limitations of SCRAM will decrease substantially over time as Motus tags are deployed in more areas, as receiving stations are deployed offshore, and/or as new tracking technologies become available. However, at this time, given the substantial limitations described above, we conclude that SCRAM outputs should be only one factor in assessing collision risk, and must be supplemented by other sources of information in order to satisfy the ESA requirement to utilize best available scientific and commercial data.

Methods for Estimating Numbers of Collisions

Given the high uncertainty associated with both Band (2012) and SCRAM, as discussed above, we consider collision projections from both models. For SCRAM, we rely on an April 23, 2023, addendum to the BA in which the BOEM presents the outputs from SCRAM version 1.0.3. As discussed 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. To estimate monthly occupancy rates (within each half degree grid cell), SCRAM uses movement modeling derived from Motus tracking data and from them produces monthly population numbers to estimate species density in the Atlantic OCS, where tracking data were available. To estimate collision risk in areas of the Atlantic OCS where data are available (and in combination with Motus tracking), SCRAM uses the density estimates at specific flight altitudes along with other known species and site characteristics, such as flight speed and number of turbines in the area of interest (Adams *et al.* 2023 in prep).

For Band (2012), we input WTG specifications provided by the BOEM, 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.* in prep). We followed the guidance from Band (2012) to develop a best estimate, not a "worst case" scenario, and we used Annex 6 – Assessing collision risks for birds on migration. Although Annex 6 is unable to account for seasonally resident birds, we expect piping plovers and rufa red knots to only occur in the action area during migration flights. We conclude that Annex 6 is the most appropriate application of the Band (2012) model to Revolution Wind.

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. This "migratory front" is an imaginary line passing through the Wind Farm Area and extending to the western and eastern edges of the migratory corridor used by each species).

Regarding assumption 1, we conclude that it generally holds true that piping plovers 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 could violate this assumption by crossing the migratory front more than twice per year. Regarding assumption 2, we conclude from tracking data that migratory bird species do not evenly distribute across a migration corridor. However, we still find it necessary and appropriate to consider Band (2012) outputs given the known gaps in SCRAM.

We used best available tracking, range maps, and other data to inform the delineation of the migration corridors. For piping plover, the corridor was based on radio tracking data for birds departing from Chatham, Massachusetts, and several sites in Rhode Island (Loring *et al.* 2020a, figures 5 and 6) and the known wintering distribution of the Atlantic Coast population (Blanco 2012, Elliott-Smith *et al.* 2015, Gratto-Trevor *et al.* 2016, Elliot-Smith and Haig 2020). The piping plover corridor measures 164 miles (264 km) wide at the latitude of the Revolution Wind Lease Area.

For rufa red knot, we delineated two different migration corridors: wide and narrow. Both were based on geolocator tracking data collected from 93 individual birds (with tags deployed across the species range) between 2009 and 2017 (Perkins 2023). The wide corridor measures 1,407 miles (2,264 km) across at the latitude of the Revolution Wind Lease Area and encompasses all rufa red knot geolocator tracks, except those that are clearly associated with the Western recovery unit. The narrow corridor measures 232 miles (373 km) wide at the latitude of the Revolution Wind Lease Area and excludes two groups of geolocator tracks that were included in the wide corridor but that are far removed from the action area: (1) overland tracks between the Atlantic Coast (Florida to Delaware Bay) and Hudson Bay (Canada); and (2) tracks far offshore between the northern Atlantic Coast (Massachusetts to the Mingan Islands (Canada)) and northern Brazil. 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 corridors because the data are still undergoing quality control, and in many cases, metadata are 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 these two migration corridors. Likewise, GIS layers were unavailable for the migration tracks shown in Smith *et al.* (2023), but the migration pathways show in Figure 2 of that paper are broadly similar to those in Perkins (2023) and further support our delineations.

The final input required to run Band (2012), Annex 6, is the number of birds crossing the migratory front each month. Appendix Table 1 presents the population data we used for this purpose. All monthly numbers were multiplied by 35 to estimate number of collisions over the operational life of the Revolution Wind turbines.

Appendix Table 1. Population data inputs to Band (2012), Annex 6

	Piping Plover	**Rufa Red Knot (Wide)**	**Rufa Red Knot (Narrow)**
Total northbound (NB)	97,020	59,269	8,761
Young of the year (YOY)	64,190	27,041	27,041
Total southbound (SB)	161,210	86,310	74,835
# of Jan crossings	0	0	0
# of Feb crossings	0	0	0
# of Mar crossings	9,730 (10% of NB)	0	0
# of Apr crossings	58,170 (60% of NB)	0	0
# of May crossings	29,120 (30% of NB)	59,269 (100% of NB)	8,761 (100% of NB)
# of Jun crossings	16,205 (10% of SB)	2,371 (3% of SB)	2,118 (3% of SB)
# of Jul crossings	96,635 (60% of SB)	7,009 (8% of SB)	6,171 (8% of SB)
# of Aug crossings	48,370 (30% of SB)	25,893 (30% of SB)	22,450 (30% of SB)
# of Sep crossings	0	25,893 (30% of SB)	22,450 (30% of SB)
# of Oct crossings	0	15,651 (18% of SB)	13,413 (18% of SB)
# of Nov crossings	0	8,631 (10% of SB)	7,483 (10% of SB)
# of Dec crossings	0	863 (1% of SB)	748 (1% of SB)

Appendix Table 1 Notes:

Piping Plover:

(1) Population data are from 2021 (USFWS 2021a) and exclude an unknown (but likely small) number of nonbreeding birds.
(2) The Southern recovery unit population is excluded.
(3) The SB total includes 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.
(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. The eastern edge of the corridor south of Cape Hatteras is also constrained westward to account for much larger numbers of piping plovers wintering in the western Bahamas, although this has no effect on the width of the corridor at the latitude of the Revolution Wind Lease Area.

Rufa Red Knot

(1) Population data are from Table 2, above. Birds from the Western recovery unit population are sometimes documented on the Atlantic coast. However, available tracking and resighting data show that the prevailing migration corridor for these birds is overland across the mid-continent (Perkins 2023, USFWS 2021b, USFWS 2014). On this basis, birds from the Western recovery unit are excluded from this analysis.
(2) In many years, a percentage of northbound birds do not depart the mid-Atlantic until early June. But for the purposes of this analysis, we attribute them all to May.
(3) Some juveniles and nonbreeding adults remain south of the migration front, others cross the migration front once in spring and spend the breeding season just south of the breeding grounds, while still others may remain resident in the mid-Atlantic for prolonged periods and may cross the migration front multiple times. We have no estimate of the total number of nonbreeding adults in a typical year, or their distribution across the species nonbreeding range. However, we do estimate the total number of juveniles. Modeling by Schwarzer (2011) found that the Florida population was stable at around

8.75 percent juveniles among wintering birds, and available data suggest the three populations considered in this analysis are currently stable (USFWS 2021b). Thus, we assume 8.75 percent of the total wintering birds are juveniles (*i.e.*, of the 59,269 total birds, we assume 5,186 are juveniles.) We have little information on the distribution of juveniles across the species' range during any month. In light of data gaps, we assume all breeding adults, nonbreeding adults, and juveniles cross the migration front twice per year.

(4) The SB total includes YOY, calculated as 1 chick per pair. Number of pairs is calculated as [the total wintering population (59,269) minus juveniles (5,186)] divided by 2. We have no way to estimate nonbreeding adults, so we include them with breeding adults, then attempt to compensate by using a reproductive rate of 1 chick per pair, below the range estimated by Wilson and Morrison (2018) as needed for a stable population.

(5) Narrow corridor NB plus YOY does not add up to SB because different population segments were excluded in spring versus fall based on geolocator data.

(6) The narrow NB total is based on methodology[6] developed for the proposed critical habitat rule. This methodology for estimating the number of northbound migrants from the Atlantic coast of New Jersey through Maine—although based on best available information—is highly uncertain. We acknowledge that this estimate errs on the high side. Conversely, this estimate does not account for birds using mid-Atlantic stopovers (*e.g.*, Long Island, Atlantic coast of New Jersey, Delaware Bay, Virginia) that may make regional flights among these areas during their stay—flights that may cross the OCS.

(7) We subtracted the following from the wide SB total (86,310) to calculate the narrow SB total (74,835): 100 percent of 9,450 southbound birds flying far offshore from Mingan to Brazil (Lyons *et al.* 2017); and 45 percent of the 4,500 southbound birds that stop in Massachusetts and head directly to Brazil (Lyons *et al*. 2019;). The percent of birds leaving Monomoy to the southeast directly for Brazil is based on stable isotope analysis by Lyons *et al*. (2019), which cannot distinguish Brazil-wintering birds from Southeast/Caribbean-wintering birds. This method can only distinguish these northern-wintering birds from southern-wintering (Argentina/Chile). Thus, it is possible that the 45 percent is a low estimate, since tracking data suggest that all birds headed directly to Brazil (which may include both Brazil-wintering and Patagonia-wintering) leave Monomoy on a southeast heading far offshore, while those headed for the Southeast, Caribbean, and Venezuela leave on a southwest heading including flights along the OCS. However, the 45 percent is based on the current best available data.

Analysis of Model Outputs and Projected Numbers of Collisions

As discussed at length in the Opinion, 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, as applied specifically to each listed species, as discussed below. 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

[6] https://www.regulations.gov/document/FWS-R5-ES-2021-0032-0009

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."

SCRAM uses only one avoidance rate (0.927) for piping plover and rufa red knot (Adams *et al.* in prep). 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). The selection of 0.927 for use in SCRAM was based on a review of available literature for 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 SCRAM model. We are not aware of any empirical, species-specific avoidance rates available for piping plovers, rufa red knots, or other shorebirds.

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). In light of the sensitivity and uncertainty around this parameter, we consider a range of avoidance rates, consistent with the recommendation of Band (2012). However, based on Adams *et al*. (in prep), Band (2012), Gordon and Nations (2016), Kleyheeg-Hartman *et al.* (2018), SNH (2018), and Cook (2021), we primarily consider the 93 and 98 percent avoidance rates in our analysis.

Appendix B. Additional Conservation Measures Included in the Project Description

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 BA 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 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. Because Conservation Measures are part of the proposed action, their implementation is required under the terms of the consultation (USFWS and NMFS 1998). The following Conservation Measures have been adopted by BOEM (*i.e.*, in the BA and/or via subsequent correspondence) to abate collision risk to listed birds posed by operation of the Revolution Wind turbines. These measures also include an ongoing, long-term commitment to reduce the uncertainty associated with the estimated rates of collision mortality for each covered bird species.

1. Turbine Configuration

a. The WTG design provides a wind turbine air gap (minimum blade tip elevation to the sea surface) to minimize collision risk to marine birds[7] (*e.g.*, roseate terns) that may fly close to the ocean surface.

b. To minimize attracting birds (*e.g.*, roseate terns) to operating turbines, Revolution Wind must install bird perching-deterrent devices where such devices can be safely deployed on WTGs and OSSs. Revolution Wind must submit for BOEM and Service approval a plan to deter perching on offshore infrastructure by roseate terns and other marine birds. The location of bird-deterrent devices proposed by Revolution Wind must be based on best management practices applicable to the appropriate operation and safe installation of the devices. The plan must include the type(s) and locations of bird perching-deterrent devices, include a maintenance plan for the life of the project, allow for modifications and updates as new information and technology become available, and track the efficacy of the deterrents. The plan will be based on best available science regarding the effectiveness of perching deterrent devices on minimizing collision risk.

[7] 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.

2. Offshore Lighting

To aid safe navigation, Revolution Wind must comply with all Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM lighting, marking, and signage requirements.

a. Revolution Wind will use lighting technology that minimizes impacts on avian species to the extent practicable.

b. Revolution Wind will implement an ADLS on WTGs. Revolution Wind must use an FAA-approved vendor for the ADLS, which will activate the FAA hazard lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night. Revolution Wind must confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the Fabrication and Installation Report.

c. Revolution Wind is required to light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc around the structure. Conditional on USCG approval, and to minimize the potential of attracting migratory birds, the top of each USCG-required marine navigation light will be shielded[8] to minimize upward illumination. Coordination with the USCG regarding maritime navigation lighting occurs post-COP approval, generally at least 120 calendar days prior to installation. The Service will be afforded an opportunity to review[9] a copy of Revolution Wind's application to USCG to establish Private Aids to Navigation (PATON), which includes a lighting, marking, and signaling plan. The PATON application will include design specifications for maritime navigation lighting.

   Following approval of the PATON by the USCG, the BOEM and the Service will work together to evaluate the USCG-approved navigation lighting system, in order to characterize the color, intensity, and duration of any light from maritime lanterns that is likely to reach the typical flight heights of listed birds and will assess the degree to which the light is likely to attract or disorient listed birds. This information will be considered, as appropriate, in future estimates of projected collision levels (see Conservation Measure 4, below), in any future updates to the incidental take statement accompanying this BO, and in future iterations of the Compensatory Mitigation Plan (see Conservation Measure 7, below).

3. Collision Risk Model Support

The BOEM has funded the development of SCRAM, 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

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[8] The Service understands that the USCG-approved lights may not be shielded, per se, but that marine lanterns typically approved for this type of usage are designed to illuminate a horizonal plane near the sea surface, and do not direct light skyward.

[9] The Service may offer recommendations to USCG on the PATON application to minimize or reduce avian impacts. However, expertise and jurisdiction for ensuring safe navigation lay with USCG. No measures to minimize avian impacts will be adopted or pursued that are not deemed by USCG as fully compatible with safe navigation.

species. The first generation of SCRAM was released in early 2023 and still reflects a number of consequential data gaps and uncertainties. The BOEM has already committed to funding Phase 2 of the development of SCRAM. 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), and as modeling methods and computing power continue to improve. Via this Conservation Measure, the 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 the BOEM from Congress. This commitment will remain in effect until one of the following occurs:

i. the Revolution Wind turbines cease operation;
ii. the Service concurs that a robust weight of evidence has demonstrated that collision risks to all listed birds from Revolution Wind turbine operation are negligible (*i.e.*, the risk of take from WTG operation is found to be discountable); or
iii. the Service concurs that further development of SCRAM (or its successor) is unlikely to improve the accuracy or robustness of collision mortality estimates.

4. Collision Risk Model Utilization

The BOEM will work cooperatively with the Service to re-run the SCRAM model (or its successor) for the Revolution 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, the BOEM will <u>also</u> re-run the 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 Revolution Wind, and at any time as desired by the BOEM. Prior to each model run, the BOEM and the Service will reach agreement on model inputs based on best available science, and the agencies may opt for multiple model runs using a range of inputs to reflect uncertainties in the inputs.

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

i. the Revolution Wind turbines cease operation;
ii. the Service concurs that a robust weight of evidence has demonstrated that collision risks to all listed birds from Revolution Wind turbine operation are negligible (*i.e.*, the risk of take from WTG operation is found to be discountable); or
iii. the Service concurs that further model runs are unlikely to improve the accuracy or robustness of collision mortality estimates.

The BOEM is currently undertaking a programmatic analysis of proposed offshore wind activities in the New York Bight. To account for potential additive and synergistic effects of offshore wind infrastructure buildout across this section of the coast, the BOEM will consider collision mortality estimates for Revolution Wind in its assessment of overall collision risk for the New York Bight. The periodic updating of collision mortality estimates for Revolution Wind, according to the above schedule, may eventually be integrated into a regional or coastwide adaptive monitoring and impact minimization framework.

5. Monitoring and Data Collection

An avian species monitoring plan for ESA-listed species and/or other priority species or groups will be developed and coordinated appropriate state wildlife agencies and the Service and implemented as required.

The BOEM will require Revolution Wind to develop and implement an Avian and Bat[10] Post-Construction Monitoring Plan based on the Avian and Bat Post-Construction Monitoring Framework (COP Appendix AB) in coordination with the Service, appropriate state wildlife agencies, 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 or concurrent with offshore construction activities, Revolution Wind must submit an Avian and Bat Post-Construction Monitoring Plan for BOEM and Service review. The BOEM and the Service will review the Avian and Bat Post-Construction Monitoring Plan and provide any comments on the plan within 30 calendar days of its submittal. Revolution Wind must resolve all comments on the Avian and Bat Post-Construction Monitoring Plan to the satisfaction of the BOEM and the Service 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 (see Conservation Measure 7, below) or other project effects on target species.

a. Monitoring. Revolution Wind must conduct monitoring as outlined in the Avian and Bat Post- Construction Monitoring Framework (COP Appendix AA). Per the framework, Revolution Wind will "…install offshore Motus receiver stations and contribute funding to

[10] The post-construction monitoring framework and plan address listed and non-listed birds and bats. This BO 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 BO. 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 U.S.C. 703-712, as amended), and/or the National Environmental Policy Act (83 Stat. 852; 42 U.S.C. 4321 et seq.).

radio-tagging efforts." 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 Wildlife Tracking System (Motus) radio tags on listed birds, in conjunction with installation and operation of Motus receiving stations on turbines in the Lease Area, following offshore Motus recommendations. The initial phase may also include deployment of satellite-based tracking technologies (*e.g.*, GPS or Argos tags).

b. Annual Monitoring Reports. Revolution Wind must submit to the BOEM (at renewable_reporting@boem.gov), the Service, and the Bureau of Safety and Environmental Enforcement (BSEE) (at OSWSubmittals@bsee.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 must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. The BOEM, the Service, and the BSEE 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. The BOEM, the BSEE, and the Service reserve the right to require reasonable revisions to the Avian and Bat Post- Construction Monitoring Plan and may require new technologies as they become available for use in offshore environments (see Conservation Measure 5.d, below).

c. Post-Construction Quarterly Progress Reports. Revolution Wind must submit quarterly progress reports during the implementation of the Avian and Bat Post-Construction Monitoring Plan to the BOEM (at renewable_reporting@boem.gov) and the Service by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The progress reports must 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 (pursuant to Conservation Measure 5.b, above), Revolution Wind must meet with the BOEM, the BSEE, the Service, and appropriate state wildlife agencies 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, based on this annual review meeting, the BOEM and the Service jointly determine that revisions to the Avian and Bat Post-Construction Monitoring Plan are necessary, the BOEM will require Revolution Wind to modify the Avian and Bat Post-Construction Monitoring Plan. If the projected collision levels, as informed by monitoring results, deviate substantially from the effects analysis included in this BO, Revolution Wind must transmit to the 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 the 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 the 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. The BOEM will require Revolution Wind to continue implementation of appropriate monitoring activities for listed birds (under the current and future versions of the Avian and Bat Post-Construction Monitoring Plan) until (1) the Revolution Wind turbines cease operation; (2) the Service concurs that a robust weight of evidence has demonstrated that collision risks to all three listed birds from Revolution Wind turbine operation are negligible (*i.e.*, the risk of take from WTG operation is found to be discountable); or (3) 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 the BOEM and Revolution Wind to reduce or offset collision mortality (see Conservation Measure 7, below).

e. Operational Reporting (Operations). Revolution Wind must submit to the BOEM (at renewable_reporting@boem.gov) and the BSEE (at OSWSubmittals@bsee.gov) an annual report summarizing monthly operational data calculated from 10-minute supervisory control and data acquisition (SCADA) data for all turbines together in tabular format: the proportion of time the turbines were actually spinning each month, the average rotor speed (monthly revolutions per minute) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. The BOEM and the BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the effects analysis included in this BO.

f. Raw Data. Revolution Wind must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to the BOEM, the BSEE, and the Service, upon request for the duration of the lease. Revolution Wind must work with the 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 the BOEM 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.

6. Incidental Mortality Reporting[11]

Revolution Wind must provide an annual report to the BOEM and the Service documenting any dead (or injured) birds or bats found on vessels and structures or in the ocean during construction, operations, and decommissioning. The report must contain the following information: the name of species (if possible), date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with Federal or research bands must be reported to the United States Geological Survey's (USGS) Bird Banding Laboratory. Any occurrence of a dead ESA-listed bird or bat must be reported to the BOEM, the BSEE, 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 any necessary wildlife permits and compliance with Revolution Wind health and safety standards.

7. Compensatory Mitigation

To minimize population-level effects on listed birds, the BOEM will require Revolution Wind to provide appropriate compensatory mitigation as needed to offset projected levels of take of listed birds from WTG collision. Compensatory mitigation will be consistent with the conservation needs of listed species as identified in Service documents including, but not limited to: listing documents, Species Status Assessments, Recovery Plans, Recovery Implementation Strategies (RISs), and 5- Year Reviews. Compensatory mitigation will preferentially address priority actions, activities, or tasks identified in a Recovery Plan, RIS, or 5-Year Review, for each of the listed bird species; however, research, monitoring, outreach, and other recovery efforts that do not materially offset birds lost to collision mortality will not be considered compensatory mitigation. Compensatory mitigation may include, but is not limited to: restoration or management of lands, waters, sediment, vegetation, or prey species to improve habitat quality or quantity for listed birds; efforts to facilitate habitat migration or otherwise adapt to sea level rise; predator management; management of human activities to reduce disturbance to listed birds; and efforts to curtail other sources of direct human-caused bird mortality such as from vehicles, collision with other structures (*e.g.*, power lines, terrestrial wind turbines), hunting, oil spills, and harmful algal blooms. Geographic considerations may include, but are not limited to: (a) any

[11] Incidental observations are extremely unlikely to document any fatalities of listed birds that may occur due to turbine collision. While this Conservation Measures 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 turbine unless there is evidence to support this conclusion.

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. Compensatory mitigation for Revolution Wind may be combined with mitigation associated with other offshore wind projects, but in no case will compensatory mitigation be double counted as applying to more than one offshore wind project.

The BOEM will require Revolution Wind to prepare a Compensatory Mitigation Plan prior to the start of WTG operation. At a minimum, the Plan will provide compensatory mitigation actions to offset projected levels of take of listed birds for the first 5 years of WTG operation at a ratio of 1:1. At its discretion, Revolution Wind may include actions to offset projected take over a longer time period and/or at a higher ratio. The Plan will include:

a. detailed description of one or more specific mitigation actions;
b. the specific location for each action;
c. a timeline for completion;
d. itemized costs;
e. a list of necessary permits, approvals, and permissions;
f. details of the mitigation mechanism (*e.g.*, mitigation agreement, applicant-proposed mitigation);
g. best available science linking the compensatory mitigation action(s) to the projected level of collision mortality as described in this BO;
h. a schedule for completion; and
i. monitoring to ensure the effectiveness of the action(s) in offsetting the target level of take.

Plan development and implementation will occur according to the following schedule:

a. At least 180 days before the start of WTG operation, Revolution Wind will distribute a draft Plan to the BOEM, the Service, appropriate state wildlife agencies, and other identified stakeholders or interested parties, for a 60-day review period.
b. At least 90 days before the start of WTG operation, Revolution Wind will transmit a revised Plan for approval by the BOEM and the Service, along with a record of comments received on the draft. Revolution Wind will rectify any outstanding agency comments or concerns before final approval by the BOEM and the Service.
c. Before or concurrent with the start of WTG operation, Revolution Wind will provide documentation to the BOEM and the Service showing financial, legal, or other binding commitment(s) to Plan implementation.

The BOEM will require Revolution Wind to prepare and implement a new Plan every 5 years for the life of the project, according to a schedule developed by the BOEM and approved by the Service. Compensatory mitigation actions included in each new Plan will reflect:

a. the level and effectiveness of mitigation previously provided by Revolution Wind, to date;
b. the level of take over the next 5 years as projected by SCRAM (or its successor) (see Conservation Measure 4);
c. current information regarding any effects of offshore lighting (see Conservation Measure 2);

and

d. the effectiveness of any minimization measures that have been implemented as required by the reasonable and prudent measures included in the Incidental Take Statement accompanying this Opinion.