Maryland Offshore Wind Project
Biological Assessment

For the Fish and Wildlife Service
December 2023

Appendices

Appendix A: USFWS Information for Planning and Consultation (IPaC) Threatened and Endangered Species Results and Consistency Letter

Appendix B: Band Model Inputs and Outputs

Appendix C: STOCHASTIC Collision Risk Assessment for Movement Inputs and Outputs

U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

BOEM
Bureau of Ocean Energy Management

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Ecological Services Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401-7307
Phone: (410) 573-4599 Fax: (410) 266-9127

In Reply Refer To:
Project Code: 2024-0020701
Project Name: Maryland Offshore Wind Project

November 29, 2023

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Coastal Barriers
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Chesapeake Bay Ecological Services Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401-7307
(410) 573-4599

PROJECT SUMMARY

Project Code: 2024-0020701
Project Name: Maryland Offshore Wind Project
Project Type: Power Gen - Wind - Offshore
Project Description: The construction and installation, operations and maintenance, and conceptual decommissioning of a proposed offshore wind energy facility within BOEM's Renewable Energy Lease Area OCS-A 0490 with a maximum nameplate capacity of up to 2,000 megawatts (MW), as well as associated submarine and upland cables connecting the wind facility to the proposed substations located in Sussex County, Delaware. Onshore support facilities would be located at existing waterfront industrial or commercial sites within the Ocean City, Maryland area.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@38.429387399999996,-74.80752420681341,14z

Counties: Delaware and Maryland

ENDANGERED SPECIES ACT SPECIES

There is a total of 6 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 3 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

BIRDS

NAME	STATUS
Eastern Black Rail *Laterallus jamaicensis ssp. jamaicensis*	Threatened
No critical habitat has been designated for this species. This species only needs to be considered under the following conditions: ▪ Potential habitat for Black Rail exists in this area. Species profile: https://ecos.fws.gov/ecp/species/10477	
Piping Plover *Charadrius melodus*	Threatened
Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. This species only needs to be considered under the following conditions: ▪ Only offshore wind projects need to be considered in this area. Species profile: https://ecos.fws.gov/ecp/species/6039	
Roseate Tern *Sterna dougallii dougallii*	Endangered
Population: Northeast U.S. nesting population No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2083	
Rufa Red Knot *Calidris canutus rufa*	Threatened
There is **proposed** critical habitat for this species. This species only needs to be considered under the following conditions: ▪ Only offshore wind projects need to be considered in this area. Species profile: https://ecos.fws.gov/ecp/species/1864	

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

FLOWERING PLANTS

NAME	STATUS
Seabeach Amaranth *Amaranthus pumilus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8549	Threatened

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

COASTAL BARRIERS

Projects within the John H. Chafee Coastal Barrier Resources System (CBRS) may be subject to the restrictions on Federal expenditures and financial assistance and the consultation requirements of the Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 et seq.). For more information, please contact the local Ecological Services Field Office or visit the CBRA Consultations website. The CBRA website provides tools such as a flow chart to help determine whether consultation is required and a template to facilitate the consultation process.

UNIT	NAME	TYPE	SYSTEM UNIT ESTABLISHMENT DATE	FLOOD INSURANCE PROHIBITION DATE
DE-07	Delaware Seashore	UNKNOWN	12/21/2018	11/16/1991
DE-07P	Delaware Seashore	UNKNOWN	N/A	11/16/1991
DE-07P	Delaware Seashore	UNKNOWN	N/A	12/21/2018

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

ESTUARINE AND MARINE DEEPWATER

- E1UBL
- E1UBLx
- M1UBL

FRESHWATER FORESTED/SHRUB WETLAND

- PSS4/1S
- PFO4S

ESTUARINE AND MARINE WETLAND

- E2EM1Nd
- E2EM1N
- M2US2N
- E2EM1Pd

IPAC USER CONTACT INFORMATION

Agency: Private Entity
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State: MD
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LEAD AGENCY CONTACT INFORMATION

Lead Agency: Bureau of Ocean Energy Management

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Ecological Services Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401-7307
Phone: (410) 573-4599 Fax: (410) 266-9127

In Reply Refer To: November 30, 2023
Project code: 2024-0020701
Project Name: Maryland Offshore Wind Project

Federal Nexus: yes
Federal Action Agency (if applicable): Bureau of Ocean Energy Management

Subject: Technical assistance for 'Maryland Offshore Wind Project'

Dear Melinda Todorov:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on November 30, 2023, for “Maryland Offshore Wind Project” (here forward, Project). This project has been assigned Project Code 2024-0020701 and all future correspondence should clearly reference this number.

The Service developed the IPaC system and associated species’ determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into the IPaC must accurately represent the full scope and details of the Project. Failure to accurately represent or implement the Project as detailed in IPaC or the Northeast Determination Key (Dkey), invalidates this letter. ***Answers to certain questions in the DKey commit the project proponent to implementation of conservation measures that must be followed for the ESA determination to remain valid.***

To make a no effect determination, the full scope of the proposed project implementation (action) should not have any effects (either positive or negative effect(s)), to a federally listed species or designated critical habitat. 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. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17). Under Section 7 of the ESA, if a federal action agency makes a no effect determination, no further consultation with, or concurrence from, the Service is required (ESA §7). If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required (except when the Service concurs, in writing, that a

proposed action "is not likely to adversely affect (NLAA)" listed species or designated critical habitat [50 CFR §402.02, 50 CFR§402.13]).

The IPaC results indicated the following species is (are) potentially present in your project area and, based on your responses to the Service's Northeast DKey, you determined the proposed Project will have the following effect determinations:

Species	**Listing Status**	**Determination**
Eastern Black Rail (*Laterallus jamaicensis ssp. jamaicensis*)	Threatened	May affect
Piping Plover (*Charadrius melodus*)	Threatened	May affect
Roseate Tern (*Sterna dougallii dougallii*)	Endangered	May affect
Rufa Red Knot (*Calidris canutus rufa*)	Threatened	May affect
Seabeach Amaranth (*Amaranthus pumilus*)	Threatened	No effect

Consultation with the Service is not complete. Further consultation or coordination with the Service is necessary for those species or designated critical habitats with a determination of "May Affect". Please contact our Chesapeake Bay Ecological Services Field Office to discuss methods to avoid or minimize potential adverse effects to those species or designated critical habitats.

In addition to the species listed above, the following species and/or critical habitats may also occur in your project area and are not covered by this conclusion:

- Monarch Butterfly *Danaus plexippus* Candidate

Please Note: If the Action may impact bald or golden eagles, additional coordination with the Service under the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d) by the prospective permittee may be required. Please contact the Migratory Birds Permit Office, (413) 253-8643, or PermitsR5MB@fws.gov, with any questions regarding potential impacts to Eagles.

If you have any questions regarding this letter or need further assistance, please contact the Chesapeake Bay Ecological Services Field Office and reference the Project Code associated with this Project.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

Maryland Offshore Wind Project

2. Description

The following description was provided for the project 'Maryland Offshore Wind Project':

> The construction and installation, operations and maintenance, and conceptual decommissioning of a proposed offshore wind energy facility within BOEM's Renewable Energy Lease Area OCS-A 0490 with a maximum nameplate capacity of up to 2,000 megawatts (MW), as well as associated submarine and upland cables connecting the wind facility to the proposed substations located in Sussex County, Delaware. Onshore support facilities would be located at existing waterfront industrial or commercial sites within the Ocean City, Maryland area.

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@38.429387399999996,-74.80752420681341,14z

QUALIFICATION INTERVIEW

1. As a representative of this project, do you agree that all items submitted represent the complete scope of the project details and you will answer questions truthfully?

   Yes

2. Does the proposed project include, or is it reasonably certain to cause, intentional take of listed species?

   Note: This question could refer to research, direct species management, surveys, and/or studies that include intentional handling/encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered, or proposed species.

   No

3. Is the action authorized, permitted, licensed, funded, or being carried out by a Federal agency in whole or in part?

   Yes

4. Is the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), or Federal Transit Administration (FTA) the lead agency for this project?

   No

5. Are you including in this analysis all impacts to federally listed species that may result from the entirety of the project (not just the activities under federal jurisdiction)?

   Note: If there are project activities that will impact listed species that are considered to be outside of the jurisdiction of the federal action agency submitting this key, contact your local Ecological Services Field Office to determine whether it is appropriate to use this key. If your Ecological Services Field Office agrees that impacts to listed species that are outside the federal action agency's jurisdiction will be addressed through a separate process, you can answer yes to this question and continue through the key.

   Yes

6. Are you the lead federal action agency or designated non-federal representative requesting concurrence on behalf of the lead Federal Action Agency?

   Yes

7. Is the lead federal action agency the Environmental Protection Agency (EPA) or Federal Communications Commission (FCC)?

   No

8. Is the lead federal action agency the Federal Energy Regulatory Commission (FERC)?

   No

9. Will the proposed project involve the use of herbicide where listed species are present?

   No

10. Are there any caves or anthropogenic features suitable for hibernating or roosting bats within the area expected to be impacted by the project?

    Yes

11. Does any component of the project associated with this action include structures that may pose a collision risk to **birds** (e.g., land-based or offshore wind turbines, communication towers, high voltage transmission lines, any type of towers with or without guy wires)?

    Note: For federal actions, answer ‘yes’ if the construction or operation of wind power facilities is either (1) part of the federal action or (2) would not occur but for a federal agency action (federal permit, funding, etc.).

    Yes

12. Does any component of the project associated with this action include structures that may pose a collision risk to **bats** (e.g., land-based wind turbines)?

    Note: For federal actions, answer ‘yes’ if the construction or operation of wind power facilities is either (1) part of the federal action or (2) would not occur but for a federal agency action (federal permit, funding, etc.).

    Yes

13. Will the proposed project result in permanent changes to water quantity in a stream or temporary changes that would be sufficient to result in impacts to listed species?

    For example, will the proposed project include any activities that would alter stream flow, such as water withdrawal, hydropower energy production, impoundments, intake structures, diversion structures, and/or turbines? Projects that include temporary and limited water reductions that will not displace listed species or appreciably change water availability for listed species (e.g. listed species will experience no changes to feeding, breeding or sheltering) can answer "No". Note: This question refers only to the amount of water present in a stream, other water quality factors, including sedimentation and turbidity, will be addressed in following questions.

    No

14. Will the proposed project affect wetlands where listed species are present?

    This includes, for example, project activities within wetlands, project activities within 300 feet of wetlands that may have impacts on wetlands, water withdrawals and/or discharge of contaminants (even with a NPDES).

    No

15. Will the proposed project activities (including upland project activities) occur within 0.5 miles of the water's edge of a stream or tributary of a stream where listed species may be present?

    No

16. Will the proposed project directly affect a streambed (below ordinary high water mark (OHWM)) of the stream or tributary where listed species may be present?

    No

17. Will the proposed project bore underneath (directional bore or horizontal directional drill) a stream where listed species may be present?

    Yes

18. Will the proposed project involve a new point source discharge into a stream or change an existing point source discharge (e.g., outfalls; leachate ponds) where listed species may be present?

    No

19. Will the proposed project involve the removal of excess sediment or debris, dredging or in-stream gravel mining where listed species may be present?

    No

20. Will the proposed project involve the creation of a new water-borne contaminant source where listed species may be present?

    Note New water-borne contaminant sources occur through improper storage, usage, or creation of chemicals. For example: leachate ponds and pits containing chemicals that are not NSF/ANSI 60 compliant have contaminated waterways. Sedimentation will be addressed in a separate question.

    No

21. Will the proposed project involve perennial stream loss, in a stream of tributary of a stream where listed species may be present, that would require an individual permit under 404 of the Clean Water Act?

    No

22. Will the proposed project involve blasting where listed species may be present?

    No

23. Will the proposed project include activities that could negatively affect fish movement temporarily or permanently (including fish stocking, harvesting, or creation of barriers to fish passage).

    No

24. Will the proposed project involve earth moving that could cause erosion and sedimentation, and/or contamination along a stream or tributary of a stream where listed species may be present?

    Note: Answer "Yes" to this question if erosion and sediment control measures will be used to protect the stream.

    No

25. Will earth moving activities result in sediment being introduced to streams or tributaries of streams where listed species may be present through activities such as, but not limited to, valley fills, large-scale vegetation removal, and/or change in site topography?

    No

26. Will the proposed project involve vegetation removal within 200 feet of a perennial stream bank where aquatic listed species may be present?

    No

27. Will erosion and sedimentation control Best Management Practices (BMPs) associated with applicable state and/or Federal permits, be applied to the project? If BMPs have been provided by and/or coordinated with and approved by the appropriate Ecological Services Field Office, answer "Yes" to this question.

    Yes

28. Is the project being funded, lead, or managed in whole or in part by U.S Fish and Wildlife Restoration and Recovery Program (e.g., Partners, Coastal, Fisheries, Wildlife and Sport Fish Restoration, Refuges)?

    No

29. Will the proposed project result in changes to beach dynamics that may modify formation of habitat over time?

    Note: Examples of projects that result in changes to beach dynamics include 1) construction of offshore breakwaters and groins; 2) mining of sand from an updrift ebb tidal delta; 3) removing or adding beach sands; and 4) projects that stabilize dunes (including placement of sand fences or planting vegetation).

    No

30. [Hidden Semantic] Is the project area located within the piping plover AOI?

    Automatically answered
    Yes

31. [Hidden Semantic] Is the project area located within the piping plover AOI?

    Automatically answered
    Yes

32. [Hidden Semantic] Is the project area located within the red knot AOI?

    Automatically answered
    Yes

33. [Hidden Semantic] Is the project area located within the roseate tern AOI?

    Automatically answered
    Yes

34. [Hidden Semantic] Is the action area located within the seabeach amaranth AOI?

    Automatically answered
    Yes

35. If you have determined that seabeach amaranth is unlikely to occur within your project's action area or that your project is unlikely to have any potential effects on the seabeach amaranth, you may wish to make a "no effect" determination for the seabeach amaranth. Additional guidance on how to make this decision can be found in the project review section of your local Ecological Services Field Office's website. CBFO: https://www.fws.gov/office/chesapeake-bay-ecological-services/project-review ; MEFO: https://www.fws.gov/office/maine-ecological-services ; NJFO: https://www.fws.gov/office/new-jersey-ecological-services/new-jersey-field-office-project-review-guide ; NEFO: https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review#Step5 ; WVFO: https://www.fws.gov/office/west-virginia-ecological-services/project-planning. If you are unsure, answer "No" and continue through the key.

    Would you like to make a no effect determination for the seabeach amaranth?

    Yes

36. [Semantic] Does the project intersect the Virginia big-eared bat critical habitat?

    Automatically answered

    No

37. [Semantic] Does the project intersect the Indiana bat critical habitat?

    Automatically answered

    No

38. [Semantic] Does the project intersect the candy darter critical habitat?

    Automatically answered

    No

39. [Semantic] Does the project intersect the diamond darter critical habitat?

    Automatically answered

    No

40. [Semantic] Does the project intersect the Big Sandy crayfish critical habitat?

    Automatically answered

    No

41. [Hidden Semantic] Does the project intersect the Guyandotte River crayfish critical habitat?

    Automatically answered

    No

42. [Hidden Semantic] Does the project intersect the Eastern black rail AOI?

    Automatically answered

    Yes

43. Does the action area include persistent emergent wetlands (salt, brackish, or freshwater)?

    No

44. Does the action area include undeveloped upland areas within 500 feet of persistent emergent wetlands (salt, brackish, or freshwater)?

    Yes

45. Have black rails or black rail habitat been identified in sufficient detail in available surveys or records from within the last 2 years to assume presence at the site? (If unsure, select "No".)

    No

46. Will the proposed project involve activities conducted in persistent emergent wetlands (salt, brackish or freshwater) that may result in permanent or long-term (greater than 1 month) modifications to hydrology (flood frequency or depth)?

    No

47. Will the proposed project involve activities conducted in persistent emergent wetlands (salt, brackish or freshwater) that may result in permanent or long-term (longer than 1 growing season) modifications to vegetation type?

    No

48. Will the proposed project involve activities conducted in persistent emergent wetlands (salt, brackish or freshwater) that may result in permanent or long-term (longer than 1 growing season) reduction of dense overhead cover of persistent emergent wetland vegetation to less than 50% of habitat, in any given calendar year?

    No

49. Does the proposed project include prescribed burns in marshy or flooded open field habitat?

    No

50. Does the project include mowing, haying, and/or other mechanical treatment activities in marshy or flooded open field habitat?

    No

51. Does the project include grazing activities on public lands containing marshy or flooded open field habitat?

    No

52. Will the project cause long-term or permanent damage, fragmentation, or conversion of eastern black rail habitat?

    No

53. Will the project cause long-term or permanent damage, fragmentation, or conversion of the contiguous wetland-upland transition zone to other habitat types or land uses (e.g., between upland habitat and wetland habitat) for eastern black rail?

    No

54. Will any part of the project take place between March 15 and May 15 OR between July 15 and October 1?

    Yes

55. Do you have any other documents that you want to include with this submission?

    No

PROJECT QUESTIONNAIRE

1. Approximately how many acres of trees would the proposed project remove?

   13.57

2. Approximately how many total acres of disturbance are within the disturbance/ construction limits of the proposed project?

   19.04

3. Briefly describe the habitat within the construction/disturbance limits of the project site.

   Land surrounding the Indian River substation within the construction/disturbance limits is forested, except for the Indian River Power Plant and electrical transmission ROWs that serve it. The Proposed Action landfall location is on a barrier island in Sussex County approximately 1 mile (1.6 kilometers) south of the Indian River Inlet, within a parking area associated with 3R's Beach.

IPAC USER CONTACT INFORMATION

Agency: Private Entity
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State: MD
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LEAD AGENCY CONTACT INFORMATION

Lead Agency: Bureau of Ocean Energy Management

COLLISION RISK ASSESSMENT
Sheet 1 - Input data

used in overall collision risk sheet
used in migrant collision risk sheet
used in single transit collision risk sheet or extended model
used in available hours sheet
used in large array correction sheet
not used in calculation but stated for reference

	Units	Value	Data sources	Source
Bird data				
Species name		**Piping plover**		
Bird length	m	0.17		Gilbert et al 2022, Table A12
Wingspan	m	0.38		Gilbert et al 2022, Table A12
Flight speed	m/sec	9.3		Gilbert et al 2022, Table A12
Nocturnal activity factor (1-5)		4		Loring et al 2019, Fig 66; value = 4
Flight type, flapping or gliding		flapping		

Bird survey data			Data sources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daytime bird density	birds/sq km														
Proportion at rotor height	%														
Proportion of flights upwind	%	8.6%													

Birds on migration data			Data sources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Migration passages	birds					405	405	405			1938					Adult & fledgings derived from USFWS 2022, P.Loring et al 2019
Width of migration corridor	km	19														Measured from COP, Vol II, Figure 1-1
Proportion at rotor height	%	15%														Loring et al 2019, Table 26
Proportion of flights upwind	%	8.6%														Loring et al 2019, Fig 72

	Units	Value	Data sources	Source
Windfarm data				
Name of windfarm site		**US Wind**		
Latitude	degrees	38.36		
Number of turbines		114		COP, Table 2-1. WTG Envelope
Width of windfarm	km	19		Measured from COP, Vol II, Figure 1-1
Tidal offset	m	1		

	Units	Value	Data sources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Source
Turbine data																
Turbine model		**18MW**														COP, Table 2-1. WTG Envelope
No of blades		3														
Rotation speed	rpm	7.56														Gaertner et al 2020, Table ES-2
Rotor radius	m	125														COP, Table 2-1. WTG Envelope, calc
Hub height	m	144														COP, Table 2-1. WTG Envelope, =36 air gap + 125 rotor radius
Monthly proportion of time operational	%			83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	see note
Max blade width	m	5.770														Gaertner et al 2020, Table ES-2
Pitch	degrees	1														

Avoidance rates used in presenting results			Data sources (if applicable)
	95.01%	X	Cook 2021, Table A2 “All Gulls and Terns” Extended Band (2012) model
	98.00%		
	99.00%		
	99.50%		

COLLISION RISK ASSESSMENT (BIRDS ON MIGRATION)

Sheet 2 - Overall collision risk

All data input on Sheet 1:
no data entry needed on this sheet!
other than to choose option for final tables

from Sheet 1 - input data
from Sheet 6 - available hours
from Sheet 3 - single transit collision risk
from survey data
calculated field

Bird details:

Species		Piping plover
Flight speed	m/sec	9.3
Flight type		flapping

Windfarm data:

Number of turbines		114
Rotor radius	m	125
Minimum height of rotor	m	144
Total rotor frontal area	sq m	5595962

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year average
Proportion of time operational	%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83.3%
Stage A - flight activity														**per annum**
Migration passages		0	0	405	405	405	0	0	1938	0	0	0	0	**3153**
Migrant flux density	birds/ km	0	0	21.316	21.316	21.31579	0	0	102	0	0	0	0	
Proportion at rotor height	%	15%												
Flux factor		0	0	477	477	477	0	0	2283	0	0	0	0	
Option 1 -Basic model - Stages B, C and D														
Potential bird transits through rotors		0	0	73	73	73	0	0	347	0	0	0	0	**565**
Collision risk for single rotor transit	(from sheet 3)	3.4%												
Collisions for entire windfarm, allowing for non-op time, assuming no avoidance	birds per month or year	**0**	**0**	**2**	**2**	**2**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**16**
Option 2-Basic model using proportion from flight distribution		**0**	**0**	**4**	**4**	**4**	**0**	**0**	**21**	**0**	**0**	**0**	**0**	**34**
Option 3-Extended model using flight height distribution														
Proportion at rotor height	(from sheet 4)	33.1%												
Potential bird transits through rotors	Flux integral	0.3681	0	0	176	176	176	0	0	840	0	0	0	0	**1367**
Collisions assuming no avoidance	Collision integral	0.01666	**0**	**0**	**7**	**7**	**7**	**0**	**0**	**32**	**0**	**0**	**0**	**0**	**52**
Average collision risk for single rotor transit		4.5%												
Stage E - applying avoidance rates														
Using which of above options?	**Option 3**	0.00%	0	0	7	7	7	0	0	32	0	0	0	0	**52**
Collisions assuming avoidance rate	birds per month or year	95.01%	0	0	0	0	0	0	0	2	0	0	0	0	**3**
		98.00%	0	0	0	0	0	0	0	1	0	0	0	0	**1**
		99.00%	0	0	0	0	0	0	0	0	0	0	0	0	**1**
		99.50%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Collisions after applying large array correction		95.01%	0	0	0	0	0	0	0	2	0	0	0	0	**3**
		98.00%	0	0	0	0	0	0	0	1	0	0	0	0	**1**
		99.00%	0	0	0	0	0	0	0	0	0	0	0	0	**1**
		99.50%	0	0	0	0	0	0	0	0	0	0	0	0	**0**

COLLISION RISK ASSESSMENT
Sheet 1 - Input data

used in overall collision risk sheet
used in migrant collision risk sheet
used in single transit collision risk sheet or extended model
used in available hours sheet
used in large array correction sheet
not used in calculation but stated for reference

	Units	Value	Data sources	Source
Bird data				
Species name		**RedKnot**		
Bird length	m	0.24		Gilbert et al 2022, Table A12
Wingspan	m	0.50		Gilbert et al 2022, Table A12
Flight speed	m/sec	20.1		Gilbert et al 2022, Table A12
Nocturnal activity factor (1-5)		5		Table A-8, Robinson Willmott et al., 2013; Loring et al 2018
Flight type, flapping or gliding		flapping		

Bird survey data			Data sources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daytime bird density	birds/sq km														
Proportion at rotor height	%														
Proportion of flights upwind	%	34.6%													

Birds on migration data			Data sources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Migration passages	birds							390		234	234	234				see BA section 5.2.1.2
Width of migration corridor	km	19														assume all pass through turbine project area
Proportion at rotor height	%	0%														Feigin et al., 2022, Table A
Proportion of flights upwind	%	34.6%														Loring et al 2018, Fig. 14

	Units	Value	Data sources	Source
Windfarm data				
Name of windfarm site		**US Wind**		
Latitude	degrees	38.36		
Number of turbines		114		COP, Table 3.3-1, Developer's preferred Alt
Width of windfarm	km	19		Measured from BA Figure 1-1
Tidal offset	m	1		

	Units	Value	Data sources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Source
Turbine data																
Turbine model		**18MW**														COP, Table 2-1. WTG Envelope
No of blades		3														
Rotation speed	rpm	7.56														Gaertner et al 2020, Table ES-2
Rotor radius	m	125														COP, Table 2-1. WTG Envelope, calc
Hub height	m	144														COP, Table 2-1. WTG Envelope, =36 air gap + 125 rotor radius
Monthly proportion of time operational	%			83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	see note
Max blade width	m	5.770														Gaertner et al 2020, Table ES-2
Pitch	degrees	1														

Avoidance rates used in presenting results			Data sources (if applicable)
	95.01%	X	Cook 2021, Table A2 “All Gulls and Terns” Extended Band (2012) model
	98.00%		
	99.00%		
	99.50%		

COLLISION RISK ASSESSMENT (BIRDS ON MIGRATION)

Sheet 2 - Overall collision risk

All data input on Sheet 1:
no data entry needed on this sheet!
other than to choose option for final tables

from Sheet 1 - input data
from Sheet 6 - available hours
from Sheet 3 - single transit collision risk
from survey data
calculated field

Bird details:

Species		RedKnot
Flight speed	m/sec	20.1
Flight type		flapping

Windfarm data:

Number of turbines		114
Rotor radius	m	125
Minimum height of rotor	m	144
Total rotor frontal area	sq m	5595962

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year average
Proportion of time operational	%		83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83.3%
Stage A - flight activity															**per annum**
Migration passages			0	0	0	0	390	0	234	234	234	0	0	0	**1092**
Migrant flux density	birds/ km		0	0	0	0	20.5263	0	12.3158	12.3158	12.3158	0	0	0	
Proportion at rotor height	%	0%													
Flux factor			0	0	0	0	459	0	276	276	276	0	0	0	
Option 1 -Basic model - Stages B, C and D															
Potential bird transits through rotors			0	0	0	0	0	0	0	0	0	0	0	0	**0**
Collision risk for single rotor transit	(from sheet 3)	3.3%													
Collisions for entire windfarm, allowing for non-op time, assuming no avoidance	birds per month or year		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Option 2-Basic model using proportion from flight distribution			**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
Option 3-Extended model using flight height distribution															
Proportion at rotor height	(from sheet 4)	34.6%													
Potential bird transits through rotors	Flux integral	0.3446	0	0	0	0	158	0	95	95	95	0	0	0	**443**
Collisions assuming no avoidance	Collision integral	0.00916	**0**	**0**	**0**	**0**	**4**	**0**	**2**	**2**	**2**	**0**	**0**	**0**	**10**
Average collision risk for single rotor transit		2.7%													
Stage E - applying avoidance rates															
Using which of above options?	**Option 3**	0.00%	0	0	0	0	4	0	2	2	2	0	0	0	**10**
Collisions assuming avoidance rate	birds per month or year	95.01%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		98.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.50%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Collisions after applying large array correction		95.01%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		98.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.50%	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Summary of simulation results from SCRAM: a stochastic collision risk assessment for movement data

03 May 2023

SCRAM was developed by Biodiversity Research Institute, the University of Rhode Island, and the U.S. Fish and Wildlife Service with funding from the Bureau of Ocean Energy Management.

SCRAM run details

```
## SCRAM - the Stochastic Collision Risk Assessment for Movement version
## Version: 1.0.3 - Cathartic Adela
## Iterations: 1000
## Type of model employed: trunc
## Model option: Option 3: slower but more precise assessment
## Proportion transient in model cell: 0.995
## Project: US Wind
## Modeler: David Bigger
## The model run was started at: Wed May 03 15:41:05 2023 EDT
## The model run was completed at: Wed May 03 16:04:25 2023 EDT
## Run 1: the probability of exceeding specified threshold (1) is < 0.001.
```

Model inputs used for this analysis

Table 1: Species input parameters (mean and 95 perc. range).

Species	Turbine model	Avoidance	Wing span	Body length	Speed	Upwind Prop.
Piping Plover	14-18MW	0.93 (0.92, 0.938)	0.381 (0.381, 0.381)	0.175 (0.17, 0.18)	11.875 (3.248, 20.732)	0.086 (0.086, 0.086)

Table 2: Species monthly (Jan-Jun) population estimates ± SD and assumptions/limitations as specified by the USFWS using the most recent data.

Species	Jan	Feb	Mar	Apr	May	Jun
Piping Plover	0 ± 0	0 ± 0	4578 ± 0	4578 ± 0	4578 ± 0	4578 ± 0

Table 3: Species monthly (Jul-Dec) population estimates ± SD and assumptions/limitations as specified by the USFWS using the most recent data.

Species	Jul	Aug	Sep	Oct	Nov	Dec
Piping Plover	4578 ± 0	7423 ± 0	7423 ± 0	7423 ± 0	0 ± 0	0 ± 0

Population data assumptions/limitations:
1) Entire Atlantic coast population could be present in area during months listed.
2) Occurrence through October to include birds stopping over in mid-Atlantic (e.g. North Carolina). Number of birds still present in Atlantic likely lower.
3) Estimate of HY fledges, uses the 20-year (2002 - 2021) average productivity (unweighted).

Table 4: Wind farm input parameters (mean and 95 perc. range).

Species	Turbine model	Num. turbines	Rotor radius	Hub height (m)	Blade width (m)	Wind speed (mps)
Piping Plover	14-18MW	114	125 (125, 125)	161 (161, 161)	5.77 (5.77, 5.77)	6.31 (4.19, 8.44)

Table 5: Wind farm input parameters (mean and 95 perc. range).

Species	Turbine model	Rotor speed (rpm)	Pitch (radians)	Farm width (km)	Lat.	Long.
Piping Plover	14-18MW	2.65 (1.76, 3.55)	0.03 (0.03, 0.04)	19	38.36	-74.78

Table 6: Monthly (Jan-Jun) wind farm operational percentage (mean and 95 perc. range) is given for each wind farm specification.

Species	Turbine model	Jan Op.	Feb Op.	Mar Op.	Apr Op.	May Op.	Jun Op.
Piping Plover	14-18MW	83.3 (79.8, 86.6)	83.3 (80, 86.9)	83.4 (79.9, 86.7)	83.3 (80, 86.7)	83.2 (79.6, 86.9)	83.2 (79.6, 86.8)

Table 7: Monthly (Jul-Dec) wind farm operational percentage (mean and 95 perc. range) is given for each wind farm specification.

Species	Turbine model	Jul Op.	Aug Op.	Sep Op.	Oct Op.	Nov Op.	Dec Op.
Piping Plover	14-18MW	83.3 (79.9, 86.7)	83.3 (80, 86.7)	83.2 (79.8, 86.5)	83.3 (79.7, 87)	83.3 (79.9, 86.5)	83.3 (79.9, 86.6)

Results for the SCRAM simulation

Table 8: The populations estimate for each month and the estimated daily number of (95 perc. prediction intervals) animals in the model cell and collisions at the wind farm. Results are not shown for months that do not have movement data. This does not mean that collisions could not occur in those months, but we do not have movement data to estimate collisions during these periods.

Species	Turbine model	Month	Population estimate	Est. daily num. of animals in the model cell	Est. daily num. of collisions in the wind farm
Piping Plover	14-18MW	Jan	0		
Piping Plover	14-18MW	Feb	0		
Piping Plover	14-18MW	Mar	4578		
Piping Plover	14-18MW	Apr	4578		
Piping Plover	14-18MW	May	4578	0 (0, 0)	0 (0, 0)
Piping Plover	14-18MW	Jun	4578	0 (0, 0)	0 (0, 0)
Piping Plover	14-18MW	Jul	4578	0.4696 (0, 3.03)	7.61e-05 (0, 0.000473)
Piping Plover	14-18MW	Aug	7423	0.2166 (0, 0)	3.34e-05 (0, 0)
Piping Plover	14-18MW	Sep	7423	0.06156 (0, 0)	8.55e-06 (0, 0)
Piping Plover	14-18MW	Oct	7423		
Piping Plover	14-18MW	Nov	0		
Piping Plover	14-18MW	Dec	0		

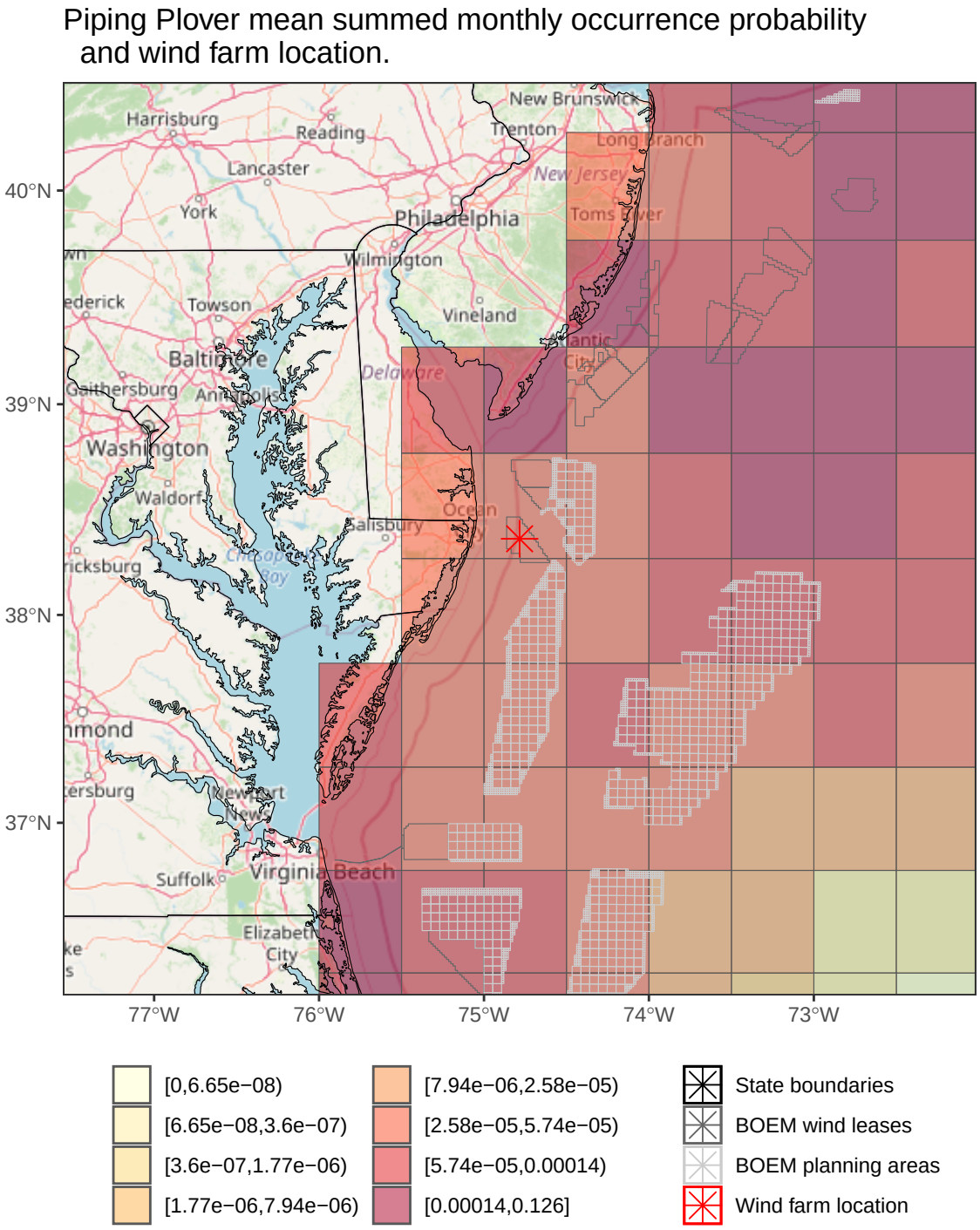


Figure 1: A map of the mean monthly species occurrence probabilities (i.e., the mean of all summed daily occurrence probabilities across all months) and wind farm location. Collision estimates use summed daily occurrence probability rather than these values as shown; the values in this figure are presented for display purposes only to show relative differences in occurrence across the area of interest.

Table 9: The estimated monthly number (95 perc. prediction intervals) of collisions. Results are not shown for months that do not have movement data and does not mean that collisions could not occur in those months.

Species	Turbine model	month	Est. num. of collisions
Piping Plover	14-18MW	Jan	
Piping Plover	14-18MW	Feb	
Piping Plover	14-18MW	Mar	
Piping Plover	14-18MW	Apr	
Piping Plover	14-18MW	May	2.17e-05 (0, 3e-05)
Piping Plover	14-18MW	Jun	2.17e-05 (0, 3e-05)
Piping Plover	14-18MW	Jul	0.00238 (3e-05, 0.0147)
Piping Plover	14-18MW	Aug	0.00106 (0, 3e-05)
Piping Plover	14-18MW	Sep	0.000278 (0, 3e-05)
Piping Plover	14-18MW	Oct	
Piping Plover	14-18MW	Nov	
Piping Plover	14-18MW	Dec	
Piping Plover	14-18MW	Annual	0.00376 (0.00015, 0.0221)

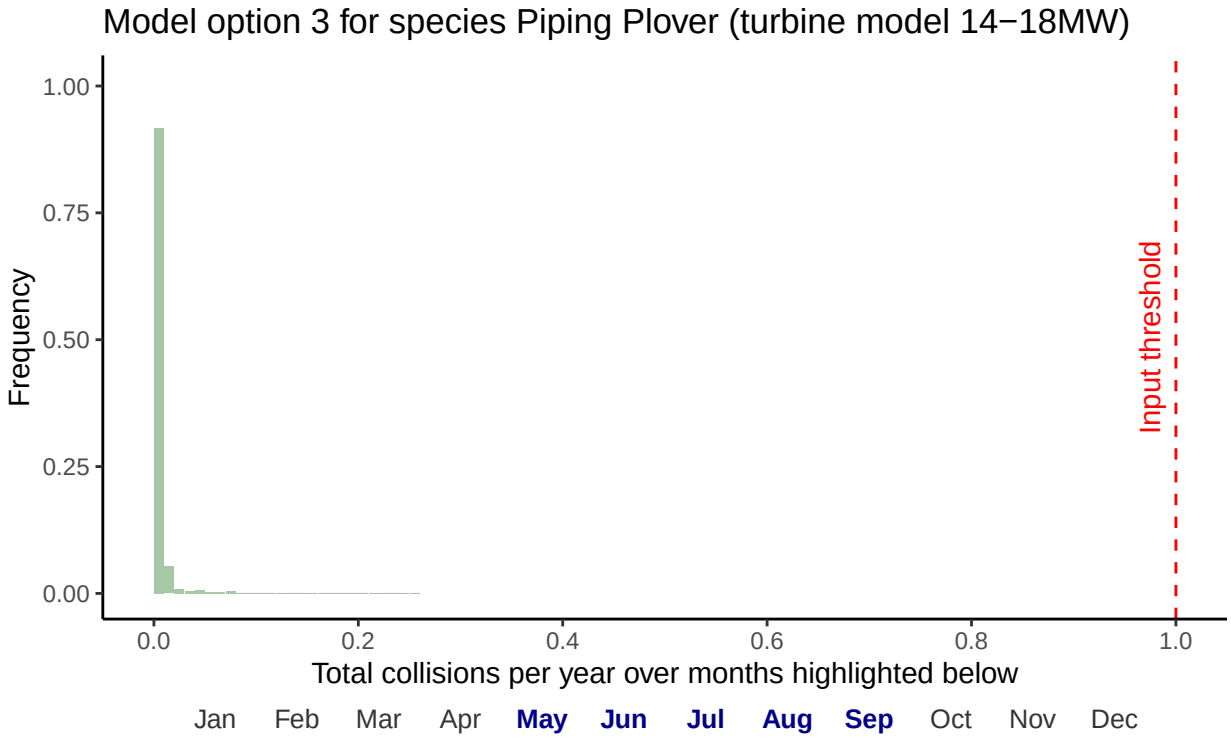


Figure 2: A frequency histogram of the total number of collisions per year. The heights of the bars show the relative frequency of each value. Months for which movement data were provided or available are shown in bold; only bold months are shown in histogram of annual collisions.

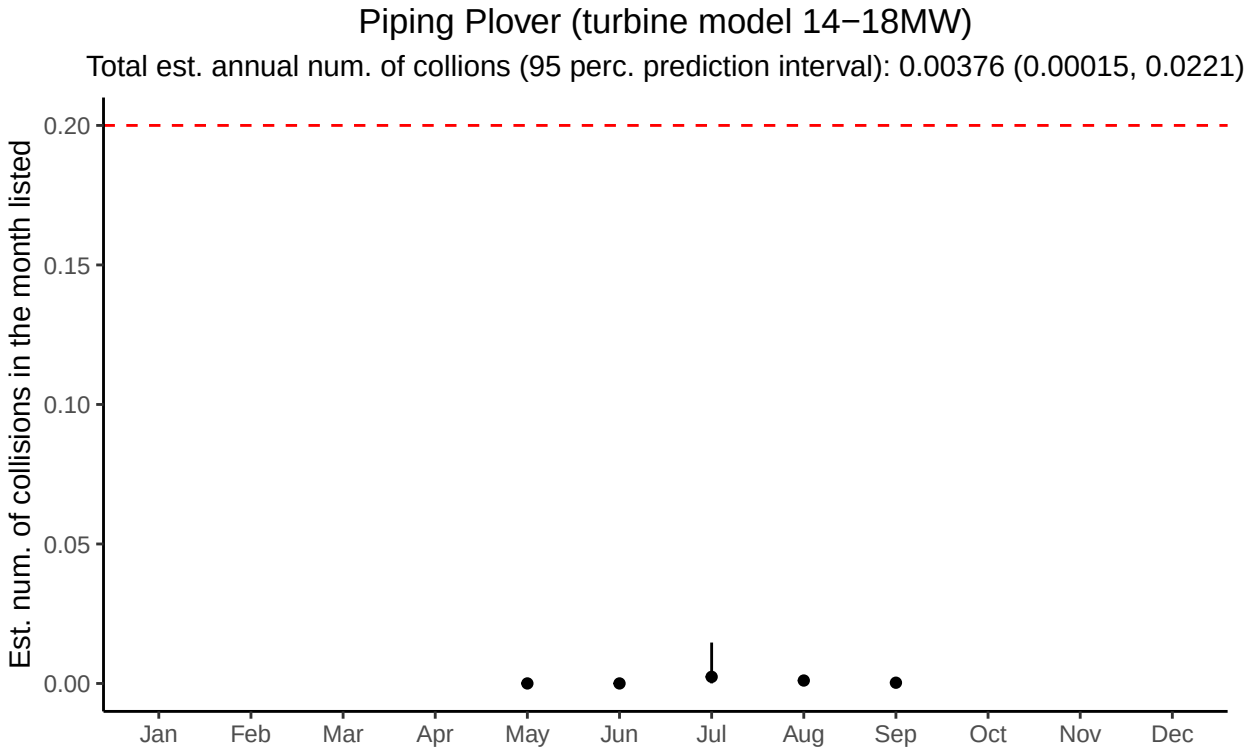


Figure 3: The predicted mean and 95 perc. prediction intervals of the number of collisions per month. Results are not shown for months that do not have movement data. Total annual collision rate and 95 perc. prediction interval are given at top. The threshold is shown divided by the number of months that movement data were available.

Summary of simulation results from SCRAM: a stochastic collision risk assessment for movement data

03 May 2023

SCRAM was developed by Biodiversity Research Institute, the University of Rhode Island, and the U.S. Fish and Wildlife Service with funding from the Bureau of Ocean Energy Management.

SCRAM run details

```
## SCRAM - the Stochastic Collision Risk Assessment for Movement version
## Version: 1.0.3 - Cathartic Adela
## Iterations: 1000
## Type of model employed: trunc
## Model option: Option 3: slower but more precise assessment
## Proportion transient in model cell: 0.365
## Project: US Wind
## Modeler: David Bigger
## The model run was started at: Wed May 03 16:07:35 2023 EDT
## The model run was completed at: Wed May 03 16:31:23 2023 EDT
## Run 1: the probability of exceeding specified threshold (1) is 0.934.
```

Model inputs used for this analysis

Table 1: Species input parameters (mean and 95 perc. range).

Species	Turbine model	Avoidance	Wing span	Body length	Speed	Upwind Prop.
Red Knot	14-18MW	0.93 (0.92, 0.939)	0.496 (0.453, 0.539)	0.24 (0.23, 0.25)	19.968 (16.305, 23.687)	0.346 (0.346, 0.346)

Table 2: Species monthly (Jan-Jun) population estimates ± SD and assumptions/limitations as specified by the USFWS using the most recent data.

Species	Jan	Feb	Mar	Apr	May	Jun
Red Knot	10400 ± 0	10400 ± 0	10400 ± 0	10400 ± 0	59200 ± 0	59200 ± 0

Table 3: Species monthly (Jul-Dec) population estimates ± SD and assumptions/limitations as specified by the USFWS using the most recent data.

Species	Jul	Aug	Sep	Oct	Nov	Dec
Red Knot	59200 ± 0	59200 ± 0	72520 ± 0	54720 ± 0	41400 ± 0	10400 ± 0

Population data assumptions/limitations:
1) All pass through in spring - #s consistent w/Lyons et al super-population estimate for 2020 in DE Bay: 40,444 (95 perc. credible interval: 33,627–49,966).
2) Winter population estimates represent the total # of adults and sub-adults (in general); they do not include hatch-year (HY) birds in the fall.
3) Southern and northern wintering birds could be present during July - Sept.
4) Only northern wintering birds could be present during Oct - Nov.
5) Only southeast US and Caribbean birds could be present during Dec.
6) Birds from western Gulf population are excluded from totals in Atlantic region due to lack of information on extent to which they use the Atlantic region.
7) Numbers do not include HY birds in fall.
8) Dec number coming from Lyons et al 2017. Just includes SE US Birds, not Caribbean.
9) Issues with double counting addressed because birds may be present in different areas of Atlantic region for weeks to months.

Table 4: Wind farm input parameters (mean and 95 perc. range).

Species	Turbine model	Num. turbines	Rotor radius	Hub height (m)	Blade width (m)	Wind speed (mps)
Red Knot	14-18MW	114	125 (125, 125)	161 (161, 161)	5.77 (5.77, 5.77)	6.35 (4.37, 8.38)

Table 5: Wind farm input parameters (mean and 95 perc. range).

Species	Turbine model	Rotor speed (rpm)	Pitch (radians)	Farm width (km)	Lat.	Long.
Red Knot	14-18MW	2.67 (1.84, 3.52)	0.03 (0.03, 0.04)	19	38.36	-74.78

Table 6: Monthly (Jan-Jun) wind farm operational percentage (mean and 95 perc. range) is given for each wind farm specification.

Species	Turbine model	Jan Op.	Feb Op.	Mar Op.	Apr Op.	May Op.	Jun Op.
Red Knot	14-18MW	83.3 (80, 86.8)	83.3 (79.9, 86.9)	83.3 (80, 86.6)	83.3 (79.8, 86.8)	83.3 (79.6, 86.8)	83.2 (79.7, 86.4)

Table 7: Monthly (Jul-Dec) wind farm operational percentage (mean and 95 perc. range) is given for each wind farm specification.

Species	Turbine model	Jul Op.	Aug Op.	Sep Op.	Oct Op.	Nov Op.	Dec Op.
Red Knot	14-18MW	83.3 (79.7, 86.8)	83.3 (79.9, 86.9)	83.3 (80, 86.7)	83.3 (79.8, 86.7)	83.3 (79.9, 86.8)	83.2 (79.7, 86.7)

Results for the SCRAM simulation

Table 8: The populations estimate for each month and the estimated daily number of (95 perc. prediction intervals) animals in the model cell and collisions at the wind farm. Results are not shown for months that do not have movement data. This does not mean that collisions could not occur in those months, but we do not have movement data to estimate collisions during these periods.

Species	Turbine model	Month	Population estimate	Est. daily num. of animals in the model cell	Est. daily num. of collisions in the wind farm
Red Knot	**14-18MW**	**Jan**	**10400**		
Red Knot	**14-18MW**	**Feb**	**10400**		
Red Knot	**14-18MW**	**Mar**	**10400**		
Red Knot	**14-18MW**	**Apr**	**10400**		
Red Knot	**14-18MW**	**May**	**59200**		
Red Knot	**14-18MW**	**Jun**	**59200**		
Red Knot	**14-18MW**	**Jul**	**59200**		
Red Knot	**14-18MW**	**Aug**	**59200**	37.1 (36.66, 45.82)	0.0208 (0.0174, 0.0258)
Red Knot	**14-18MW**	**Sep**	**72520**	30.18 (29.39, 58.78)	0.0169 (0.0138, 0.0291)
Red Knot	**14-18MW**	**Oct**	**54720**	0 (0, 0)	0 (0, 0)
Red Knot	**14-18MW**	**Nov**	**41400**	2.859 (0, 20.13)	0.00159 (0, 0.0121)
Red Knot	**14-18MW**	**Dec**	**10400**		

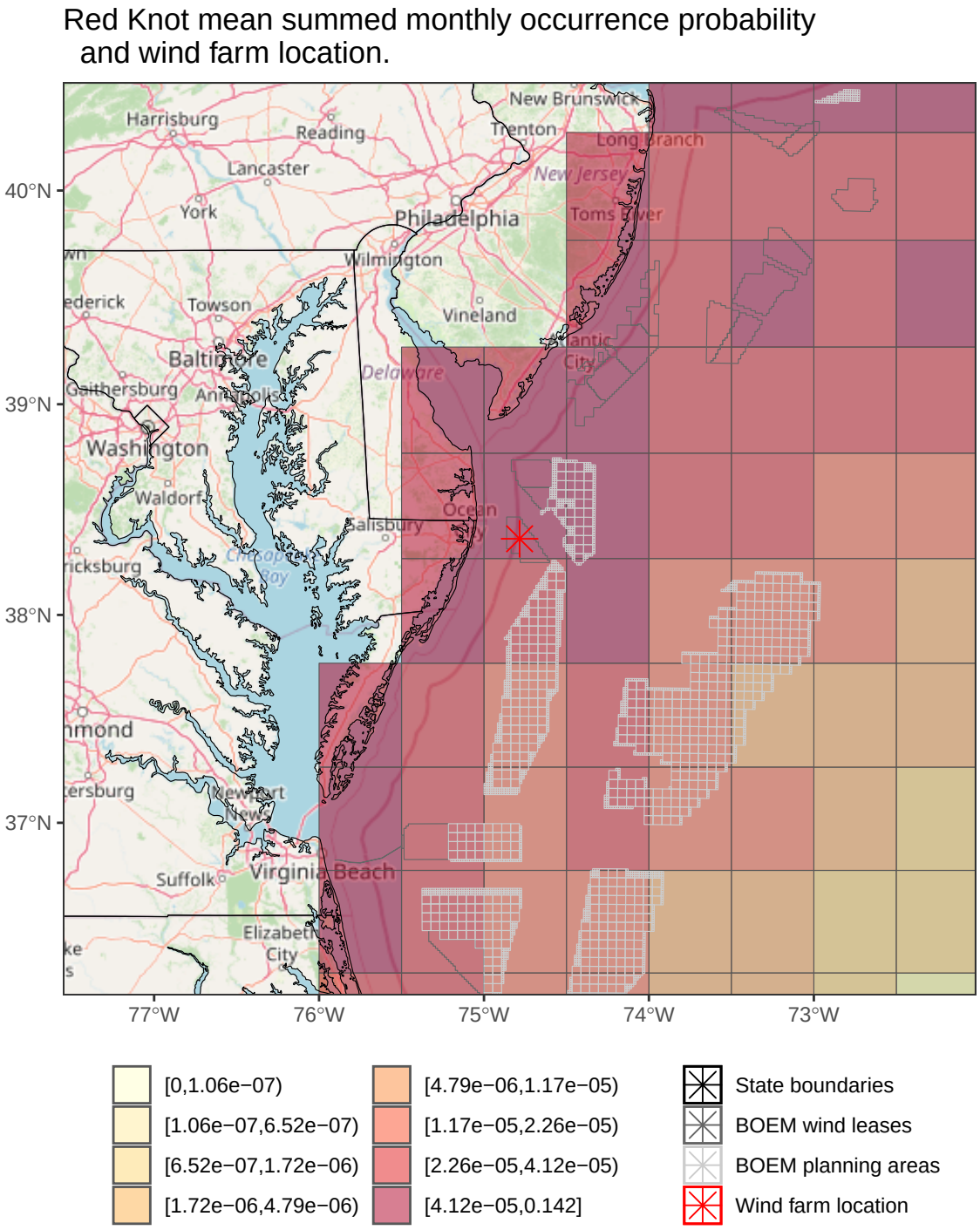


Figure 1: A map of the mean monthly species occurrence probabilities (i.e., the mean of all summed daily occurrence probabilities across all months) and wind farm location. Collision estimates use summed daily occurrence probability rather than these values as shown; the values in this figure are presented for display purposes only to show relative differences in occurrence across the area of interest.

Table 9: The estimated monthly number (95 perc. prediction intervals) of collisions. Results are not shown for months that do not have movement data and does not mean that collisions could not occur in those months.

Species	Turbine model	month	Est. num. of collisions
Red Knot	14-18MW	Jan	
Red Knot	14-18MW	Feb	
Red Knot	14-18MW	Mar	
Red Knot	14-18MW	Apr	
Red Knot	14-18MW	May	
Red Knot	14-18MW	Jun	
Red Knot	14-18MW	Jul	
Red Knot	14-18MW	Aug	0.645 (0.538, 0.799)
Red Knot	14-18MW	Sep	0.508 (0.413, 0.872)
Red Knot	14-18MW	Oct	0 (0, 0)
Red Knot	14-18MW	Nov	0.0477 (0, 0.363)
Red Knot	14-18MW	Dec	
Red Knot	14-18MW	Annual	1.2 (0.964, 1.65)

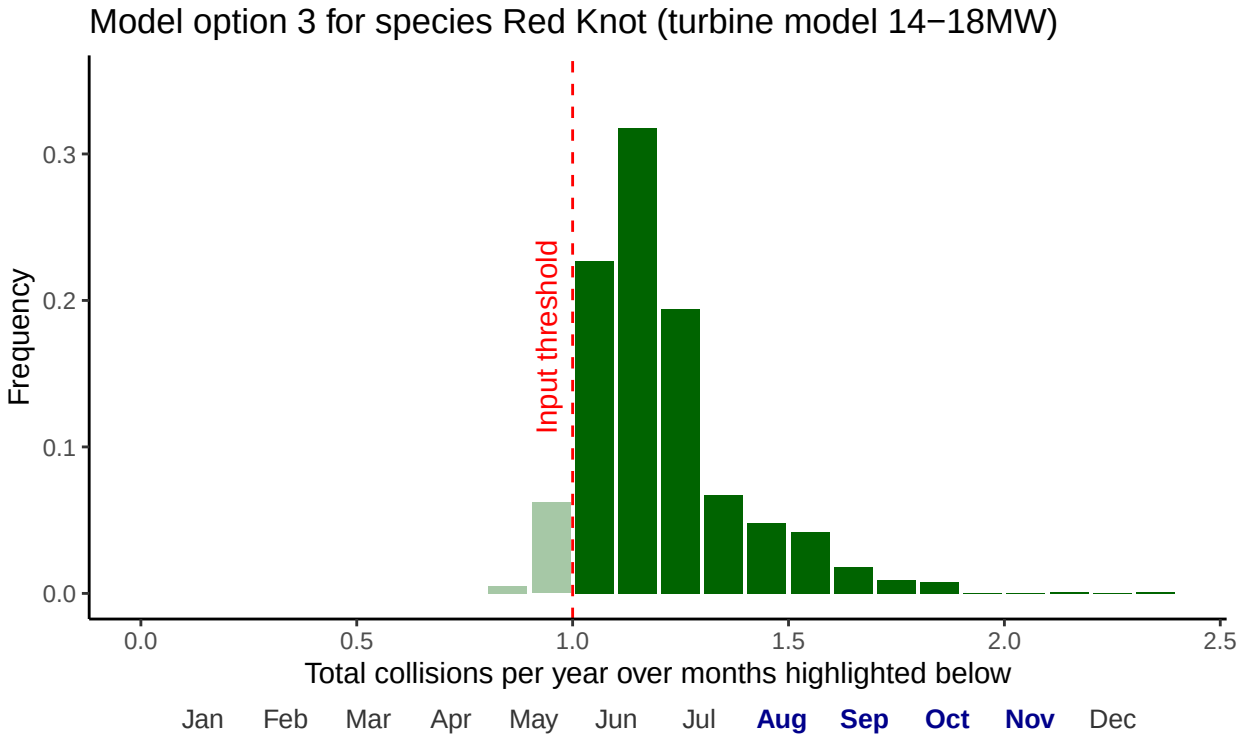


Figure 2: A frequency histogram of the total number of collisions per year. The heights of the bars show the relative frequency of each value. Months for which movement data were provided or available are shown in bold; only bold months are shown in histogram of annual collisions.

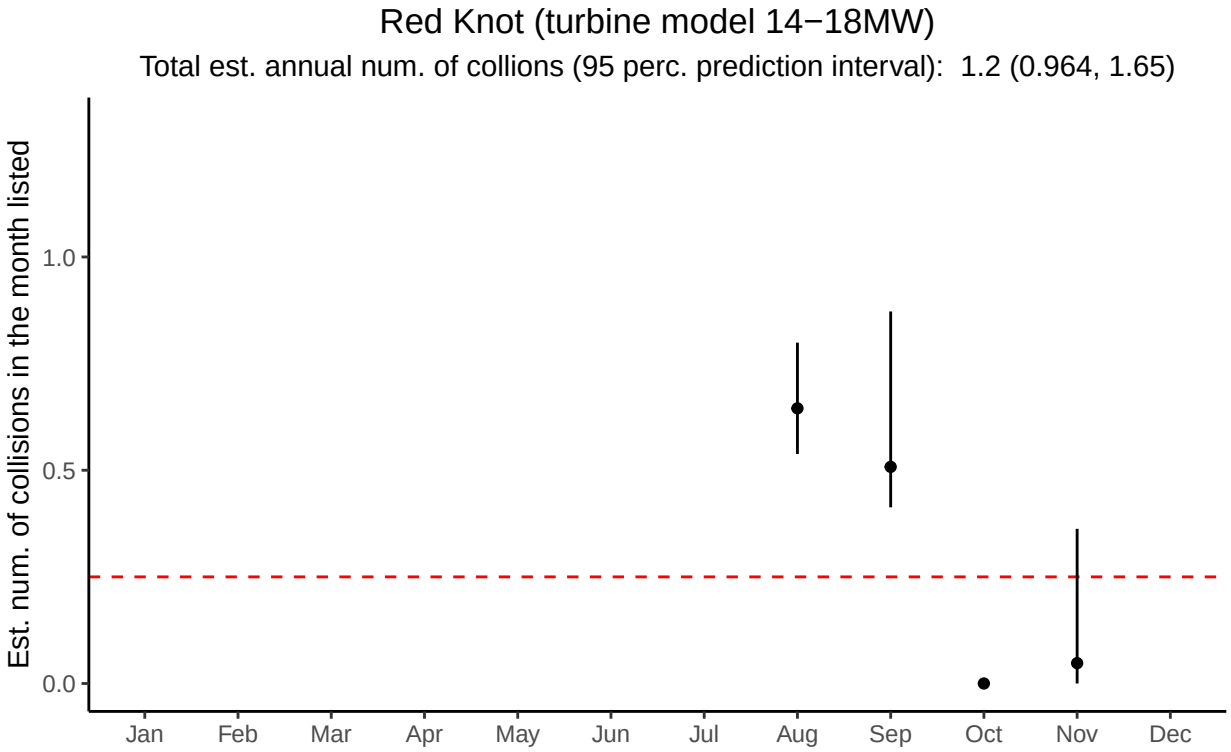


Figure 3: The predicted mean and 95 perc. prediction intervals of the number of collisions per month. Results are not shown for months that do not have movement data. Total annual collision rate and 95 perc. prediction interval are given at top. The threshold is shown divided by the number of months that movement data were available.

Summary of simulation results from SCRAM: a stochastic collision risk assessment for movement data

03 May 2023

SCRAM was developed by Biodiversity Research Institute, the University of Rhode Island, and the U.S. Fish and Wildlife Service with funding from the Bureau of Ocean Energy Management.

SCRAM run details

```
## SCRAM - the Stochastic Collision Risk Assessment for Movement version
## Version: 1.0.3 - Cathartic Adela
## Iterations: 1000
## Type of model employed: trunc
## Model option: Option 3: slower but more precise assessment
## Proportion transient in model cell: NA
## Project: US Wind
## Modeler: David Bigger
## The model run was started at: Wed May 03 16:33:37 2023 EDT
## The model run was completed at: Wed May 03 16:57:38 2023 EDT
## Run 1: the probability of exceeding specified threshold (1) is < 0.001.
```

Model inputs used for this analysis

Table 1: Species input parameters (mean and 95 perc. range).

Species	Turbine model	Avoidance	Wing span	Body length	Speed	Upwind Prop.
Roseate Tern	14-18MW	0.929 (0.92, 0.938)	0.76 (0.72, 0.8)	0.371 (0.333, 0.411)	13.216 (4.344, 22.198)	0.375 (0.375, 0.375)

Table 2: Species monthly (Jan-Jun) population estimates ± SD and assumptions/limitations as specified by the USFWS using the most recent data.

Species	Jan	Feb	Mar	Apr	May	Jun
Roseate Tern	0 ± 0	0 ± 0	0 ± 0	10916 ± 0	10916 ± 0	10916 ± 0

Table 3: Species monthly (Jul-Dec) population estimates ± SD and assumptions/limitations as specified by the USFWS using the most recent data.

Species	Jul	Aug	Sep	Oct	Nov	Dec
Roseate Tern	16251 ± 0	16251 ± 0	16251 ± 0	16251 ± 0	0 ± 0	0 ± 0

Population data assumptions/limitations:
1) Entire NW Atlantic pop could be present in area during months listed.
2) Average of most recent (2018 and 2019) productivity data from three largest colonies (representing >90 perc. of population) representative of entire population.
3) Fledging and post-breeding dispersal period occurs from July through Sept.
4) Numbers of non-breeding adults are not included.
5) Does not include non-breeding 1 and 2 year old birds that return but do not breed.
6) From Gochfeld and Burger (2020): Northeastern birds first arrive at Nantucket and Martha's Vineyard, MA, in large flocks, then disperse north as well as west. They arrive 26 Apr-20 May at Bird I., MA (Nisbet 1980, Nisbet 1981b, Nisbet 1989b), slightly later at Falkner I., CT, and Great Gull I., NY.
7) From Gochfeld and Burger (2020): Apparently all birds migrate directly from the staging area around Cape Cod across the w. North Atlantic to the West Indies (Nisbet 1984, C. Mostello). Very small numbers occur at sea off N. Carolina from late Aug to late Sep, with a peak in early Sep; the latest date was 28 Oct (D. Lee).

Table 4: Wind farm input parameters (mean and 95 perc. range).

Species	Turbine model	Num. turbines	Rotor radius	Hub height (m)	Blade width (m)	Wind speed (mps)
Roseate Tern	14-18MW	114	125 (125, 125)	161 (161, 161)	5.77 (5.77, 5.77)	6.34 (4.18, 8.57)

Table 5: Wind farm input parameters (mean and 95 perc. range).

Species	Turbine model	Rotor speed (rpm)	Pitch (radians)	Farm width (km)	Lat.	Long.
Roseate Tern	14-18MW	2.66 (1.76, 3.6)	0.03 (0.03, 0.04)	19	38.36	-74.78

Table 6: Monthly (Jan-Jun) wind farm operational percentage (mean and 95 perc. range) is given for each wind farm specification.

Species	Turbine model	Jan Op.	Feb Op.	Mar Op.	Apr Op.	May Op.	Jun Op.
Roseate Tern	14-18MW	83.2 (79.8, 86.7)	83.3 (79.7, 86.9)	83.3 (79.8, 86.5)	83.3 (80, 86.6)	83.2 (80, 86.5)	83.2 (79.8, 86.4)

Table 7: Monthly (Jul-Dec) wind farm operational percentage (mean and 95 perc. range) is given for each wind farm specification.

Species	Turbine model	Jul Op.	Aug Op.	Sep Op.	Oct Op.	Nov Op.	Dec Op.
Roseate Tern	14-18MW	83.3 (79.8, 86.5)	83.2 (79.9, 86.7)	83.4 (80.1, 86.9)	83.3 (79.9, 86.7)	83.3 (79.8, 86.8)	83.3 (79.9, 86.7)

Results for the SCRAM simulation

Table 8: The populations estimate for each month and the estimated daily number of (95 perc. prediction intervals) animals in the model cell and collisions at the wind farm. Results are not shown for months that do not have movement data. This does not mean that collisions could not occur in those months, but we do not have movement data to estimate collisions during these periods.

Species	Turbine model	Month	Population estimate	Est. daily num. of animals in the model cell	Est. daily num. of collisions in the wind farm
Roseate Tern	14-18MW	Jan	0		
Roseate Tern	14-18MW	Feb	0		
Roseate Tern	14-18MW	Mar	0		
Roseate Tern	14-18MW	Apr	10916		
Roseate Tern	14-18MW	May	10916		
Roseate Tern	14-18MW	Jun	10916		
Roseate Tern	14-18MW	Jul	16251		
Roseate Tern	14-18MW	Aug	16251		
Roseate Tern	14-18MW	Sep	16251		
Roseate Tern	14-18MW	Oct	16251		
Roseate Tern	14-18MW	Nov	0		
Roseate Tern	14-18MW	Dec	0		

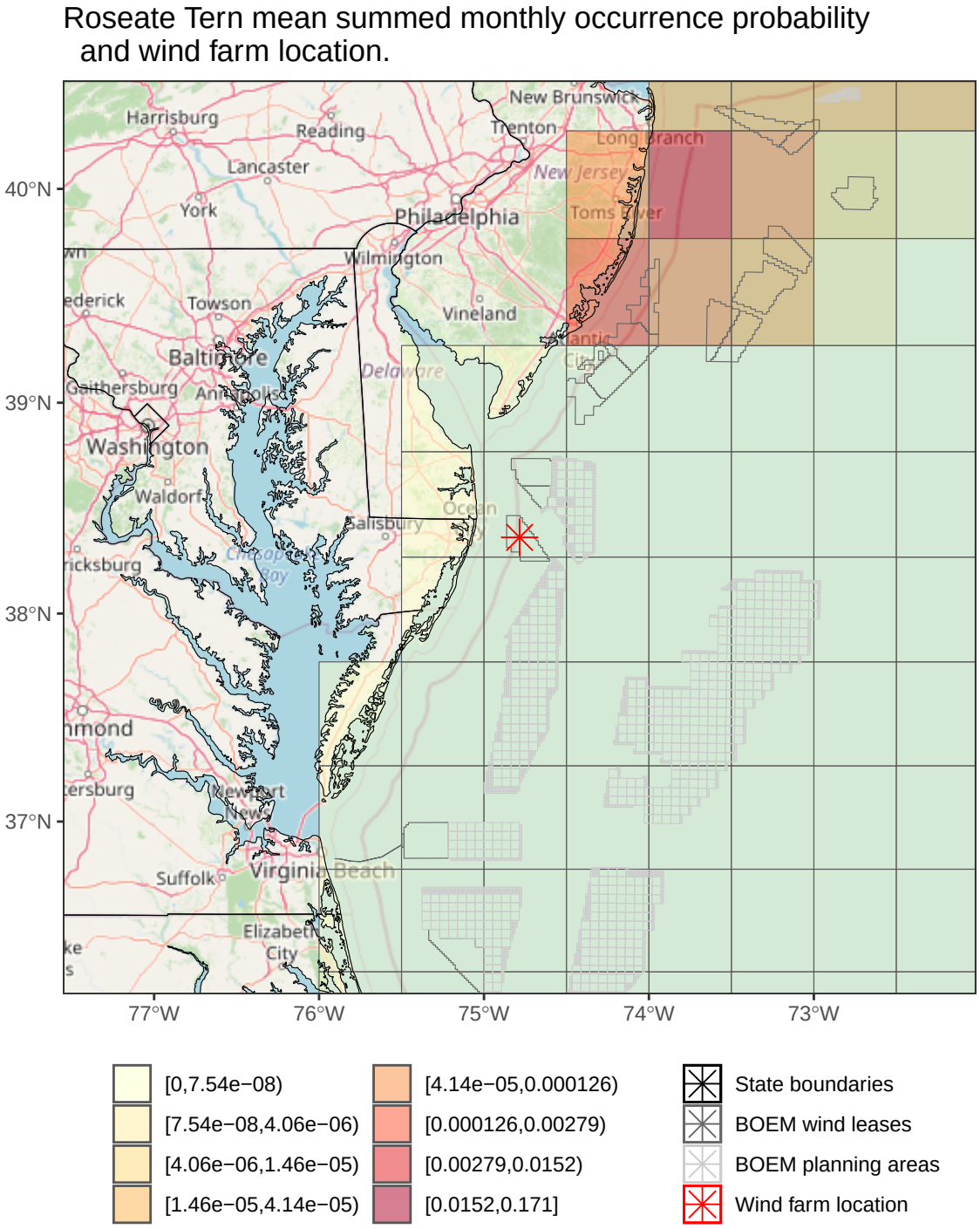
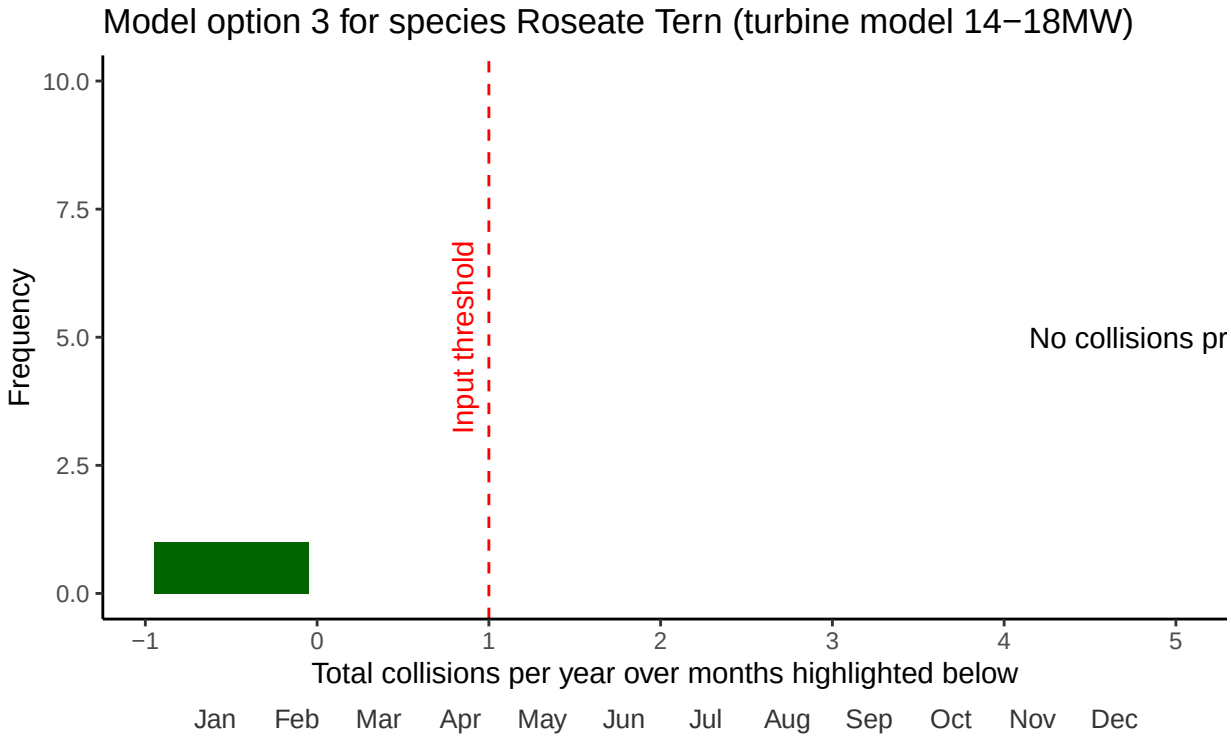


Figure 1: A map of the mean monthly species occurrence probabilities (i.e., the mean of all summed daily occurrence probabilities across all months) and wind farm location. Collision estimates use summed daily occurrence probability rather than these values as shown; the values in this figure are presented for display purposes only to show relative differences in occurrence across the area of interest.

Table 9: The estimated monthly number (95 perc. prediction intervals) of collisions. Results are not shown for months that do not have movement data and does not mean that collisions could not occur in those months.

Species	Turbine model	month	Est. num. of collisions
Roseate Tern	14-18MW	Jan	
Roseate Tern	14-18MW	Feb	
Roseate Tern	14-18MW	Mar	
Roseate Tern	14-18MW	Apr	
Roseate Tern	14-18MW	May	
Roseate Tern	14-18MW	Jun	
Roseate Tern	14-18MW	Jul	
Roseate Tern	14-18MW	Aug	
Roseate Tern	14-18MW	Sep	
Roseate Tern	14-18MW	Oct	
Roseate Tern	14-18MW	Nov	
Roseate Tern	14-18MW	Dec	
Roseate Tern	14-18MW	Annual	0 (0, 0)



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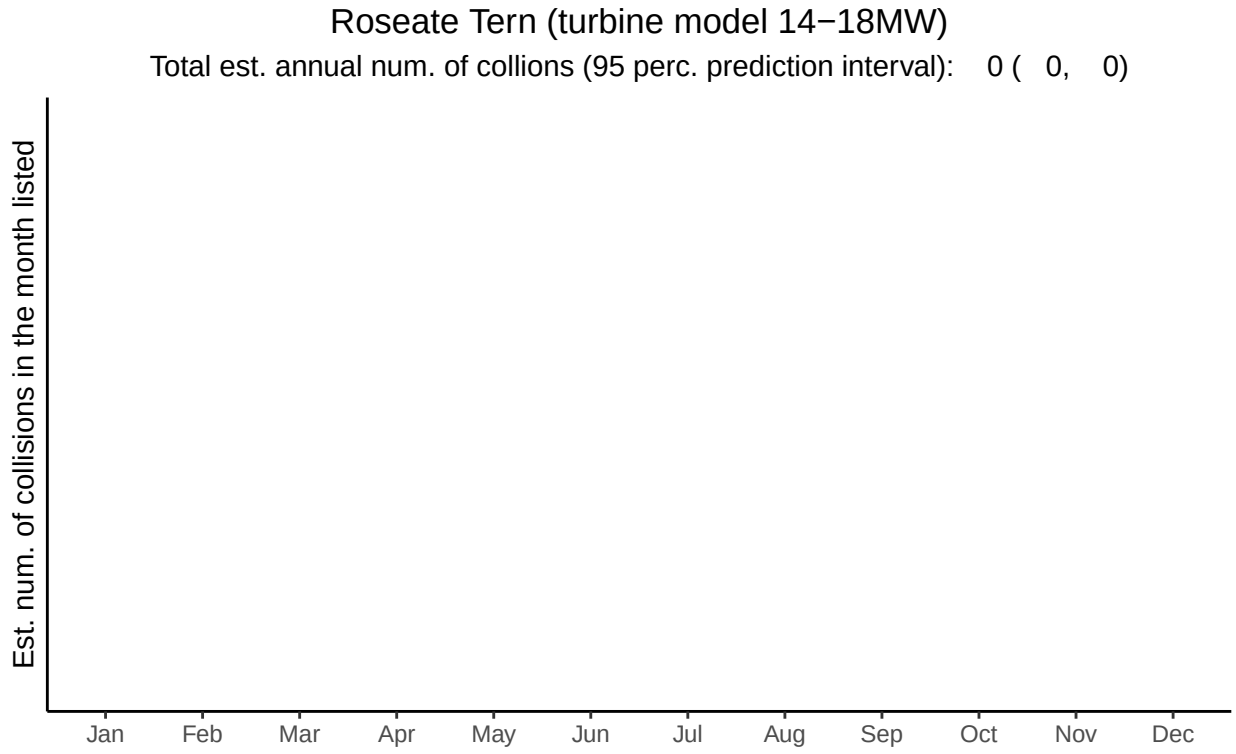

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