MAY 06 | 2022

Appendix O-1: Avian and Bat Impact Assessment

Coastal Virginia Offshore Wind Commercial Project

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The assessment presented herein is consistent with the Project Design Envelope considered by Dominion Energy Virginia (Dominion Energy) prior to summer 2022. Due to maturation of the Coastal Virginia Offshore Wind Commercial Project (Project) design, Dominion Energy was able to refine several components of the Project and has subsequently revised the Construction and Operations Plan (COP) as re-submitted in February 2023. The primary changes are summarized as follows:

- The Maximum Layout includes up to 202 wind turbine generators (WTGs), with a maximum WTG capacity of 16 megawatts. As the Preferred Layout, Dominion Energy proposes to install a total of 176, 14.7-megawatt capacity WTGs with 7 additional positions identified as spare WTG locations. For both the Preferred Layout and Maximum Layout, the Offshore Substations will be within the WTG grid pattern oriented at 35 degrees and spaced approximately 0.75 nautical mile (1.39 kilometers) in an east-west direction and 0.93 nautical mile (1.72 kilometers) in a north-south direction.
- Removal of Interconnection Cable Route Options 2, 3, 4, and 5 from consideration. As the Preferred Interconnection Cable Route Option, Dominion Energy proposes to install Interconnection Cable Route Option 1.

The analysis presented in this appendix reflects the initial 205 WTG position layout as well as Interconnection Cable Route Options 1, 2, 3, 4, 5, and 6 as the maximum Project Design Envelope. Reduction in the Project Design Envelope is not anticipated to result in any additional impacts not previously considered in the COP. Therefore, in accordance with the Bureau of Ocean Energy Management's Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan (2018), the appendix has not been revised. Additional details regarding evolution of the Project is provided in Section 2 of the COP and details regarding the full Project Design Envelope are provided in Section 3 of the COP.

Assessment of the Potential Effects of the Coastal Virginia Offshore Wind (CVOW) Commercial Project on Birds & Bats

– Lease Area OCS-A 0483 –

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Suggested Citation:

Biodiversity Research Institute. 2021. Assessment of the Potential Effects of Coastal Virginia Offshore Wind (CVOW) Commercial Project on Birds & Bats: Lease Area OCS-A 0483. Report to Tetra Tech. Biodiversity Research Institute, Portland, ME. 256 pp.

Executive Summary

The Virginia Electric and Power Company, doing business as Dominion Energy Virginia (hereinafter referred to as Dominion Energy), is proposing to construct, own, and operate the Coastal Virginia Offshore Wind (CVOW) Commercial Project (hereafter referred to as the Project). The Project will be located in the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS) Offshore Virginia (Lease No. OCS-A-0483) (Lease Area).

The goal of this assessment is to provide a detailed analysis of the bird and bat species that may be exposed to each of the Project components, and to describe potential impacts to those species at the population and, where necessary, species or individual level. For each subject group, a semi-quantitative approach was taken that first describes impact-producing factors, the species that would potentially be exposed to the impact-producing factors, and the vulnerability of the species exposed.

Offshore, the proposed Project is unlikely to impact bat populations. While some individual cave-hibernating bats may occur within the Lease Area during operation of the Project, and will be vulnerable to collision with operating turbines, the exposure of cave-hibernating bats to operating turbines is expected to be limited, given their distance from shore. Migratory tree bats are expected to occur in the Lease Area; however, this is reasonably expected to include low numbers of individuals, given the Project's distance from shore and tree bat activity will be concentrated during a small portion of the year.

Within the Nearshore Trenchless Installation Area, the Offshore Export Cable will be installed using trenchless installation from the Offshore Trenchless Installation Punch-Out Location to the Cable Landing Location where the Offshore Export Cable transitions to the Onshore Export Cable. Burying the cables and siting the Cable Landing Location within a proposed parking lot will minimize potential impacts to bats by avoiding habitat disruption. Along the Onshore Export Cable Route, impacts will be minimized by burying the cable within previously disturbed areas and existing roadways. The Interconnection Cable Route Alternatives pass through an area of wetlands identified as having very high ecological value and tree cutting has the potential to impact the habitat of a variety of bat species, including northern long-eared bats and Indiana bats. The two Switching Station Alternatives are also located adjacent to or within areas of high ecological value and have the potential to disturb bat habitat depending on which alternative is chosen and the extent of tree clearing required; the Fentress Substation largely avoids disturbing suitable summer bat habitat because development will be primarily confined to an existing developed area. Since the Interconnection Cable Route Alternatives have the potential to impact bat habitat, Dominion Energy will conduct field surveys, if required, prior to construction activities, to identify if species of conservation concern are present and will work with the Bureau of Ocean Energy Management (BOEM), Virginia Department of Wildlife Resources (VDWR) and the US Fish and Wildlife Service (USFWS) to minimize potential impacts.

Based on the analysis provided in this Risk Assessment, activities occurring in the Lease Area are unlikely to affect the populations of coastal or marine birds because, with the exception of storm-petrels, exposure for most species is minimal to low. The Lease Area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species and avoid marine bird concentration areas. Federally listed species, (Golden Eagle, Bald Eagle, Red Knot, Piping Plover, and Roseate Tern as well as the Black-capped Petrel which is a candidate species) are expected to have limited exposure, and thus risk to individuals is unlikely.

Onshore habitat modification will be limited at the Cable Landing Location and along the Onshore Export and Interconnection Cable Routes, and little impacts are expected. The Interconnection Cable Routes and the Switching Station Alternatives would be located near areas identified as having high or very high ecological value and tree cutting has the potential to impact species of conservation concern habitat. Since these Onshore Project Components have the potential to impact bird habitat, Dominion Energy will conduct field surveys, if required, prior to construction activities, to identify if species of conservation concern are present and will work with BOEM, VDWR and USFWS to minimize potential impacts.

Table of Contents

List of Figures:

List of Tables:

List of Acronyms and Abbreviations

AC	alternating current
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
CSV	comma-separated value
EBS	Ecological Baseline Studies
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FAA	Federal Aviation Administration
ft	feet
ha	hectare
JSON	JavaScript Object Notation
km	kilometer
kW	kilowatt
m	meter
MBTA	Migratory Bird Treaty Act
MDAT	Marine-life Data and Analysis Team
mi	miles
MLLW	Mean Lower Low Water
MMS	Minerals Management Service
MW	megawatt
NEPA	National Environmental Policy Act
NCCOS	National Centers for Coastal Ocean Science
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
POI	Point of Interconnection
RSZ	rotor swept zone
SGCN	Species of greatest conservation need
USFWS	United States Fish and Wildlife Service
UTM	Universal Transverse Mercator
WEA	Wind Energy Area
WTG	Wind Turbine Generator

1 Part I: Introduction

1.1 Project Description

The Virginia Electric and Power Company, doing business as Dominion Energy Virginia (hereafter referred to as Dominion Energy), is proposing to construct, own, and operate the Coastal Virginia Offshore Wind (CVOW) Commercial Project (hereafter referred to as the Project). The Project will be located in the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS) Offshore Virginia (Lease No. OCS-A-0483; Lease Area), which was awarded through the Bureau of Ocean Energy Management (BOEM) competitive renewable energy lease auction of the Wind Energy Area (WEA) offshore of Virginia in 2013. The Lease Area covers approximately 112,799 acres (ac; 45,658 hectares [ha]) and is approximately 27 statute miles (mi; 23.75 nautical miles [nm], 43.99 kilometers [km]) off the Virginia Beach coastline (Figure 1-1).

The offshore components of the Project, including up to 205 Wind Turbine Generators (WTGs), with an expected minimum air gap and blade tip height of 82–804 [25–245 m] and maximum air gap and blade tip height of 112–869 ft [34–265 m]), and up to three Offshore Substations, will be located in federal waters within the Lease Area. The Offshore Export Cable Corridor will traverse both federal and state territorial waters of Virginia. The onshore components of the Project will include the Cable Landing Location, Switching Station, Onshore Substation, and Onshore Export and Interconnection Cable Route Corridors, and will be located in the cities of Virginia Beach and Chesapeake, Virginia. During construction, the Project will additionally involve temporary construction laydown area(s) and construction port(s). The operations and maintenance (O&M) stage of the Project will include an onshore (O&M) facility with an associated Base Port.

The locations of Offshore and Onshore Project Components for development of the Project have been selected based on the preliminary environmental and engineering site characterization studies that have been completed to date. These locations will be further refined by the final engineering design, as well as ongoing and continuing discussions, agency reviews, public input, and the National Environmental Policy Act (NEPA) review process.

The purpose of this Project is to provide between 2,500 and 3,000 megawatts (MW) of clean, reliable offshore wind energy; to increase the amount and availability of renewable energy to Virginia consumers; to create the opportunity to displace electricity generated by fossil fuel-powered plants, and to offer substantial economic and environmental benefits to the Commonwealth of Virginia. This Project represents a viable and needed opportunity for Virginia to obtain clean renewable energy and realize its economic and environmental goals.

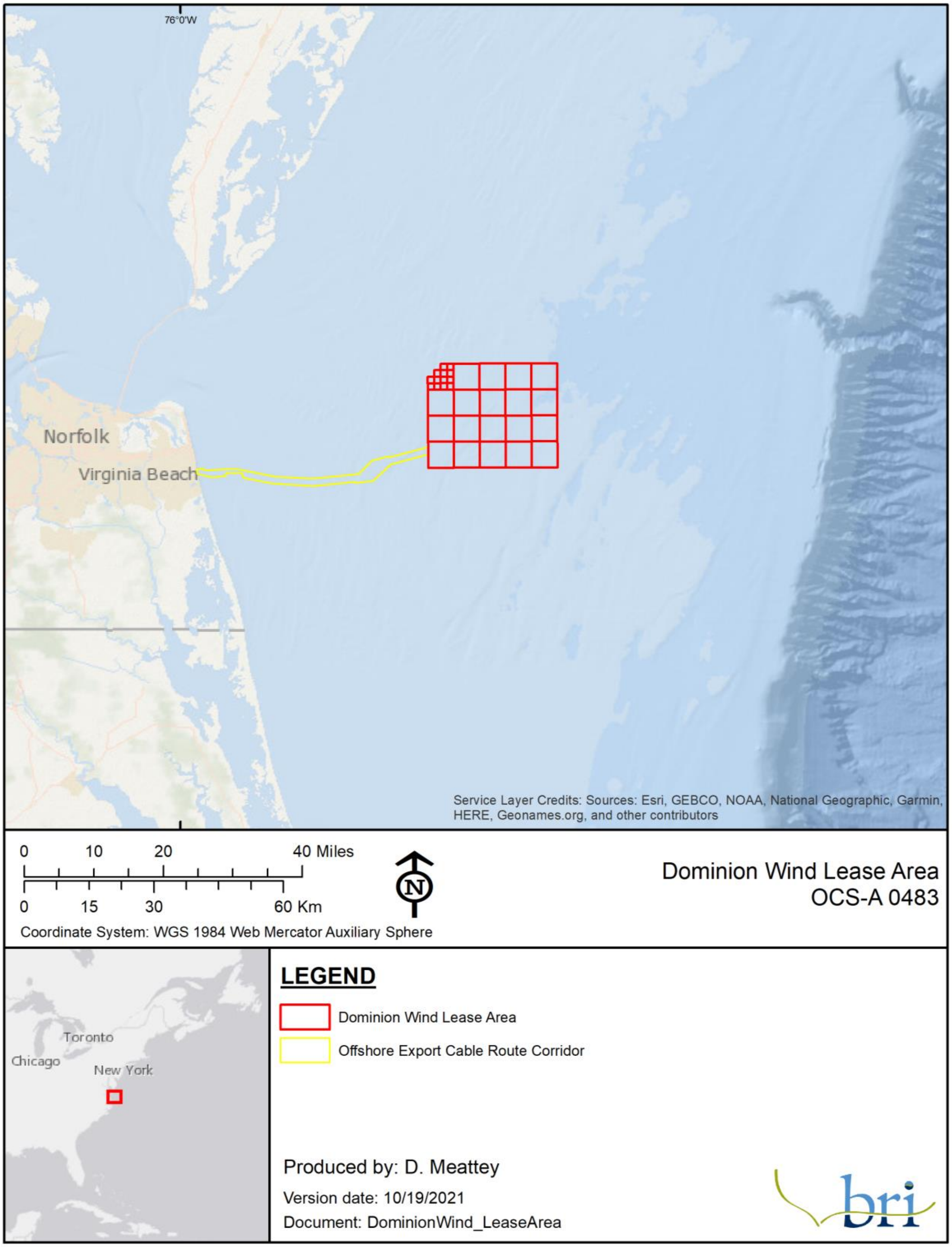

Figure 1-1. Overview of the Offshore Project Area

1.2 Wildlife Regulatory Background

Impacts to birds and bats are regulated primarily under three federal laws: the Endangered Species Act (ESA), the Migratory Bird Treaty Act (MBTA), and the Bald and Golden Eagle Protection Act (BGEPA). In addition, the National Environmental Policy Act (NEPA) requires that federal agencies evaluate environmental effects of major federal actions, including issuance of federal permits. Impacts to biological resources, including birds and bats, must therefore be identified and evaluated as part of the environmental review process for the Project. This assessment was developed to meet Construction and Operation Plan (COP) requirements (30 CFR 585.626), align with BOEM's 2020 Avian Guidelines (BOEM 2020b), provide information for NEPA review, and support agency consultations.

1.3 Assessment Approach

This assessment provides an overview of the species that have the potential to be affected by the proposed onshore and offshore activities, with separate sections on federally listed species. The potential impacts were evaluated for each stage (construction, operation, and decommissioning) of the Project, including habitat modification, collision, and displacement. For the Onshore Project Components, the assessment focused on the habitats that would potentially be disturbed, and the bat and bird species that may occupy each major habitat type.

For the offshore assessment, a semi-quantitative approach was taken that first described impact-producing factors (e.g., wind turbines), the species that would potentially be exposed to the impact-producing factors, and the vulnerability of the species exposed. The assessment process was as follows:

- *Impact-Producing Factors* – The first step in the assessment was to describe the impact-producing factors, which are the activities or Project Components that have the potential to pose a hazard to birds or bats. For the Project, wind turbine generators and vessels used for construction or maintenance are the impact-producing factors.

- *Exposure* – The next step in this process was to assess exposure for each species and each taxonomic group, where 'exposure' is defined as the extent of overlap between a species' seasonal or annual distribution and the Lease Area. For species where site-specific data was available, a semi-quantitative exposure assessment was conducted. The exposure of birds to the Lease Area was assessed using multiple datasets, species accounts (Birds of the World), and other information from a literature review. This assessment of exposure was focused exclusively on the horizontal, or two-dimensional, likelihood that a bird would use the Lease Area.

- *Relative Vulnerability* – Potential effects were then assessed qualitatively by combining the exposure assessment with the best information available on behavioral vulnerability to offshore wind. For the purposes of this analysis, 'behavioral vulnerability' is defined as the degree to which a species is expected to be affected by the Project based on known effects at similar offshore developments. This assessment of behavioral vulnerability was done using a quantitative scoring process for marine birds, and qualitatively for non-marine migratory birds and bats using information on avoidance behaviors, flight heights, and collision risks published in the literature.

- *Risk* – The likelihood that the Project would impact birds and/or bats was then evaluated using a weight-of-evidence approach, based upon the exposure and vulnerability assessments described above. Recognizing that there is uncertainty in any risk assessment, impacts were determined by considering the likelihood that the viability of the resource (i.e., birds and bats) would be threatened by the impact-producing factor. For non-listed species, the assessment provides information for BOEM to make their impact determination at a population level, as has been done for recent assessments of other WEAs (WEA; BOEM 2016b) and project-specific Environmental Impact Statements (EIS; BOEM 2018). For federally listed species, this assessment provides information on an individual level because the loss of one individual from the breeding population has a greater likelihood of affecting a population than non-listed species.

2 Part II: Bats

2.1 Overview of bats in Virginia

There are 17 species of bats known to occur in the Commonwealth of Virginia, 14 of those species have been documented within and adjacent to the Project Area (Table 2-1). These species can be divided into two major groups based on their wintering strategy: cave-hibernating bats and migratory tree bats (Fleming 2019). Both groups of bats are nocturnal insectivores that use a variety of forested and open habitats for foraging during the summer (Barbour and Davis 1969). Cave-hibernating bats are generally not observed offshore (Dowling and O'Dell 2018); in the fall, these bats migrate from summer habitat to winter hibernacula in the mid-Atlantic region (Maslo and Leu 2013). Migratory tree bats generally migrate to southern parts of the U.S. (Cryan 2003), with some species likely present year-round in Virginia (Timpone et al. 2011), and have been observed offshore during migration (Hatch et al. 2013).

Table 2-1. Bat species present in the Project Area and their conservation status (Virginia Department of Game and Inland Fisheries 2018).

Type[1]	Common Name	Scientific Name	VA State Status[3]	Federal Status[3]
Cave-hibernating bats	Little brown bat	*Myotis lucifugus*	E	
	Northern long-eared bat	*Myotis septentrionalis*	T	T
	Indiana bat	*Myotis sodalis*	E	E
	Southeastern myotis	*Myotis austroriparius*		
	Tri-colored bat	*Perimyotis subflavus*	E	
	Big brown bat	*Eptesicus fuscus*		
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	E	
	Brazilian free-tailed bat	*Tadarida brasiliensis*		
Migratory tree bats	Evening bat	*Nycticeius humeralis*		
	Eastern red bat	*Lasiurus borealis*		
	Seminole bat	*Lasiurus seminolus*		
	Hoary bat	*Lasiurus cinereus*		
	Silver-haired bat	*Lasionycteris noctivigans*		
	Northern yellow bat	*Lasiurus intermedius*		

[1] "Type" refers to two major life history strategies among bats in eastern North America; cave-hibernating bats roost in large numbers in caves during the winter (year-round residents), while migratory tree bats do not aggregate in caves and are known to migrate considerable distances.
[3] E = *Endangered*; T = *Threatened*.

Two federally listed bat species may overlap with the Project Area: the Indiana bat, and northern long-eared bat. The northern long-eared bat is found throughout the Commonwealth of Virginia, while the range of the Indiana bat does not typically include the eastern part of the state (Timpone et al. 2011; VDGIF 2020a; 2020b; 2020g). However, recent studies have documented presence of Indiana bats in the coastal plain of Virginia (Silvis et al. 2017; De La Cruz and Ford 2020), including possible year-round activity (De La Cruz and Ford 2018), and a maternity colony recently discovered in Caroline County (St. Germain et al. 2017). In addition, the northern long-eared bat and Indiana bat are also listed as state-threatened and -endangered species respectively (VDGIF 2018). Three other state-listed bat species may also overlap the Project Area: little brown bat, tri-colored bat, and Rafinesque's big-eared bat. Recent studies and monitoring efforts have suggested the presence of coastal populations of these species in Virginia (St. Germain et al. 2017; De La Cruz 2018; 2020; Tetra Tech 2019). Based on this available information, these federal and state-protected bat species are considered to have the potential to occur in or near the Project Area. Maternity colonies of northern long-eared bats have been found at Naval Auxiliary Landing Field Fentress (Figure 2-12).

Prior to severe population declines, northern long-eared bats were historically known to occur statewide in Virginia (VDGIF 2020d). Recent mist-netting and acoustic surveys indicate catch rates and acoustical detections of northern long-eared bats as still relatively low, but higher in the transition area from the Piedmont into the Coastal Plain than in the western mountains (De La Cruz and Ford 2018, 2020). This suggests that southeastern Virginia may be an increasingly important area for bats. Northern long-eared bats are an insectivorous species that hibernates in caves, mines, and other locations in winter, and spends the remainder of the year in forested habitats. Most known northern long-eared bat hibernacula in Virginia are reported along the western boundary of the state (VDGIF 2020e). The species' range includes most of the eastern and mid-western U.S. and southern Canada. Due to impacts from the fungal disease known as white-nose syndrome (WNS), the species has declined by 90–100% in most locations where the disease has occurred. This includes Virginia, where a comparison of pre- and post-WNS capture rates suggests significant declines (Reynolds et al. 2016). Declines are expected to continue as this disease spreads throughout the remainder of the species' range (USFWS 2016). As a result, northern long-eared bats were listed as *Threatened* under the ESA in 2015.

The northern long-eared bat is active throughout early spring to late fall (March-November; Brooks and Ford 2005; Pettit and O'Keefe 2017), though suspected non-hibernating populations appear to maintain some level of activity throughout the winter in southeastern Virginia and northeastern North Carolina (Figure 2-1; Grider et al. 2016; De La Cruz and Ford 2018). At summer roosting locations, northern long-eared bats form maternity colonies (aggregations of females and juveniles) where females give birth to young in mid-June. These maternity colonies are moved every 2-14 days by the females carrying their pups; colonies can consist of 1–30 female bats with pups (Menzel et al. 2002). Juveniles are flightless until mid-July (Carter and Feldhamer 2005). Adult females and volant juveniles remain in maternity colonies until mid-August, at which time the colonies begin to break up and bats begin migrating to their hibernation sites (Menzel et al. 2002). Bats forage around the hibernation site and mating occurs prior to entering hibernation in a period known as the "fall swarm" (Broders and Forbes 2004, Brooks and Ford 2005). During breeding and in the summer, northern long-eared bats have small home ranges (less than 25 ac [10 ha]; Silviset et al. 2016 *in* Dowling et al. 2017) and migratory movements can be up to 170 mi (275 km; Griffin 1945 *in* Dowling et al. 2017).

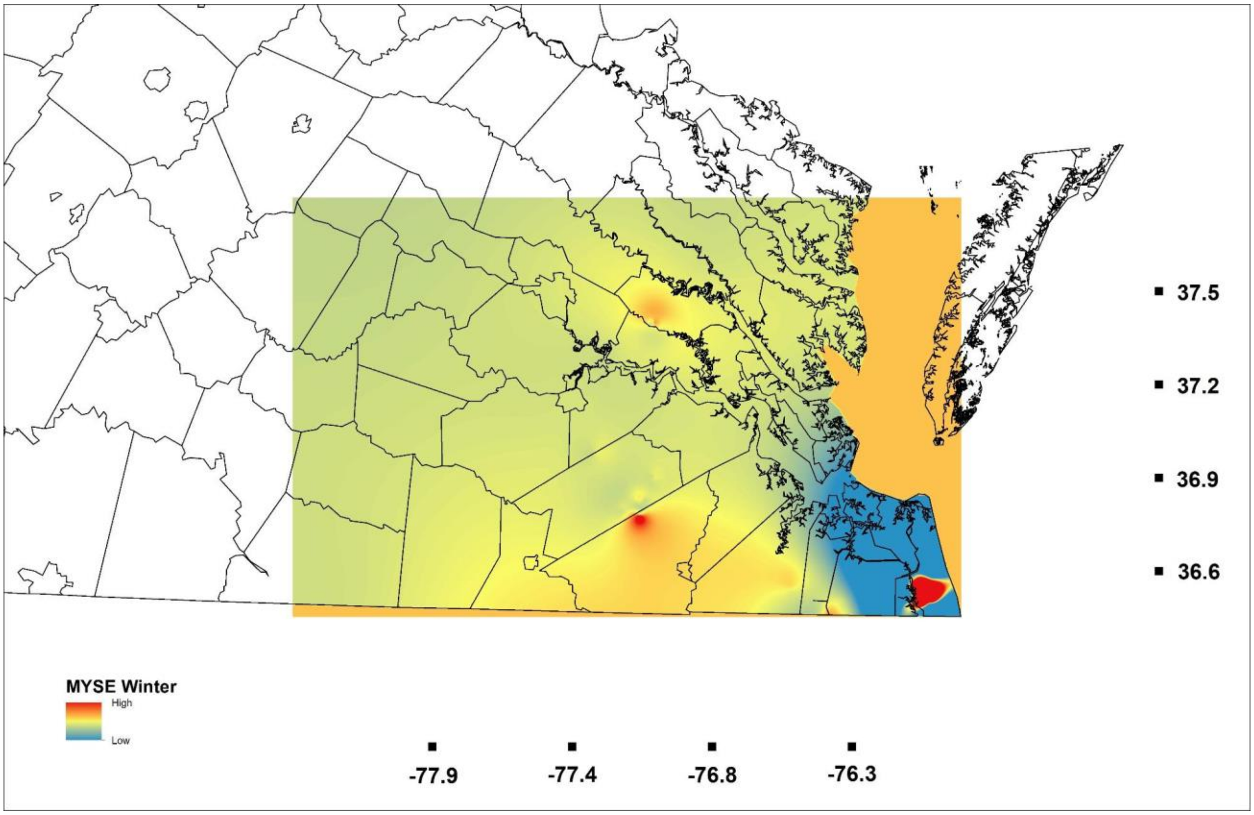

Figure 2-1. Relative activity of northern long-eared bats (*Myotis septentrionalis*) during winter in southeastern Virginia, 2017–2018 (Figure 12 in De La Cruz et al. 2018).

The Indiana bat was originally listed as in danger of extinction under the Endangered Species Preservation Act of 1966, is currently listed as *Endangered* under the Endangered Species Act of 1973 (U.S. Fish and Wildlife Service 2007), and is an International Union for the Conservation of Nature (IUCN) red-listed species (Arroyo-Cabrales and Ospina-Garces 2016). Indiana bats are primarily found in eastern and Midwestern parts of the U.S., with the range extending into some southern states (Thogmartin et al. 2013). After modest population growth through the mid-2000s, particularly in the Northeast, over 40,000 bats have been lost to white-nose syndrome, with over ~95% of populations expected to decline below extirpation thresholds in the next 50 years (Thogmartin et al. 2013). The summer range of Indiana bats in the state is also likely minimal outside the western portion of the state, although a maternity colony was recently discovered in Caroline County (approx. 110 mi. [177 km] from the Project Area), which is a first record in the Virginia coastal plain (St. Germain et al. 2017). In addition, recent acoustic studies and mist-netting efforts in southeastern Virginia have identified apparent year-round activity of Indiana bats in the coastal plain (Silvis et al. 2017; De La Cruz and Ford 2018).

The Indiana bat is typically active throughout early spring to late fall, though suspected non-hibernating populations appear to maintain some level of activity throughout the winter in southeastern Virginia and northeastern North Carolina (Figure 2-2; De La Cruz and Ford 2018). Indiana bats begin to emerge from winter hibernacula in caves and mines in early April and migrate to their summer breeding areas (Kurta and Murray 2002). During the summer, female Indiana bats form maternity colonies composed of 20–100 individuals, primarily roosting under exfoliating bark on trees or dead snags, and less commonly in cracks and crevices (Timpone et al. 2010; Carter and Feldhamer 2005; Foster and Kurta 1999). Dead snags are most commonly used for day-roosts, though use of live trees with exfoliating bark (particularly shagbark hickory [*Carya ovata*]) has been documented (Humphrey et al. 1977). Maternity roosts in the core breeding range have included several hardwood species (e.g., ash [*Fraxinus* spp.], oak [*Quercus* spp.], sweetgum [*Liquidambar* spp.]; Carter and Feldhamer 2005), while maternity roosts documented in the southeastern U.S. have been found commonly in conifer snags (Britzke et al. 2003). The first documented maternity colony in the coastal plain of Virginia was found in a loblolly pine (*Pinus taeda*; St. Germain et al. 2017). Indiana bat maternity colonies commonly use one or more primary roosts, with a series of alternate roosts that may be used less frequently by fewer bats during instances of poor weather (Humphrey et al. 1977), to access certain foraging grounds, or as a precaution against damage or loss of primary roost trees (Kurta and Murray 2002; Carter and Feldhamer 2005; Silvis et al. 2014). Foraging activity has been linked to riparian areas and forest edges (Jachowski et al. 2014; Menzel et al. 2005), as well as forested areas with high canopy cover (Womack et al. 2013), with relative plasticity in foraging range size based on resource availability.

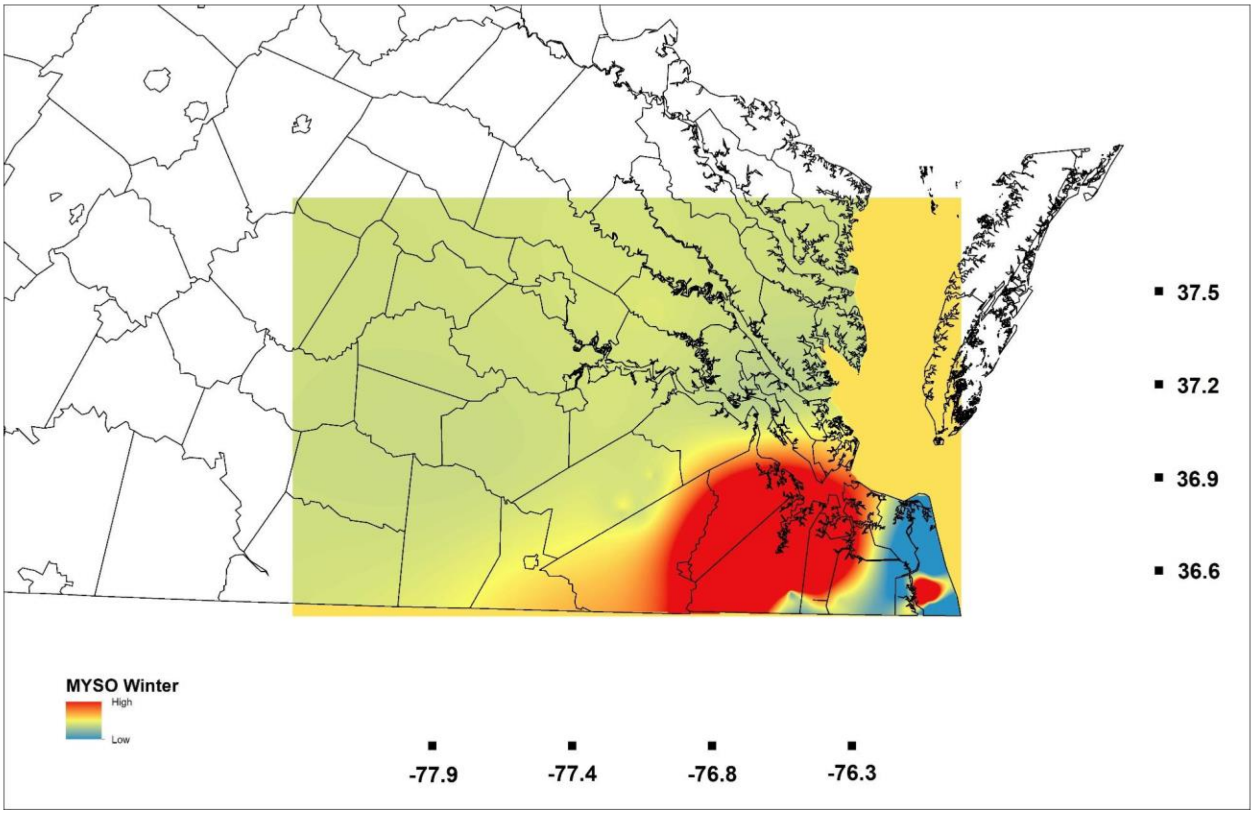

Figure 2-2 Relative activity of Indiana bats (*Myotis sodalis*) during winter in southeastern Virginia, 2017–2018 (Figure 15 in De La Cruz et al. 2018).

2.2 Methods

The impact assessment was conducted using a weight-of-evidence approach by evaluating (a) the likelihood bats will occur in the Project Area (i.e., exposure), and (b) the known vulnerability of bats to collisions with Onshore and Offshore Project Components. The likely presence of bat species was categorized based on criteria presented below, using the best available data and information on geographic range and habitat requirements (Table 2-2). Literature was used to determine vulnerability for each species or group, based on behavior, habitat requirements, seasonality of use, and known impacts associated with construction, operation, and decommissioning of proposed Project infrastructure.

Table 2-2. Exposure categories and definitions

Exposure category	Exposure definition
Minimal	Not likely to be present, and little to no evidence of use of the offshore/onshore environment for breeding, or wintering, and minor predicted use during migration.
Low	Little evidence of the use of the offshore/onshore environment and a low proportion of the population exposed.
Medium	Moderate evidence of the use of the offshore/onshore environment and a moderate proportion of the population is exposed.
High	Strong evidence of the use of the offshore/onshore environment, the environment is primary habitat, and a high proportion of the population is exposed.

2.2.1 Data sources

2.2.1.1 Northern long-eared bat surveys and radio telemetry near and within the Project Area

Tetra Tech, Inc. (Tetra Tech) was contracted by the U.S. Navy to conduct mist-netting and radio-tracking surveys for the federally *Threatened* northern long-eared bat at Naval Support Activity Hampton Roads Northwest Annex (NSAHR Northwest Annex or Installation), Naval Air Station Oceana, Naval Air Station Oceana Dam Neck Annex, and Naval Auxiliary Landing Field Fentress in Virginia and North Carolina between 2014 and 2019 (Tetra Tech 2016a, b, c, 2019). Northern long-eared bats, especially lactating females, were targeted for radio-tracking to locate maternity roosts and to characterize roost choices, but other rare, threatened, and endangered bats were also fitted with radio transmitters to maximize the number of transmitters deployed. If roosts were found, emergence counts were performed to identify the presence of maternity colonies. A home range or known habitat analysis was created from the compilation of capture sites and multiple roost sites to document the areas of the Installations that are being used by northern long-eared bats. At some Installations, bat detectors were deployed near mist-net sites during each survey night to inform siting and to survey for species more easily detected through acoustics than capture. The information in these studies provides additional information about bat distributions in the vicinity of the onshore Project Area to support the COP.

2.2.1.2 Acoustic Surveys Conducted by Tetra Tech

Eight different geophysical and geotechnical survey vessels were equipped with a full spectrum Wildlife Acoustics SM4 bat detector and a total of 592 bat passes were recorded in the Offshore Project Area across approximately 411 detector-nights from April 2020 to May 2021 (Table 2-3). The recorded passes were from the silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*)/Seminole bat (*Lasiurus seminolus*), hoary bat (*Lasiurus cinereus*), unidentified high frequency species, and unidentified low frequency species. Eastern red bats and Seminole bats are included in a single group because their echolocation calls are indistinguishable from each other during manual vetting, however eastern red bats are more common both onshore and offshore. All bat species confirmed were from migratory tree bats, but some cave species may be present in the unidentified high and low frequency groups for bat passes that are too low quality to distinguish the species (see Appendix O-2). During the survey period, eight bats were visually observed roosting on survey vessels during the day and night or flying around them during the day. Hoary bat, eastern red bat, and silver-haired bat were all observed, as were two that could not be identified. Six bats were observed in the fall of 2020 and two eastern red bats in the spring of 2021. Of these visual observations, four were observed while in the Lease Area, one offshore, one while docked in Norfolk, and two were unknown (see Appendix O-2 for more details).

Table 2-3. Summary of survey effort and bat activity from acoustic detectors deployed aboard research vessels in the Lease Area, 2020-2021 (see Appendix O-2).

Detector	Vessel	Survey Dates	Detector-Nights a/	Total Bat Passes During a Detector-Night b/	Activity Rates: Bat Passes/ Detector-Night (Standard Error) c/	Total Bat Passes d/
CVOW-1	Terrasond Sara Bordelon	04/14/2020-12/13/2020	73	73	1.00 (0.54)	170
CVOW-2	Alpine Ocean Shearwater	5/13/2020-7/23/2020	0	0	0.00 (0)	0
CVOW-3	Terrasond Marcelle	4/21/2020-12/18/2020	28	0	0.00 (0)	34
CVOW-4	Geoquip Speer	6/3/2020-7/30/2020	34	12	0.35 (0.35)	12
CVOW-5	Geoquip Dina Polaris	6/22/2020-10/1/2020	59	324	5.49 (2.54)	324
CVOW-6	Geoquip Saentis	6/26/2020-8/31/2020	10	0	0.00 (0)	0
CVOW-7	Terrasond Kommandor Iona	8/28/2020-11/30/2020	21	9	0.43 (0.30)	28
CVOW-8	Alpine Ocean Minerva	9/16/2020-11/13/2020	0	0	0.00 (0)	0
CVOW-9	Geoquip Dina Polaris	11/13/2020-5/13/2021	111	1	0.01 (0.01)	2
CVOW-10	Geoquip Speer	11/13/2020-3/12/2021	41	2	0.05 (0.05)	2
CVOW-11	Geoquip Saentis	3/20/2021-5/15/2021	34	19	0.56 (0.39)	20
Overall			**411**	**440**	**1.07 (0.39)**	**592**

a/ Detector nights include nights in which the vessel was within the Lease Area at both sunset and sunrise.
b/ Incudes bat passes recorded during nights fulfilling detector-night definition above.
c/ Activity rates include only bat passes recorded during nights fulfilling detector-night definition above.
d/ Incudes all bat passes recorded in the Lease Area regardless of the vessels' location at sunset and sunrise.

2.2.1.3 Coastal Virginia Offshore Wind Pilot Project Post-Construction Monitoring

Post-construction monitoring at the recently constructed CVOW Pilot Project (OCS-A 0497) has commenced in 2021, and results from these efforts will be incorporated into this report when they become available.

2.2.1.4 Offshore Observations of Eastern Red Bats (Lasiurus borealis) in the Mid-Atlantic United States Using Multiple Survey Methods

Aerial and boat-based surveys of wildlife in the mid-Atlantic region, conducted as part of the Mid-Atlantic baseline surveys (Figure 2-3; Williams et al. 2015), detected a possible migration event of eastern red bats in September 2012 (Hatch et al. 2013). Eleven bats were observed between 10.5 mi (16.9 km) and 25.9 mi (41.8 km) east of New Jersey. The information in this study provides additional information about bat distributions in the vicinity of the Lease Area to support the COP.

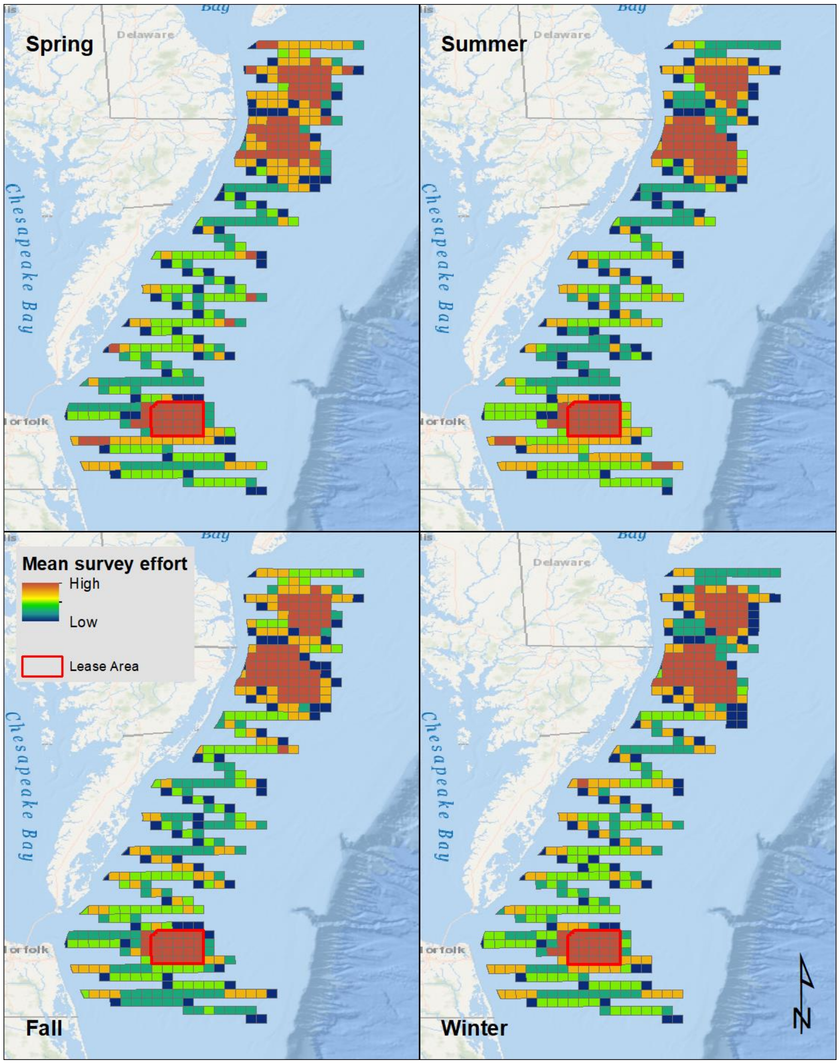

Figure 2-3. Seasonal survey effort of the Mid-Atlantic Baseline Surveys

2.2.1.5 Offshore Activity of Bats along the Mid-Atlantic Coast

The University of Maryland Center for Environmental Science conducted shipboard bat surveys using Anabat II detectors from March-October 2009 (Sjollema et al. 2014). The goal of this project was to study the offshore occurrence of bats along the Delmarva Peninsula. Acoustic monitoring of bats off the Atlantic coast (from Massachusetts to North Carolina) was conducted for 86 nights from March 2009 to August 2010 in spring (March-beginning of June) and fall (August–October). They recorded 166 bat detections over 898 hours of recording time. Maximum detection distance from shore was 13.6 mi (21.9 km) and mean distance was 5.2 mi (8.4 km). The information in this study is sufficient in spatial and temporal extent to describe the existing conditions of bat distribution in the vicinity of the Lease Area to support the COP.

2.2.1.6 Autumn Coastal Bat Migration Relative to Atmospheric Conditions: Implications for Wind Energy Development

Acoustic monitoring for bats was completed along the Atlantic coast of southern New England during fall (range August-October) 2010–2012 (Smith and McWilliams 2016). During 775 detector nights, 47,611 bat detections were recorded. The most commonly identified calls belonged to eastern red bats and silver-haired bats. Bat activity varied with regional wind conditions, indicative of cold fronts, and was strongly associated with various aspects of temperature.

2.3 Results

2.3.1 Offshore

This section discusses the species of bats that may be exposed to construction, operation, and decommissioning of the Offshore Project Components. The Lease Area covers approximately 112,799 acres (ac; 45,658 ha) and is approximately 27 statute miles (mi; 23.75 nm, 43.99 km) off the Virginia Beach coastline. The Offshore Project Components, including the WTGs and up to three Offshore Substations, will be primarily located in federal waters within the Lease Area, while the Offshore Export Cable Corridor will traverse both federal and state territorial waters of Virginia to the shore, but the cables are located on/within the seafloor and therefore are not expected to be an impact producing factor for bats, consistent with the Supplemental EIS for the Vineyard Wind 1 (VW1 SEIS) offshore wind project, which did not consider new cable laying as a hazard to bats (BOEM 2020b).

2.3.1.1 Exposure

While there is uncertainty on the specific movements of bats offshore in Virginia, bats have been documented in the marine environment in the U.S. (Grady and Olson 2006; Cryan and Brown 2007; Johnson et al. 2011; Hatch et al. 2013; Dowling and O'Dell 2018; Pelletier et al. 2013; Stantec 2016) and in Europe (Boshamer and Bekker 2008; Ahlén et al. 2009; Lagerveld et al. 2015; Lagerveld et al. 2020). Bats have been observed to temporarily roost on structures on nearshore islands, such as lighthouses (Dowling et al. 2017), and there is evidence of bats, particularly eastern red bats, migrating offshore in the Atlantic (Hatch et al. 2013). In the mid-Atlantic, only the silver-haired bat, eastern red bat, and hoary bat are considered to possibly migrate or forage in Wind Energy Areas in the region (BOEM 2012b; BOEM 2020). In a mid-Atlantic bat acoustic study conducted during the spring and fall of 2009 and 2010 (86 nights), the maximum distance that bats were detected from shore was 13.6 mi (21.9 km) and the mean distance was 5.2 mi (8.4 km; Sjollema et al. 2014). In the same acoustic study, 78% of all bat detections offshore were eastern red bats (166 bat detections during 898 monitoring hours), and bat activity decreased as wind increased (Sjollema et al. 2014). In addition, eastern red bats were detected up to 27.3 mi (44 km) offshore by high resolution video aerial surveys in the mid-Atlantic (Hatch et al. 2013). Acoustic bat detectors deployed aboard research vessels at sea have detected bat activity up to 80 mi (130 km) from shore (Stantec 2016).

Several studies outside of Virginia have also highlighted the relationship between bat activity and weather conditions, which may represent how bats behave offshore in the mid-Atlantic. In general, bat activity has been found to occur primarily during nights with warmer temperatures and low wind speeds (Fiedler 2004; Reynolds 2006; Cryan et al. 2014; Gorresen et al. 2020; Stantec 2016). Smith and McWilliams (2016) developed predictive models of regional nightly bat activity using continuous acoustic monitoring at several locations in coastal Rhode Island. Bat activity was found to steadily decrease with decreasing temperatures, and departures from seasonally normal temperatures increasingly inhibited bat activity later in the season (September through October). Although Smith and McWilliams (2016) found no association with wind speed and activity of migratory bats (primarily eastern red bats and silver-haired bats), they demonstrated a strong relationship with "wind profit," a variable that combines wind speeds and directions that would likely induce favorable conditions for coastal flight paths.

During the 2020-2021 offshore acoustic survey, 411 detector-nights were sampled within the Offshore Project Area from April 14, 2020 to May 15, 2021 and showed no presence of federally listed species (Appendix O-2). A total of 592 bat passes were recorded in the Offshore Project Area, with a mean of 1.07 bat passes per detector night. Species in the Offshore Project Area included only long distance migratory tree bats: eastern red bat/Seminole bat (0.36 bat passes per detector night), silver-haired bat (0.12 bat passes per detector night), and hoary bat (0.01 bat passes per detector night). Although the acoustic signatures of eastern red bat cannot be distinguished from Seminole bat, the activity documented in this survey likely represents eastern red bat because they are Virginia's most common tree bat, and are commonly documented offshore (Hatch et al. 2013, Dowling et al. 2017, VDWR 2021).

Bat passes were recorded at low levels in the spring and summer, and higher levels during the fall migratory period (85 percent, August 15 through November; Appendix O-2). Bat passes were distributed across the Offshore Project Area and although concentrations of passes occur, they often represent single nights with multiple bat passes and not repeated use of the same area over many nights. Twelve (12) groups of over ten continuously recorded bat passes total 409 bat passes or 69 percent of all bat basses recorded in the Offshore Project Area. This suggests a small number of individual bats contributing large amounts of bat activity. Bats were documented day and night roosting on the vessels within the Offshore Project Area.

In land-based surveys, bat activity levels are known to be affected by temperature and wind speed. Temperature is generally positively correlated with bat activity (Arnett et al. 2007; Wolbert et al. 2014) and high wind speed negatively correlated with bat activity (Arnett et al. 2007). However, this study did not find any significant correlation between temperature or wind speed and bat activity, which could be due to the different conditions recorded at the offshore weather buoy and at the vessel locations within the Lease Area, or simply that bat activity was unaffected by temperature or wind speed near the vessels (Appendix O-2). There was a significant correlation between bat activity and hour of the night with a pulse of activity between eight and ten in the evening and again between two and six in the morning.

The findings from this study are consistent with our current understanding of bat activity offshore and demonstrate low levels of bat activity (1.07 bat passes per detector night) within the area proposed for development and concentrated during the fall migration period (Appendix O-2). For comparison, activity rates in onshore pre-construction wind farm surveys averaged 1.89 bat passes per detector night with a range of 0.53 to 6.27 bat passes per detector night (Solick et al. 2020).

<u>Cave-hibernating bats</u>: Cave-hibernating bats in Virginia hibernate regionally in caves, mines, and other structures, and feed primarily on insects in terrestrial and fresh-water habitats. These species generally exhibit lower activity in the offshore environment than the migratory tree bats (Sjollema et al. 2014), with movements primarily during the fall (Peterson et al. 2014, Stantec 2016). Individuals of the *Myotis* genus are capable of, and may make, long distance offshore flights (Stantec 2016), but it is uncommon in the mid-Atlantic. In a mid-Atlantic study, the maximum distance *Myotis* bats were detected offshore was 7.2 mi (11.5 km; Sjollema *et al.* 2014). As shown by these studies, the use of coastline as a migratory pathway by cave-hibernating bats is likely limited to the fall migration period. Furthermore, acoustic studies generally indicate lower use of the offshore environment by cave-hibernating bats (as compared to tree-roosting species; BOEM 2020c) and cave-hibernating bats do not regularly feed on insects over the ocean. Results from the CVOW Commercial Project offshore bat acoustic survey for 2020 and 2021 did not document *Myotis* species in the Offshore Project Area or at any point during the survey (Figure 2-4). All identified bat species were migratory tree bats, but some cave-hibernating species may be present in the unidentified high and low frequency groups for bat passes that are not high enough quality to

distinguish species (see Appendix O-2). For these reasons, exposure to the Lease Area is considered ***minimal* to *low*** for cave-hibernating bats in general.

There remains uncertainty whether northern long-eared bats and Indiana bats travel offshore, since research on the movements of these bats in the marine environment is limited. If they were to migrate over water, movements would likely be in close proximity to the mainland. Based on available data collected during surveys and from the literature, northern long-eared bats and Indiana bats are not expected in the Lease Area, because they were not detected in the acoustic surveys and, like other cave-hibernating bats, they do not regularly use the offshore environment for foraging or migrating (BOEM 2020c; BOEM 2019; Dowling et al. 2017). Given that there is little evidence of use of the offshore environment by northern long-eared bats or Indiana bats, exposure is expected to be ***minimal***.

Migratory tree bats: Tree bats generally migrate to southwestern and southern parts of the U.S., including coastal regions, to overwinter (Cryan 2003; Cryan et al. 2014), and have been documented in the offshore environment (Hatch et al. 2013). Eastern red bats were detected in the mid-Atlantic up to 25.9 mi (41.8 km) offshore by high resolution video aerial surveys (Hatch et al. 2013). The bats observed in the Hatch et al. (2013) study were all observed in September to the north of the WEA off the coast of Delaware and Maryland, as shown in Figure 2-5. Eastern red bats have been detected migrating from Martha's Vineyard late in the fall, and one bat was tracked as far south as Maryland (Dowling et al. 2017). This particular bat made a single-night jump from Martha's Vineyard to Cape May, NJ – a straight line journey of approximately 280 mi (450 km) that could possibly have taken the bat up to 62 mi (100 km) from shore, if it traveled in a direct path. These results are supported by historical observations of eastern-red bats offshore, as well as acoustic and survey results (Hatch et al. 2013; Peterson et al. 2014; Sjollema et al. 2014). Acoustic surveys conducted within the Lease Area positively identified only migratory tree bat species, including eastern red bats, hoary bats, and silver-haired bats. Tree bats are most likely to pass through the Lease Area during the migration period (late summer/early fall), but their use of the Lease Area would "likely be rare" (BOEM 2012). Furthermore, in the VW1 SEIS, BOEM determined that tree bats offshore use is expected to be "very low and limited to spring and fall migration periods" and "under very specific conditions like low wind and high temperatures" (BOEM 2020b). Since bat movement offshore is generally limited to fall migration, spatiotemporal exposure is expected to be ***low***.

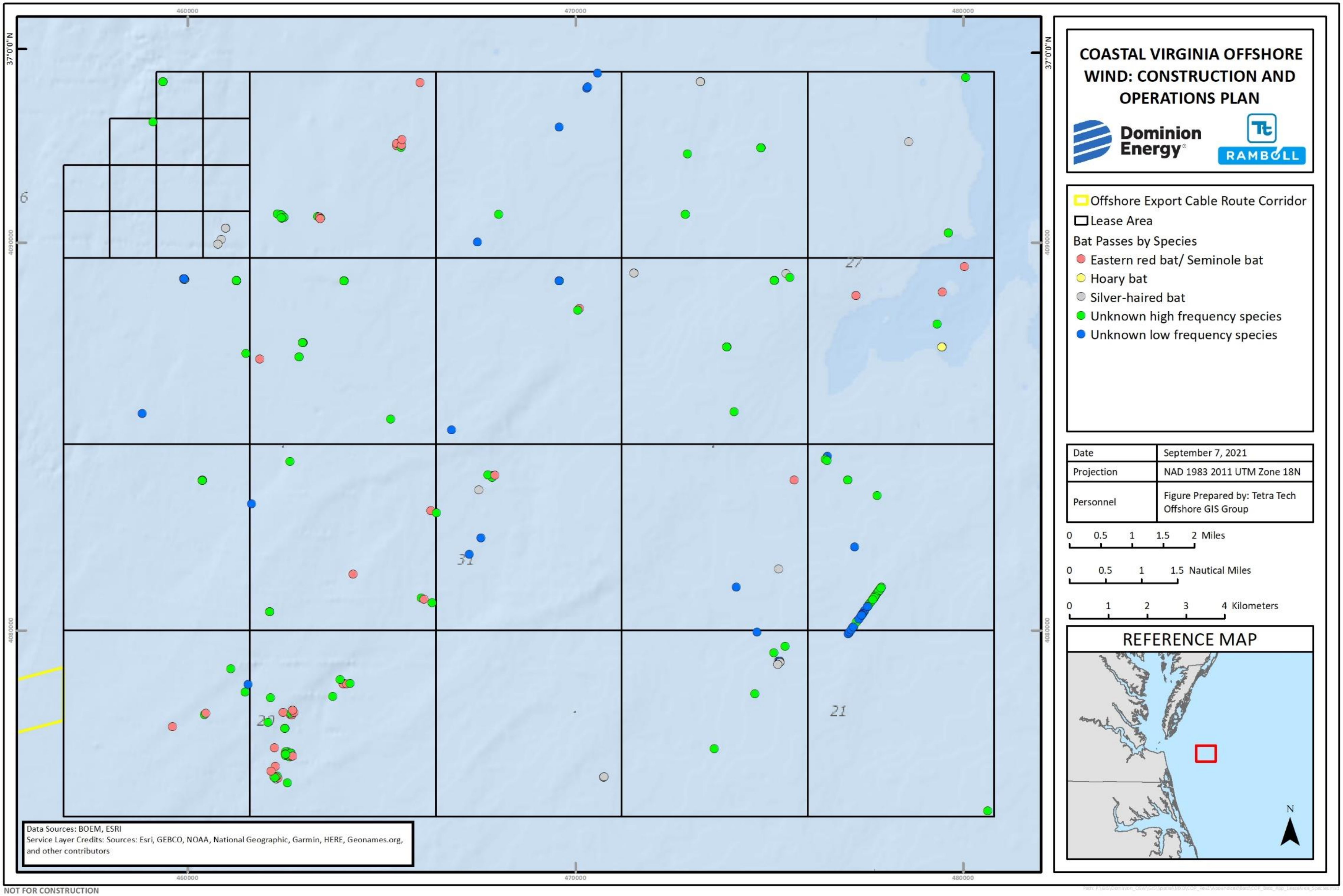

Figure 2-4 Bat passes by location and species in the Lease Area, 2020-2021.

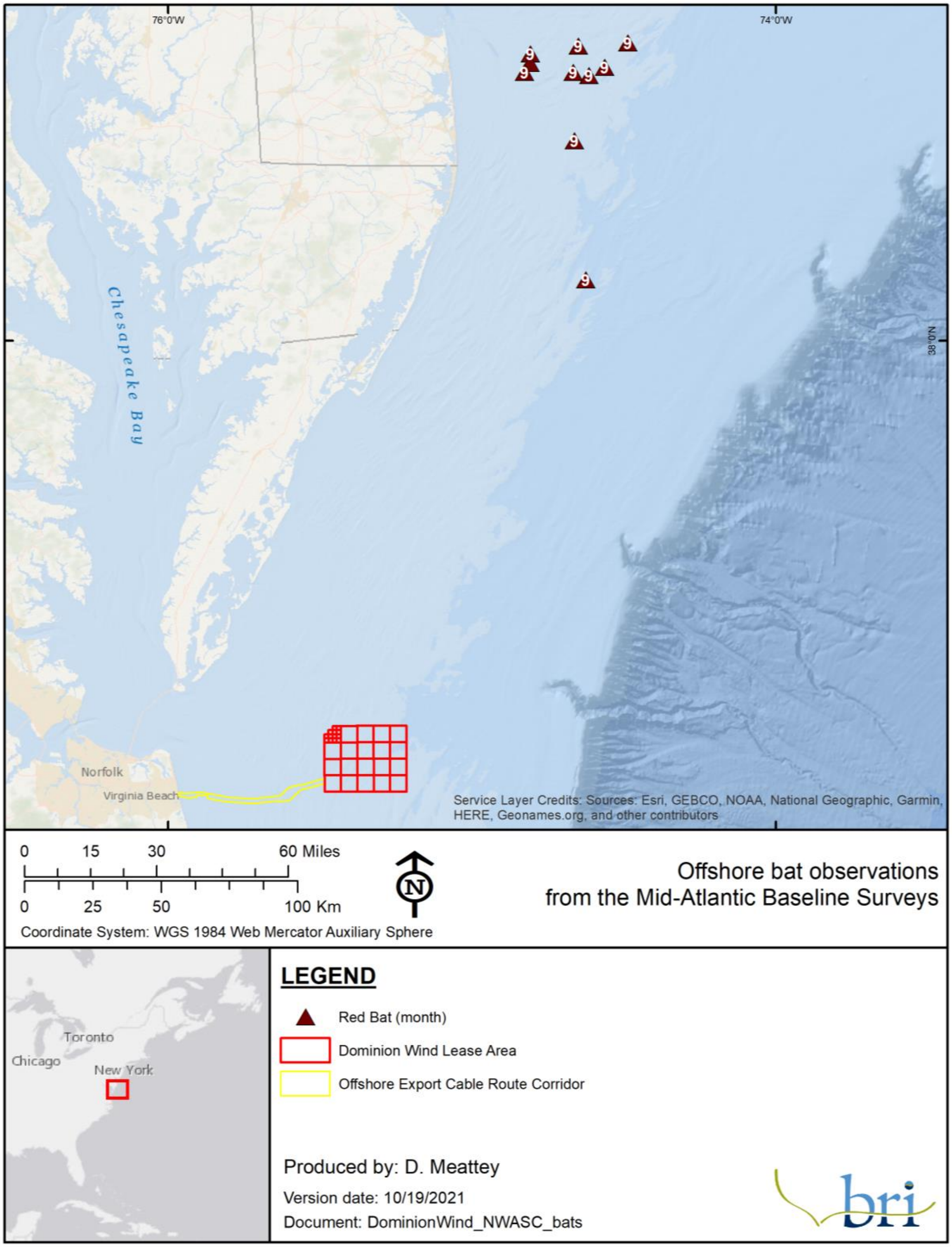

Figure 2-5 Location of eastern red bats detected in the mid-Atlantic baseline surveys.

2.3.1.2 Impacts

2.3.1.2.1 Impact Producing Factors

Offshore, the primary hazards bats may be exposed to are construction and maintenance vessels and wind turbines. Except for vessel activities during construction, the Offshore Export Cable Route is not considered a hazard for bats (BOEM 2020b) and therefore no impact analysis was conducted. For the analysis below, the full range of turbine sizes that may be used by the Project are considered and it is also assumed that foundation type will not significantly change the hazards during construction.

2.3.1.2.2 Construction and Installation

Bats may be attracted to the offshore construction areas, including lighted vessels, as they are moving throughout the Offshore Project Components. Bats at onshore wind facilities have been documented showing higher attraction and more frequent approaches to turbines when the blades are not spinning (Cryan et al. 2014a), so attraction may be stronger during the construction period prior to operation of turbines. However, stationary objects are not generally considered a collision risk for bats (BOEM 2014) due to their use of echolocation (Johnson et al. 2004; Horn et al. 2008) and as such, individual bats are unlikely to collide with construction equipment or offshore facility structures during construction. BOEM determined that noise from pile-driving is short-term, temporary, and highly localized; is not expected to cause direct impacts (i.e., hearing loss); and, while bats may avoid offshore construction areas, indirect effects (and direct effects) are expected to be negligible (BOEM 2020b). Furthermore, exposure to construction and installation infrastructure is temporary so population level impacts are unlikely.

2.3.1.2.3 Operation and Maintenance

During migration, bats may be attracted to the Offshore Project Components by lighted maintenance vessels, turbines, and substations. The primary potential impact of the operational component of the Project to bats is mortality or injury resulting from collision with WTGs, and, based on collision mortalities documented at terrestrial wind farms, all bats with potential to occur within the Lease Area are vulnerable to collision. Barotrauma from extreme pressure changes near rotating turbine blades has also been hypothesized as a contributor to bat mortality at terrestrial wind farms (Baerwald et al. 2008), though more recent studies have suggested collisions likely account for most mortalities (Lawson et al. 2020). At terrestrial wind farms in the U.S., bat mortality has been documented (Cryan and Barclay 2009, Hayes 2013, Smallwood 2013, Martin et al. 2017, Pettit and O’Keefe 2017) predominantly impacting migratory tree-roosting bats (Kunz et al. 2007). The highest proportion of bat fatalities tends to occur in late summer and early fall (Cryan 2008, Măntoiu et al. 2020), and some studies suggest that population-level effects could result without proper fatality reduction measures (Frick et al. 2017, EPRI 2020). In Europe, there is some evidence to suggest that bats forage over the surface of the ocean, and increase their altitude when foraging around obstacles (i.e., lighthouses and wind turbines; Ahlén et al. 2009). In addition to foraging behavior, fatality risk in the offshore environment may also be influenced by flight height during migration. Bats migrating over the Baltic Sea have been observed frequently flying below 33 ft (10 m; Ahlén et al. 2009) and bats observed during ship-based surveys in the North Sea flew at heights between 16–66 ft (5–20 m; Lagerveld et al. 2014). Brabant et al. (2018) reported that offshore acoustic bat activity recorded at nacelle height is significantly less than at lower heights, though high altitude flight offshore (particularly during migration) has been reported in the eastern U.S. (Hatch et al. 2013), and is likely a common occurrence elsewhere (Hüppop and Hill 2016). Fatality risk to offshore wind infrastructure may also be influenced by exploratory behavior around WTGs (Ahlén et. al. 2009), attraction to red aviation lighting (Voigt et al. 2018), and daytime roosting opportunities (Lagerveld et al. 2017).

Several studies have investigated the impacts of different lighting methods on attraction and avoidance behaviors in bats. Red aviation lights on top of WTG towers have been considered to be a potential source of interest to bats (Voigt et al. 2018); however, studies have shown that mortality at land-based towers with aviation lights is similar to or even less than mortality at towers without aviation lights (Arnett et al. 2008, Bennett and Hale 2014). Bennett and Hale (2014) reported higher red bat fatalities at unlit WTGs in comparison with those lit with red aviation lights. Bats may also be attracted to maintenance vessels servicing WTGs and Offshore Substation(s), particularly if insects are drawn to the lights of the vessels.

Bats are not expected to regularly forage in the Lease Area but may be present during migration (BOEM 2012; BOEM 2020). As discussed above, the exposure of cave-hibernating bats to the Lease Area is expected to be minimal to low because they are rarely encountered offshore and would only occur on rare occasions during migration. Therefore, population level impacts to cave hibernating bats are unlikely during offshore operations of the Project. Furthermore, the Offshore Project Components are expected to pose little to no to risk to individual northern long-eared bats and Indiana bat because these species are highly unlikely to forage or migrate offshore.

Migratory tree bats have the potential to pass through the Lease Area, but overall a small number of bats are expected in the Lease Area (BOEM 2020b), given its distance from shore (BOEM 2012). While there is evidence of bats visiting wind turbines close to shore (2.5–4.3 mi [4–7 km]) in the Baltic Sea (enclosed by land; Ahlén et al. 2009; Rydell and Wickman 2015) and bats are demonstrated to be vulnerable to collisions, bats entering the Lease Area are expected to occur in low numbers (relative to the population), which would be primarily during late summer/fall migration. Therefore, population-level impacts are unlikely. In a different region, this finding is consistent with the Supplemental Environmental Impact Statement developed by BOEM for the Vineyard Wind 1 project, which found that the direct and indirect impacts of the project would be "negligible to minor" (BOEM 2020b).

2.3.1.2.4 Decommissioning

In general, decommissioning activities are expected to resemble construction activities and will involve removal of some portions, or all, of the Project infrastructure. Thus, the potential impact to bats from decommissioning is expected to be equal to or less than impacts from construction. For these reasons, decommissioning of the offshore portion of the Project is unlikely to impact populations of bats of any species.

2.3.2 Onshore

This section discusses the species of bats that may be exposed to construction and operation of the Onshore Project Components, which include the Cable Landing Location, Onshore Export Cable, Switching Stations, Interconnection Cables, and Onshore Substation (see Onshore bird section for further details). The Onshore Project Area is located within the heavily developed cities of Virginia Beach and Chesapeake, characterized by dense residential and commercial developments, forested wetlands, major watercourses and associated floodplains, the Intracoastal Waterway, agricultural fields, military airfield facilities, sports complexes, and golf courses. Onshore Project Components are discussed below.

- *Cable Landing Location*: The Offshore Export Cable will transition to shore using trenchless installation and will terminate in the Proposed Parking Lot, west of Firing Range at SMR, located east of Regulus Avenue and north of Rifle Range Road (Figure 2-6). The proposed parking lot does not provide important habitat for any bat species.

- *Onshore Export Cable Route*: Cable Landing Location to Common Location north of Harpers Road (Figure 2-7):

The Onshore Export Cable will be buried within the previously disturbed areas (See Onshore Birds section), and construction will largely avoid cutting trees or disturbing vegetation. In some areas, individual trees or vegetation immediately adjacent to the Onshore Export Cable Route Corridor may need to be removed.

The Onshore Export Cable Route passes through several habitat types, including open water, developed, forested, shrub/scrub, agricultural field, and wetlands (See Onshore Birds section) and includes areas that have been identified as having general to very high ecological value. Roost trees and nighttime foraging locations of non-listed species (e.g., tricolored bat, southeastern *Myotis*) have been identified in the forested areas bordering Birdneck Road (Tetra Tech 2019). Tri-colored bats are state-listed as *Endangered* in Virginia, thus making these areas of added importance for this species. Bat mist-netting efforts in the vicinity of this route (within 0.5 mi [0.8 km]), particularly along Birdneck Road and within the SMR have not reported captures of any federally listed species. Acoustic analysis in this same area (within 0.5 mi [0.8 km] of Onshore Export Cable Route) had no confirmed northern long-eared bat calls. While 16 passes were classified as Indiana bat by acoustic analysis software, presence was not confirmed during manual vetting (Tetra Tech 2019). The calls of Indiana bats and little brown bats are nearly indistinguishable, and recent studies have suggested the presence of coastal populations in Virginia (St. Germain et al. 2017, De La Cruz and Ford 2018, 2020), so the absence of the Indiana bat cannot be assumed.

- *Switching Station Alternatives:* The station would be constructed to collect power and transition from underground transmission line to overhead transmission line, and would be located either north of Harpers Road on Navy property (Interconnection Cable Route [Alternatives 1 through 5] or north of Princess Anne Road [Alternative 6]; Figure 2-9). The parcels consist of a mix of forested, woody wetlands, developed areas, and agricultural field. The Switching Station operational footprint is anticipated to be a maximum of approximately 26.3 ac (10.6 ha) north of Harpers Road or 22.3 ac (9.0 ha) north of Princess Anne Road, depending on which alternative is selected, including any associated stormwater facilities, parking areas, etc. The Harpers Switching Station is expected to be constructed within part of an existing golf course on Navy property, resulting in minimal vegetation clearing. The Chicory Switching Station is located in an area of mixed forest and vegetation clearing will be required.

- *Interconnection Cable Route Alternatives*: Interconnection Cable Route Alternatives run from the Common Location north of Harpers Road to Fentress Substation. There are currently six alternatives under consideration (Figure 2-8): five overhead and one hybrid (a combination of overhead and underground). The underground section of the hybrid route alternative is co-located with existing roadways and overhead transmission lines are primarily co-located with either roadways or existing transmission corridors to varying degrees (See Onshore Birds section). The Interconnection Cable Routes pass through several habitat types, including open water, developed, forested, shrub/scrub, agricultural field, and wetland (See Onshore Birds section). There are three broad portions of the Interconnection Cable Route Alternatives. The first portion is from the Common Location north of Harpers Road up to the forested and wetland habitat adjacent to the North Landing River, which primarily passes through a mix of urban developed areas and agricultural land. The second portion passes through a relatively undisturbed area of mixed forest, wetlands, and riverine habitat associated with the North Landing River (i.e., Gum Swamp) and is assessed to have "very high" ecological value. The third portion passes through a mix of agricultural land and wetlands adjacent to a canal. While each of the sections may provide roosting and/or foraging habitat for bats, the central portion around the North Landing River likely provides the greatest amount of high-quality habitat.

- *Onshore Substation*: There is one Onshore Substation site associated with the Project Area. The Interconnection Cable Route Alternatives will terminate at the Fentress Substation. The Fentress parcel consists of an existing substation and surrounding forest habitat (Figure 2-11). Proposed construction activities include the expansion of the existing substation footprint from approximately 12 acres (4.9 ha) to an additional 13 acres (5.3 ha), for a total of approximately 25 acres (10 ha). Limited tree cutting may be required in the area adjacent to the substation. The forest is in an area that is bordered by agricultural areas, urban development and roads, and could provide limited roosting and/or foraging habitat.

Figure 2-6. **Proposed Onshore Cable Landing Location.**

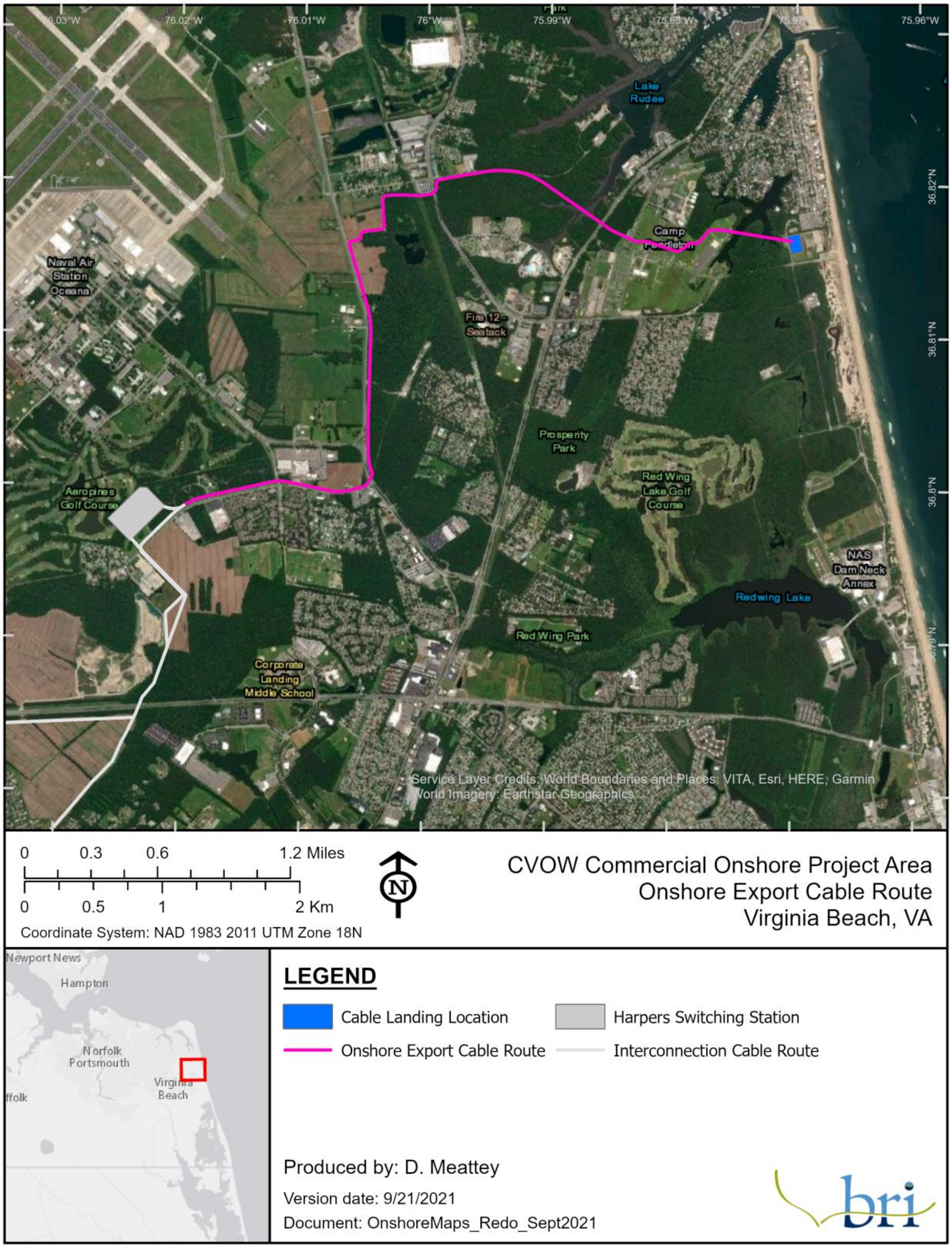

Figure 2-7. Overview of the proposed CVOW Commercial Onshore Export Cable Route.

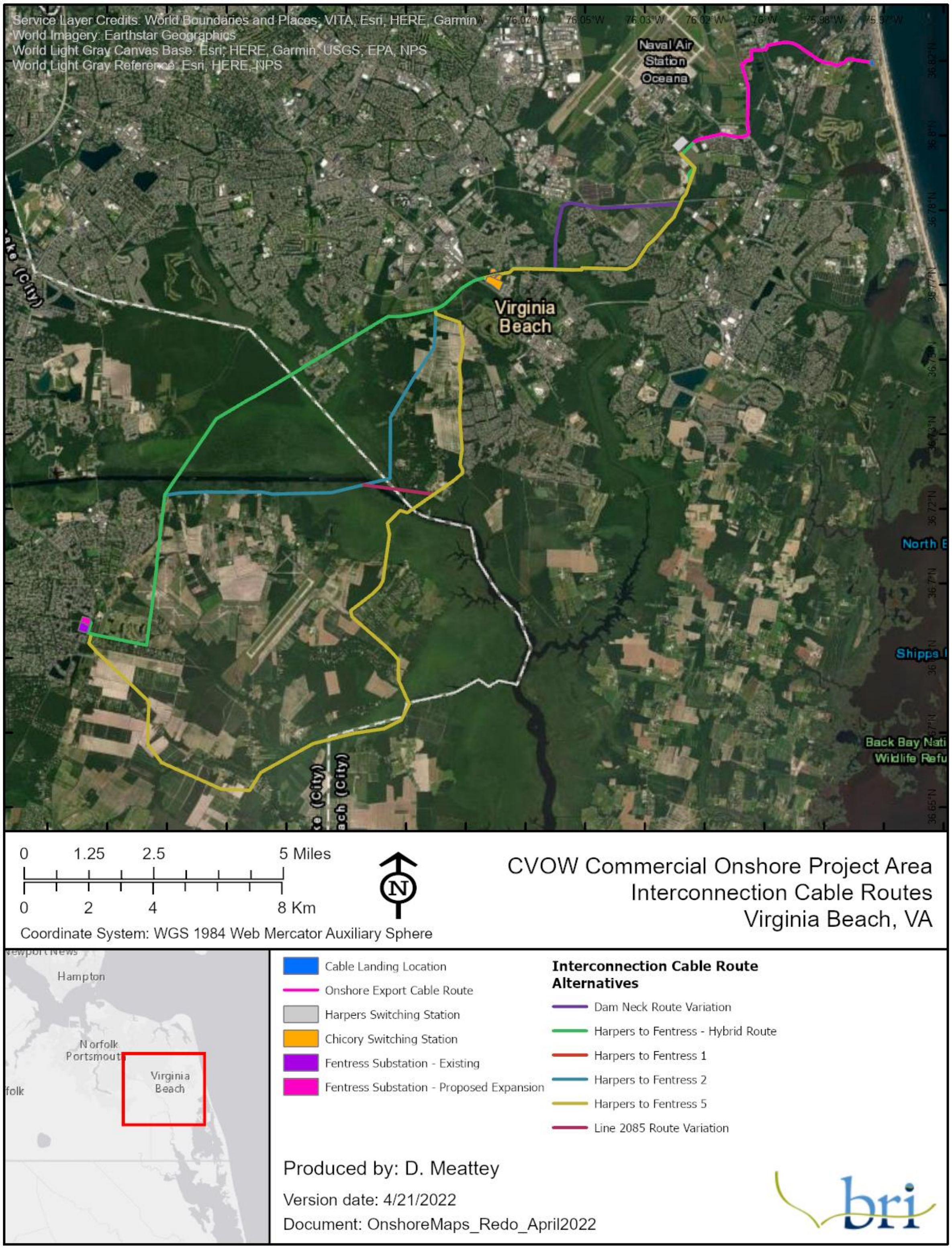

Figure 2-8. Overview of the proposed CVOW Commercial Interconnection Cable Route Alternatives.

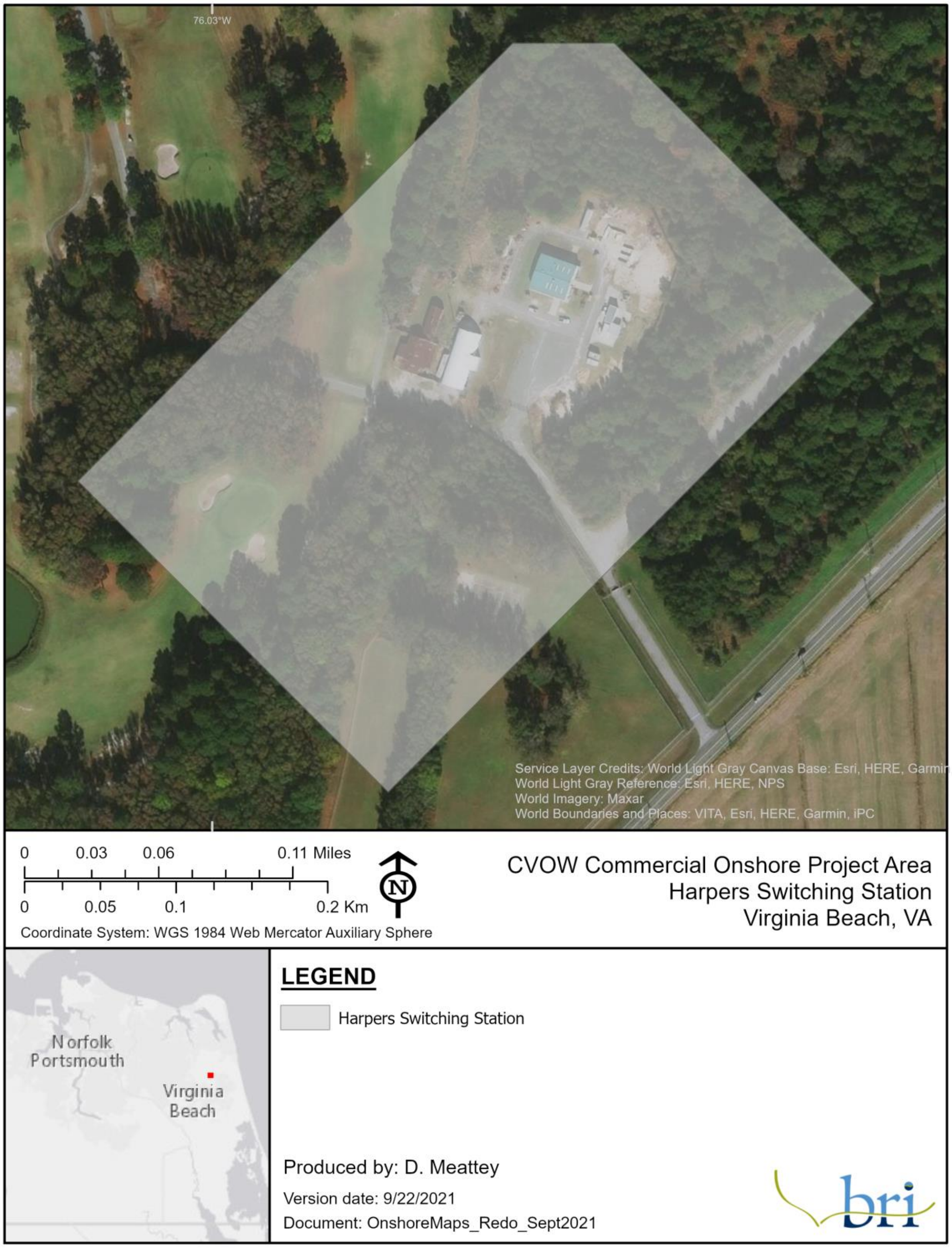

Figure 2-9. Harpers Switching Station Parcel.

Figure 2-10. Chicory Switching Station Parcel

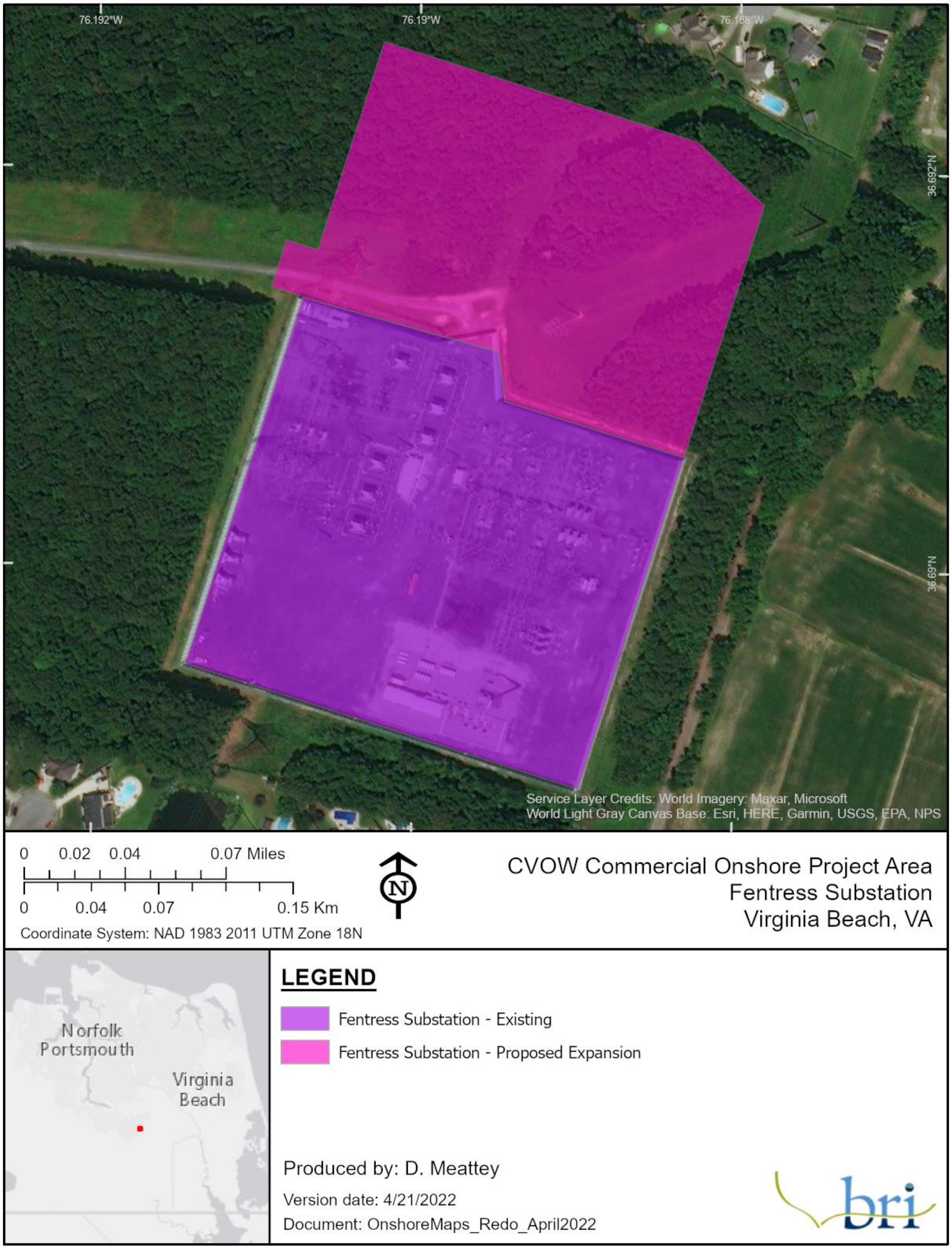

Figure 2-11. Onshore Substation (Fentress) Parcel.

2.3.2.1 Exposure

All bat species present in Virginia are nocturnal insectivores. Preferred foraging habitats vary among species. Foraging habitat selected may be linked to flight and echolocation capabilities, as well as preferred diets (Norberg and Rayner 1987). Small, maneuverable species, like northern long-eared bats and little brown bats, can forage in cluttered conditions, such as the forest understory or small forest gaps. Larger, faster-flying bats, such as hoary bats, often forage above the forest canopy or in forest gaps (Taylor 2006). Some species, such as little brown bats and tri-colored bats, regularly forage over water sources. Several bat species are also known to use waterways as foraging areas, as well as travel corridors (Barbour and Davis 1969, Brooks and Ford 2005).

Forested habitats, such as areas adjacent to the potential onshore cable routes, can provide roosting and/or foraging areas for both migratory and non-migratory species. All bat species present in Virginia (migratory and non-migratory) are known to use forested areas of varying types during summer for roosting and foraging. Some of these species roost solely in the foliage of trees, while others select dead and dying trees where they roost under peeling bark or inside crevices. Some species may select forest interior sites, while others prefer edge habitats (Barbour and Davis 1969; Silvis et al. 2016).

Caves and mines provide key habitat for non-migratory bats. These locations serve as winter hibernacula, fall swarm locations, and summer roosting locations for some individuals. Four main factors are understood to determine whether a cave or mine is suitable for use as a hibernaculum: low levels of disturbance; suitable temperature; humidity; and airflow (Tuttle and Taylor 1998). While the nearest known hibernacula occur far from the Project Area along the western and northwestern borders of the state, maternity roosts and active detections (mist net captures and acoustic recordings) have been reported for northern long-eared bats in areas around Virginia Beach, with the nearest reported maternity roosts located adjacent to the Fentress Air Field and in close proximity (within 1,000 ft [305 m]) to some proposed Interconnection Cable Route Alternatives (Figure 2-12). In addition, recent acoustic studies have documented year-round use by both northern long-eared bats and Indiana bats in nearby areas (e.g., Great Dismal Swamp NWR and Princess Anne WMA; Figure 2-1, Figure 2-2), suggesting the presence of non-hibernating overwintering populations, and highlighting the coastal plain as a potentially important refuge for several bat species affected by WNS (De La Cruz and Ford 2018, 2020). No captures, and only one confirmed acoustic detection, of northern long-eared bat were reported and no captures or acoustic detections of Indiana bat were reported during surveys at NAS Oceana Dam Neck Annex, located near the Onshore Project Area (within approximately 2 mi [3.2 km] of Cable Landing Location and Onshore Export Cable Route) (Tetra Tech 2016a, 2019).

Overall, both cave-hibernating and migratory tree bats may occur within or in the vicinity of the Onshore Project Area. The Cable Landing Location is unlikely to provide bat habitat and bats species are unlikely to use the urbanized, developed areas within the onshore portions of the Project Area. While bats may be present in habitat adjacent to the Onshore Export Cable Route, exposure is considered ***minimal*** to ***low***, because the route is primarily co-located with existing development areas. Developed areas are unlikely to provide high quality foraging or roosting habitat. Routing through existing disturbed areas will also lessen the amount of clearing or habitat disturbance. The Interconnection Cable Route Alternatives have the potential to provide core habitat, as they vary in their degree of co-location within existing disturbed areas (e.g., roads, transmission corridors) and pass through several areas designated as high or very high ecological value. For these reasons, bat exposure to Interconnection Cable Routes is considered to be ***medium*** to ***high***. At the potential Switching Station locations there is some likelihood that bats could use the treed areas for foraging and roosting and open field areas for foraging during the bat active period (generally April to October), as well as potentially during the winter if non-hibernating populations persist in this area. Therefore, exposure to the Switching Station Alternatives is considered ***low*** to

medium. Exposure to the Onshore Substation is considered ***low***, because it is primarily located in existing disturbed areas.

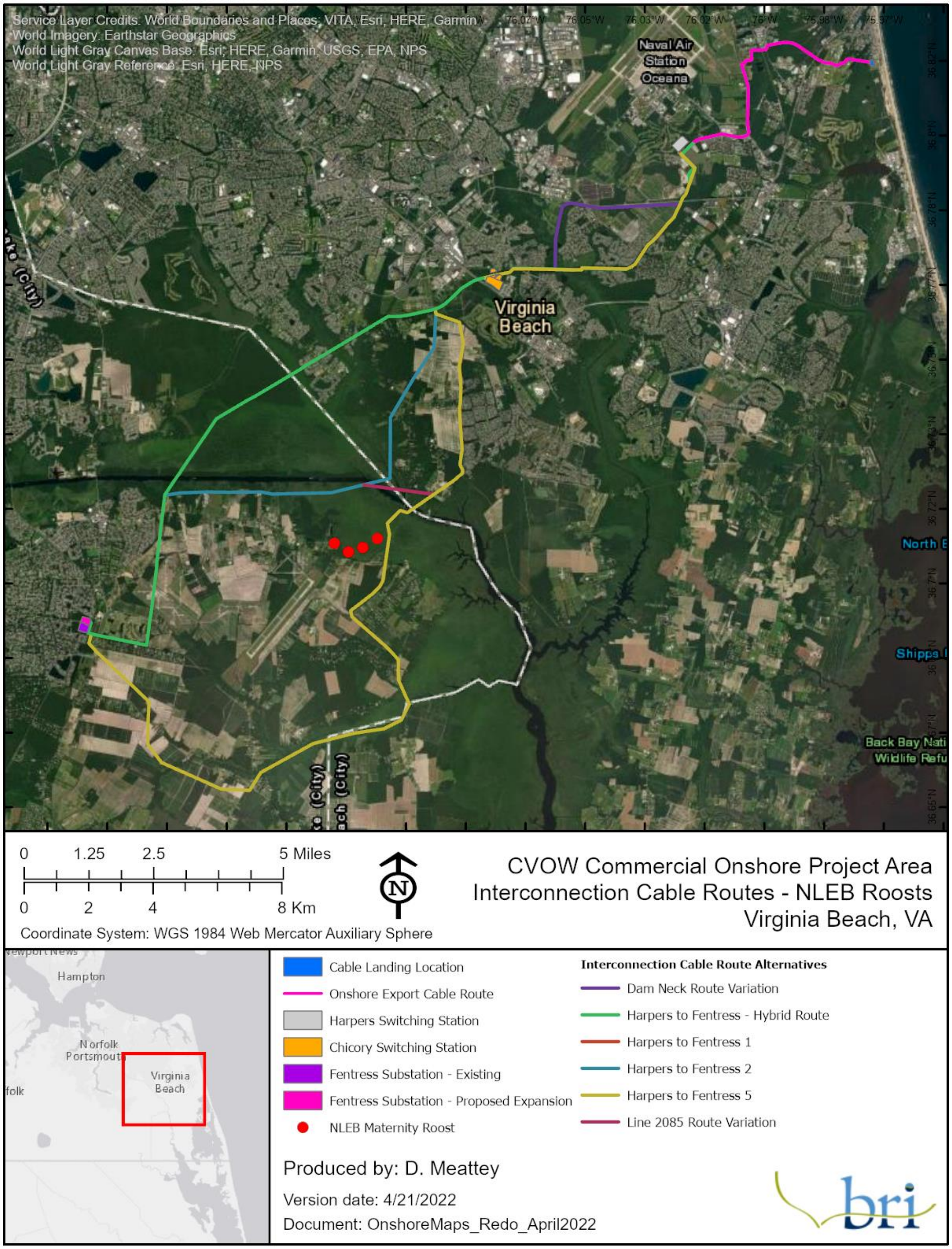

Figure 2-12. Known NLEB maternity roosts in relation to the CVOW Interconnection Cable Route Alternatives (Tetra Tech 2016c, VDGIF 2020e).

2.3.2.2 Potential Impacts

2.3.2.2.1 Impact Producing Factors

Onshore, the primary hazard is temporary and/or permanent habitat modification (e.g., tree clearing, vegetation clearing, and soil disturbance) during construction. During operation, maintenance activities have the potential to cause temporary habitat modification (e.g., ground disturbance), but disturbance would generally be similar to or less than the construction of the Onshore Export Cable (e.g., impact smaller areas for short durations). As stationary objects are not generally considered a collision risk for bats (BOEM 2014) due to their use of echolocation (Johnson et al. 2004; Horn et al. 2008), overhead transmission lines are generally not considered a hazard for bats. Thus, onshore operations are not expected to have any specific long-term hazards.

2.3.2.2.2 Construction and Installation

Habitat Modification

Cable Landing Location: Overall, coastal disturbance during construction will be temporary and there will be little to no direct disturbance of the beach or dunes and the Cable Landing Location is in a proposed parking lot. The Cable Landing Location is not expected to provide quality roosting or foraging habitat for bats and impacts to bat habitat are unlikely.

Onshore Export Cable Route Corridor: Overall, habitat loss from the Onshore Export Cable Route Corridor will be limited because the cable will be buried within previously disturbed areas to limit disturbance to habitat. Individual trees need to be removed in limited quantities, and species-specific time of year cutting restrictions will be followed if necessary pending coordination/consultation with federal and state agencies (see Mitigation and Monitoring section).

Interconnection Cable Route Corridors: The Onshore Interconnection Cable Route Corridor Alternatives pass through a variety of habitat types, with 34–69% of the routes passing through freshwater wetlands. The portion of the routes that pass through the forested and wetland areas associated with the North Landing River likely provide quality roosting and/or foraging habitat for bats. Habitat loss and co-occurrence with existing linear infrastructure varies among the proposed Interconnection Cable Route Corridor Alternatives (See Onshore Birds section), though less than 50% of the Routes 2-5 are co-located with existing linear development such as roads and transmission lines. Overall, impacts to bat habitat during construction are expected because northern-long eared bat maternity roosts have been documented immediately adjacent to the routes (within 1,000 ft [305 m]), there have been acoustic detections of Indiana bats in the region (12-14 mi [19-22 km] from the Cable Landing Location and Fentress Substation), and bat activity has been documented throughout the year. Due to these potential impacts, monitoring and mitigation during all seasons may be required (see Mitigation and Monitoring section).

Switching Station Alternatives and Onshore Substation: The Switching Station parcel at Harpers Road (Interconnection Cable Route Alternatives 1 through 5) is located adjacent to areas identified has having high ecological value, and the station would be built in a semi-developed area and part of an existing golf course. Since the Harpers Switching Station is located adjacent to non-disturbed areas, there is potential for impacts to bat habitat if tree clearing is required (see Mitigation and Monitoring). The Chicory Switching Station (Interconnection Cable Route Alternative 6) is located in an area identified has having high ecological value, and would be built within a forested parcel, with potential for disturbing bat habitat if tree clearing is required (see Mitigation and Monitoring). The Onshore Substation Parcel (Fentress) is located in an existing developed area and is associated with fragmented habitat; therefore, depending upon the number of trees that need to be removed, impacts to bat habitat are unlikely.

Temporary Disturbance: Noise and Vibration

In the VW SEIS, BOEM determined that onshore construction noise would not cause direct effects, but there is potential for short-term, temporary, localized indirect impacts. Construction noise could cause limited temporary displacement, but BOEM determined that these impacts will not be "biologically significant," and while bats may move to different roosts, impacts are not expected because bats often change roosting location (BOEM 2020b). Overall, BOEM concludes that onshore noise from offshore wind development is not expected to impact individual fitness or populations (BOEM 2020b). Any displaced bats are expected to return once construction activity is complete. Thus, the potential impact to bat populations from noise is unlikely. For the Onshore Export Cable, Switching Station, Interconnection Cable and Onshore Substation, noise is not expected to be an independent hazard during construction.

Due to their generally high mobility, bats are likely to leave construction areas during construction activities, as a result of disturbance from noise and equipment. However, since the Switching Stations and the Interconnection Cable Routes have the potential to disturb areas where bats may be present, Dominion Energy will follow minimization measures and conduct the necessary field surveys, if required, to identify the presence/absence of bat species, particularly those federally listed.

2.3.2.2.3 Operation and Maintenance

There is the potential for bats to be temporarily disturbed by noise during maintenance activities, but these are expected to be ephemeral in nature, and bats that are disturbed would likely return to the area once the activities have ceased. Other maintenance activities are not likely to further modify bat habitat. Therefore, the potential impacts of operation and maintenance activities to individual bats, including northern long-eared bats and Indiana bats, and bat populations overall are unlikely.

2.3.2.2.4 Decommissioning

While the specifics of decommissioning activities are not fully known at this time, impacts from decommissioning are expected to be equal to or less than impacts from construction. The Project will use best practices available at the time to minimize potential effects to bats.

2.4 Mitigation and Monitoring

Exposure of bat populations to WTGs has been minimized by siting the Project's WTGs offshore, in a WEA designated by BOEM. In addition, the Project will take the following mitigation and monitoring measures:

Onshore

- Since northern long-eared bats and Indiana bats may be present year-round, Dominion Energy would (1) conduct surveys (mist-net), if required, and (2) develop avoidance and minimization measures possibly including time of year restrictions (pending the results of site-specific surveys) or potential waivers of such restrictions, in coordination with BOEM, USFWS and VDWR.

Offshore

- Comply with Federal Aviation Administration (FAA) and United States Coast Guard (USCG) requirements for lighting and, to the extent practicable, use lighting technology (e.g., low-intensity strobe lights, flashing red aviation lights) that minimize impacts on bat species;

- Develop a robust post-construction monitoring plan with clear goals, monitoring questions, and methods, including monitoring that focuses on areas of uncertainty such as bat presence offshore;
- Install automated radio telemetry receiver station (e.g., Motus towers) on select offshore structures; and
- Document any dead or injured bats found on Project vessels or infrastructure (offshore and onshore) during construction, operation, or decommissioning, in an annual report submitted to BOEM and USFWS.

2.5 Summary and Conclusions

Overall, the offshore components of the Project are unlikely to impact bat populations. While some individual cave-hibernating bats may occur within the Lease Area during operation of the Project, and will be vulnerable to collision with operating turbines, the exposure of cave-hibernating bats (including northern long-eared bat, Indiana bat, and state-listed species) to operating turbines is expected to be minimal to low, given their distance from shore. Small numbers of migratory tree bats are expected to occur in the Lease Area during construction and operations; however, this is reasonably expected to include low numbers of individuals (BOEM 2020b) given the Lease Area's distance from shore and concentrated nature of tree bat activity during a narrow window each year (i.e., fall migration; August to October; BOEM 2012). Due to low exposure of bats to the Lease Area, the Offshore Project Components are unlikely to have population level impacts for any species of bats. In addition, individual federal and state-level listed bat species are unlikely to be affected.

These findings are consistent with BOEM cumulative impacts assessment conducted for VW1, which encompasses all offshore wind projects along the Atlantic coast of the U.S., including CVOW. BOEM determined that the cumulative impacts for all offshore wind projects, along with the impact-producing factors of climate change and ongoing onshore habitat loss, would result only in minor impacts and "none of the IPFs associated with future offshore wind activities that occur offshore would be expected to appreciably contribute to overall impacts on bats" (BOEM 2020b).

At the Cable Landing Location, potential impacts will be minimized by using trenchless installation and by locating the Cable Landing Location in a proposed parking lot. Along the Onshore Export Cable Route, impacts are minimized by burying the cable within previously disturbed areas. The Interconnection Cable Route Alternatives pass through an area of wetlands identified has having very high ecological value and tree cutting has the potential to impact the habitat of a variety of bat species, including both federally listed and state listed species.

The Switching Station alternatives are also located adjacent to or within areas of high ecological value and development has the potential to disturb bat roosting and/or foraging habitat if tree cutting is required; the Onshore Substation largely avoids disturbing bat habitat because development will be primarily confined to an existing developed area. Since the Onshore Export Cable Route, Switching Station Alternatives, and Interconnection Cable Route Alternatives have the potential to impact bat habitat, Dominion Energy will conduct field surveys, if required, to identify if species of conservation concern are present and will work with BOEM, USFWS and VDWR to minimize potential impacts.

3 Part III: Birds – Offshore

3.1 Overview of Offshore Species

A diverse range of avian species may pass through the Lease Area, including migrant landbirds (such as raptors and songbirds), coastal birds (such as shorebirds, waterfowl, and waders), and marine birds (such as seabirds and sea ducks; Table 3-1). A high diversity of marine birds may use the Lease Area because it is located at the southern end of the Mid-Atlantic Bight, an area of overlap between northern and southern species assemblages. This assessment follows the taxonomic order presented in the most recent checklist produced by the North American Classification and Nomenclature Committee of the American Ornithological Society (Chesser et al. 2019).

Table 3-1. Bird species recorded offshore of Virginia in the DOE Mid-Atlantic Baseline Studies high-resolution digital video aerial and boat-based surveys, cross referenced with USFWS IPaC database (https://ecos.fws.gov/ipac/). • = present in the dataset.

Taxonomic Group	Species	Aerial Survey	Boat Survey	IPaC
Dabblers, Geese, and Swans				
Brant	*Branta bernicla*	•	•	
Canada Goose	*Branta canadensis*		•	
Green-winged Teal	*Anas crecca*		•	
American Coot	*Fulica americana*		•	
Coastal Diving Ducks				
Bufflehead	*Bucephala albeola*		•	
Common Goldeneye	*Bucephala clangula*		•	
Sea Ducks				
Surf Scoter	*Melanitta perspicillata*	•	•	
White-winged Scoter	*Melanitta fusca*	•	•	
Black Scoter	*Melanitta americana*	•	•	
Long-tailed Duck	*Clangula hyemalis*		•	
Red-breasted Merganser	*Mergus serrator*		•	
Grebes				
Horned Grebe	*Podiceps auritus*	•	•	
Red-necked Grebe	*Podiceps grisegena*		•	
Shorebirds				
Wilson's Plover	*Charadrius wilsonia*		•	
Semipalmated Plover	*Charadrius semipalmatus*		•	
Whimbrel	*Numenius phaeopus*		•	
Ruddy Turnstone	*Arenaria interpres*		•	
Sanderling	*Calidris alba*		•	
Dunlin	*Calidris alpina*		•	
Least Sandpiper	*Calidris minutilla*		•	
White-rumped Sandpiper	*Calidris fuscicollis*		•	
Semipalmated Sandpiper	*Calidris pusilla*		•	
Lesser Yellowlegs	*Tringa flavipes*		•	
Phalaropes				
Red-necked Phalarope	*Phalaropus lobatus*		•	
Red Phalarope	*Phalaropus fulicarius*		•	
Skuas and Jaegers				
Pomarine Jaeger	*Stercorarius pomarinus*	•	•	•
Parasitic Jaeger	*Stercorarius parasiticus*	•	•	
Auks				
Dovekie	*Alle alle*	•	•	
Common Murre	*Uria aalge*		•	
Thick-billed Murre	*Uria lomvia*		•	
Razorbill	*Alca torda*	•	•	

Taxonomic Group	Species	Aerial Survey	Boat Survey	IPaC
Atlantic Puffin	*Fratercula arctica*	•	•	
Small Gulls				
Sabine's Gull	*Xema sabini*	•	•	
Bonaparte's Gull	*Chroicocephalus philadelphia*	•	•	•
Little Gull	*Hydrocoloeus minutus*		•	
Medium Gulls				
Black-legged Kittiwake	*Rissa tridactyla*		•	•
Laughing Gull	*Leucophaeus atricilla*	•	•	
Ring-billed Gull	*Larus delawarensis*	•	•	
Large Gulls				
Herring Gull	*Larus argentatus*	•	•	•
Lesser Black-backed Gull	*Larus fuscus*	•	•	
Great Black-backed Gull	*Larus marinus*	•	•	•
Small Terns				
Least Tern	*Sternula antillarum*		•	
Black Tern	*Chlidonias niger*	•	•	
Medium Terns				
Roseate Tern	*Sterna dougallii*		•	
Common Tern	*Sterna hirundo*	•	•	
Forster's Tern	*Sterna forsteri*		•	
Royal Tern	*Thalasseus maximus*	•	•	
Large Terns				
Caspian Tern	*Hydroprogne caspia*	•	•	
Loons				
Red-throated Loon	*Gavia stellata*	•	•	•
Common Loon	*Gavia immer*	•	•	•
Storm-Petrels				
Wilson's Storm-Petrel	*Oceanites oceanicus*	•	•	•
Leach's Storm-Petrel	*Oceanodroma leucorhoa*			•
Shearwaters and Petrels				
Northern Fulmar	*Fulmarus glacialis*	•	•	•
Cory's Shearwater	*Calonectris diomedea*	•	•	•
Sooty Shearwater	*Ardenna grisea*	•	•	
Great Shearwater	*Ardenna gravis*	•	•	•
Manx Shearwater	*Puffinus puffinus*	•	•	•
Audubon's Shearwater	*Puffinus lherminieri*			•
Gannet				
Northern Gannet	*Morus bassanus*	•	•	•
Cormorants				
Double-crested Cormorant	*Phalacrocorax auritus*	•	•	
Pelicans				
Brown Pelican	*Pelecanus occidentalis*	•	•	
Heron and Egrets				
Great Blue Heron	*Ardea herodias*	•	•	
Green Heron	*Butorides virescens*		•	
Snowy Egret	*Egretta thula*	•		
American Bittern	*Botaurus lentiginosus*	•		
Raptors				
Black Vulture	*Coragyps atratus*		•	
Osprey	*Pandion haliaetus*	•		
Songbirds				
Northern Flicker	*Colaptes auratus*		•	
Purple Martin	*Progne subis*		•	
Barn Swallow	*Hirundo rustica*	•	•	
Red-breasted Nuthatch	*Sitta canadensis*		•	
Golden-crowned Kinglet	*Regulus satrapa*		•	
Ruby-crowned Kinglet	*Regulus calendula*		•	

Taxonomic Group	Species	Aerial Survey	Boat Survey	IPaC
American Robin	*Turdus migratorius*		•	
Cedar Waxwing	*Bombycilla cedrorum*	•	•	
American Pipit	*Anthus rubescens*		•	
Dark-eyed Junco	*Junco hyemalis*		•	
Red-winged Blackbird	*Agelaius phoeniceus*		•	
Brown-headed Cowbird	*Molothrus ater*		•	
Northern Waterthrush	*Parkesia noveboracensis*		•	
Tennessee Warbler	*Oreothlypis peregrina*		•	
Mourning Warbler	*Geothlypis philadelphia*		•	
American Redstart	*Setophaga ruticilla*		•	
Blackpoll Warbler	*Setophaga striata*		•	
Black-throated Blue Warbler	*Setophaga caerulescens*		•	
Palm Warbler	*Setophaga palmarum*		•	
Yellow-rumped Warbler	*Setophaga coronata*		•	
Common Nighthawk	*Chordeiles minor*	•		
Belted Kingfisher	*Megaceryle alcyon*	•		
Baltimore Oriole	*Icterus galbula*	•		

The Mid-Atlantic Bight is an oceanic region that spans an area from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina, and is characterized by a broad expanse of gently sloping, sandy-bottomed continental shelf. This shelf extends up to (93 mi) 150 km offshore, where the waters reach about 650 ft (200 m) deep. Beyond the shelf edge, the continental slope descends rapidly to around 10,000 ft (~3,000 m). Most of this mid-Atlantic coastal region is bathed in cool Arctic waters introduced by the Labrador Current. At the southern end of this region, around Cape Hatteras, these cool waters collide with the warmer waters of the Gulf Stream. The mid-Atlantic region exhibits a strong seasonal cycle in temperature, with sea surface temperatures spanning 3–30 °C (Williams et al. 2015).

The Lease Area is located within one of four major North American north-south migration routes (known as ‘flyways’) for many species of seabirds, shorebirds, waterfowl, raptors and songbirds (Menza et al. 2012). The Atlantic Flyway is located along the Atlantic coast of North America and includes US states and Canadian provinces that span the route from Canada to Central America, South America, and the Caribbean. Coastal and marine environments along the Atlantic Flyway provide important habitat and food resources for hundreds of avian species at stop-over sites, breeding locations, and wintering areas (Menza et al. 2012).

3.2 Methods

3.2.1 Impact-producing factors

Hazards (i.e., impact-producing factors) are defined as the changes to the environment caused by Project activities during each offshore wind development stage (BOEM 2012, Goodale and Milman 2016). For birds, the primary impact-producing factors for the Offshore Project Components of the Project are above water and include vessels, lighting, wind turbines, and Offshore Substations (Table 3-2). Below-water Project activities, including but not limited to WTG and Offshore Substation Foundations and Inter-Array and Export Cable installation, are not expected to be a long-term hazard for birds (Bureau of Ocean Energy Management 2018a) and are not discussed in detail. Low probability events, such as spills, are discussed in the body of the COP and the Oil Spill Response Plan (COP Appendix Q).

Table 3-2. Potential effects on birds from offshore activities and the Project stages for which they are assessed.

Impact-Producing Factor(s)	Potential Effect	Description	Construction & Decommissioning*	Operation
Vessels, lighting, wind turbines, Offshore Substations	Collision	Mortality and injury caused by collision with Project structures	✓	✓
Vessels, noise from pile-driving, wind turbine and Offshore Substation Foundations	Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	✓	
Wind turbines, Offshore Substations	Displacement (Permanent), Collision	Permanent avoidance and/or displacement from habitat		✓
*Effects of decommissioning are expected to be less than or equal to construction activities.				

3.2.2 Risk Framework

The potential effects associated with the Project were evaluated qualitatively using a risk assessment framework. The framework uses a weight-of-evidence approach and combines an assessment of exposure and behavioral vulnerability within the context of the literature to establish potential risk (Figure 3-1). Exposure has both spatial and temporal components. Spatially, birds are exposed on the horizontal (i.e., habitat area) and vertical planes (i.e., flight altitude); temporally, bird exposure is dictated by a species' life history and may be limited to breeding, staging, migrating, or wintering. Therefore, to be at risk of potential effects, a bird must be both *exposed* to an offshore wind development (i.e., overlapping in distribution) **and** be *vulnerable* to either displacement or collision (Goodale and Stenhouse 2016).

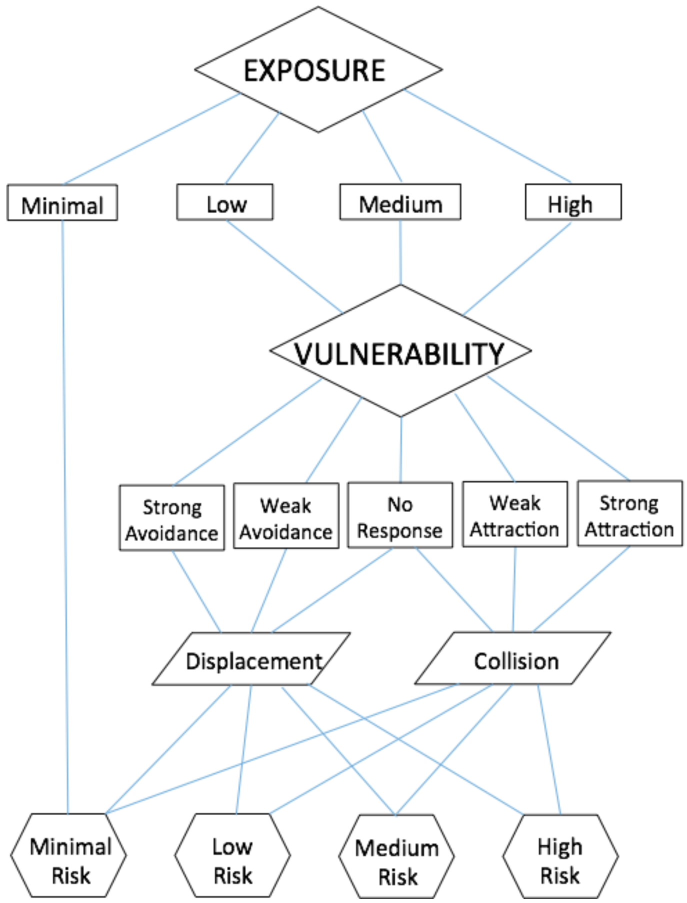

Figure 3-1. Risk assessment framework. First exposure was assessed, second vulnerability was assessed, and then, using a weight of evidence approach, the risk was evaluated.

Exposure was evaluated based on (1) high resolution digital video aerial surveys conducted as part of the Mid-Atlantic Baseline Studies (MABS) project (Williams et al. 2015); (2) boat surveys conducted as part of the MABS project (Williams et al. 2015); (3) version 2 of the Marine-life Data and Analysis Team (MDAT) marine bird relative density and distribution models (hereafter MDAT models; Curtice et al. 2016); (4) individual tracking studies; and (5) records in the Northwest Atlantic Seabird Catalog. Due to gaps in knowledge on the relationship between the number of turbines and risk, this assessment analyzes the exposure of birds to the total area of development rather than to a specific number of turbines.[1]

Behavioral vulnerability was evaluated based on the literature (Furness et al. 2013; Wade et al. 2016), and vulnerability score for the turbines being considered by the Project. See section 3.2.4 (p. 51) for details on the vulnerability assessment.

Individual risk was assessed for listed species, while population level risk was assessed for non-listed species (Table 3-3). Population vulnerability was considered in assigning a final risk category, where a

[1] Risk may not increase in a linear manner as the number of turbines increases because birds' avoidance response may increase as the numbers of turbines increases. Risk is also likely affected by the size and spacing of turbines: larger turbines have fewer revolutions than smaller turbines, may have a greater airgap between the water and the lowest blade position, and may be spaced much further apart. Thus, fewer larger turbines may pose a lower risk than many smaller turbines (Johnston et al. 2014a).

risk score was adjusted up or down based on the overall conservation status of the population (discussed in detail in section 3.2.4).

Table 3-3. Final risk evaluation matrix. CV = collision vulnerability; DV = displacement vulnerability, and PV = population vulnerability. An initial risk determination is made based upon vulnerability and exposure, and then the PV score is used to either keep the score the same, adjust the score up or down, or with a risk range eliminate the lower or upper portion of the range.

	Vulnerability (CV & DV)				
Exposure	*Minimal*	*Low*	*Medium*	*High*	*PV*
Minimal	Minimal	Minimal	Minimal	Minimal	↑
Low	Minimal	Low	Low	Low	↕
Medium	Minimal	Low	Medium	Medium	↕
High	Minimal	Low	Medium	High	↓
PV	←	↔	↔	→	

3.2.3 Exposure Framework

Exposure has both a horizontal and vertical component. The assessment of exposure focused exclusively on the horizontal exposure of birds. Vertical exposure (i.e., flight height) was considered within the assessment of vulnerability, although little is known about migration altitudes for most birds. The exposure assessment was quantitative where site-specific survey data was available. For birds with no available site-specific data, species accounts and the literature were used to conduct a qualitative assessment. For all birds, exposure was considered both in the context of the proportion of the population predicted to be exposed to the Lease Area, as well as absolute numbers of individuals. The following sections introduce the data sources used in the analysis, the methods used to map taxonomic group exposure, methods used to assign an exposure metric, methods to aggregate scores to year and taxonomic group, and interpretation of exposure scores.

3.2.3.1 Exposure Assessment Data Sources and Coverage

To assess the proportion of marine bird populations exposed to the Lease Area, a series of primary data sources were used to evaluate local and regional marine bird use: (1) high resolution digital video aerial survey data collected as part of the MABS study (Williams et al. 2015a), (2) version 2 of the Marine-life Data and Analysis Team (MDAT) marine bird relative density and distribution models (Curtice et al. 2016), and (3) modeled flight heights derived from offshore survey data in the Northwest Atlantic Seabird Catalog maintained by NOAA. The MABS surveys provide local coverage of both the Lease Area and surrounding waters. The MDAT models are modeled abundance data providing a large regional context for the Lease Area but are built from offshore survey data collected from 1978–2016. Of note, the MABS aerial and boat survey data were included in the MDAT modeling effort. Each of these primary sources is described in more detail below, along with additional data sources used to inform the avian impact assessment. Data collected during these surveys are in general agreement with BOEM guidelines and the goals detailed above and described below.

3.2.3.1.1 Mid-Atlantic Baseline Studies (MABS) surveys

Fifteen aerial surveys were conducted over two years (March 2012-May 2014) in shelf waters offshore of Delaware, Maryland, and Virginia (Figure 3-2, Figure 3-3). Surveys were flown at high densities (narrow spacing) within proposed WEAs (20% coverage) and at much lower density (2.1% coverage) across a large area in a sawtooth pattern extending from the federal/state waters boundary to approximately the 30 m isobath, or beyond where the WEAs extended into deeper waters. Additional survey coverage was added to offshore Maryland waters to increase survey coverage between the Maryland WEA and shore. All digital aerial video surveys used an array of four cameras covering a total strip width of 200 m at 2 cm ground spatial resolution (GSR). A few early sawtooth surveys had a strip width of 300 m at 3 cm GSR, but it was quickly determined that 3 cm GSR was not sufficient resolution to provide good species identification rates; therefore, beginning in September 2012 all surveys were conducted at 2 cm GSR. All surveys were flown at an altitude of 610 m and a flight speed of 250 km/hr.

Digital video data was analyzed in a video lab, where initially video reviewers examined every frame and marked any objects observed, after which marked objects were assessed by a wildlife biologist and identified to the lowest taxonomic level possible. A measure of certainty was assigned to each identification using three levels of confidence (definite, probable, and possible), where definite species are >95% certain, probable are 50–95% certain, and possible are <50% certain. To be conservative, all identifications deemed "possible" were downgraded to the next highest taxonomic grouping (e.g., possible Black Scoter became a definite/probable unidentified scoter). An extensive process of QA/QC was performed, specific details of which can be found in the MABS final report (Williams et al. 2015).

Flight altitude data was determined for as many targets in the video as possible using an estimate based on the principles of parallax. However, since this study was conducted, further work has demonstrated that valid confidence intervals cannot be determined for flight heights using this method (A. Webb, personal communication) and so these estimated flight heights are not consistently reliable enough to be used for vulnerability assessment in this study.

In the MABS project, more than 46,000 birds from 121 species were identified across 49,576 km (10,403 km^2) of surveys, nearly half of these were not identified to species level, but at a broader taxonomic level (e.g., unidentified large tern). Due to the large numbers of birds not identified to species, the analyses was conducted across the following broad taxonomic groupings: ducks, geese, and swans; coastal diving ducks; sea ducks; grebes; shorebirds; phalaropes; skuas and jaegers; auks; small gulls; medium gulls; large gulls; all gulls; small terns; medium terns; large terns; all terns; loons; storm-petrels; shearwaters and petrels; gannet; cormorants; pelicans; heron and egrets; raptors; passerines; and all birds, rather than at the species level. Groupings such as all terns, consist of all species and higher taxonomic groupings within the terns, including small, medium, and large terns. The all birds group consists of all birds identified. Grouping species in this manner maximized the data for analysis but came at the expense of species level analysis. For example, all unidentified scoter identifications were used along with all scoters identified to species in the sea duck group for analyzing exposure of sea ducks.

In addition to digital video aerial surveys, 16 boat-based surveys were also conducted in 2012–2104 as part of the MABS project (Figure 3-2). These surveys covered ~559 km in long transects transiting the northern and southern sections of the MABS study area, with a large break in coverage between surveys areas. Boat-based surveys did cross through the WEAs, and parts of three transects surveyed by boat traversed the Lease Area. For this reason, the digital aerial video survey data were used as the primary data source for exposure analysis, but the boat surveys provide secondary information on non-marine species occurring sporadically across the MABS study area. All boat-based surveys were conducted using a distance sampling method (Buckland et al. 2001). Observations were made within a 360-degree view of the observer because good visibility on the vessel allowed for a greater than normal survey area; however, effort was concentrated within a 90 degree bow to beam arc and within 300 m of the vessel. Distance and angle to each bird (or group) was estimated, along with behavior, sex, age, etc., if known and time allowed for entry.

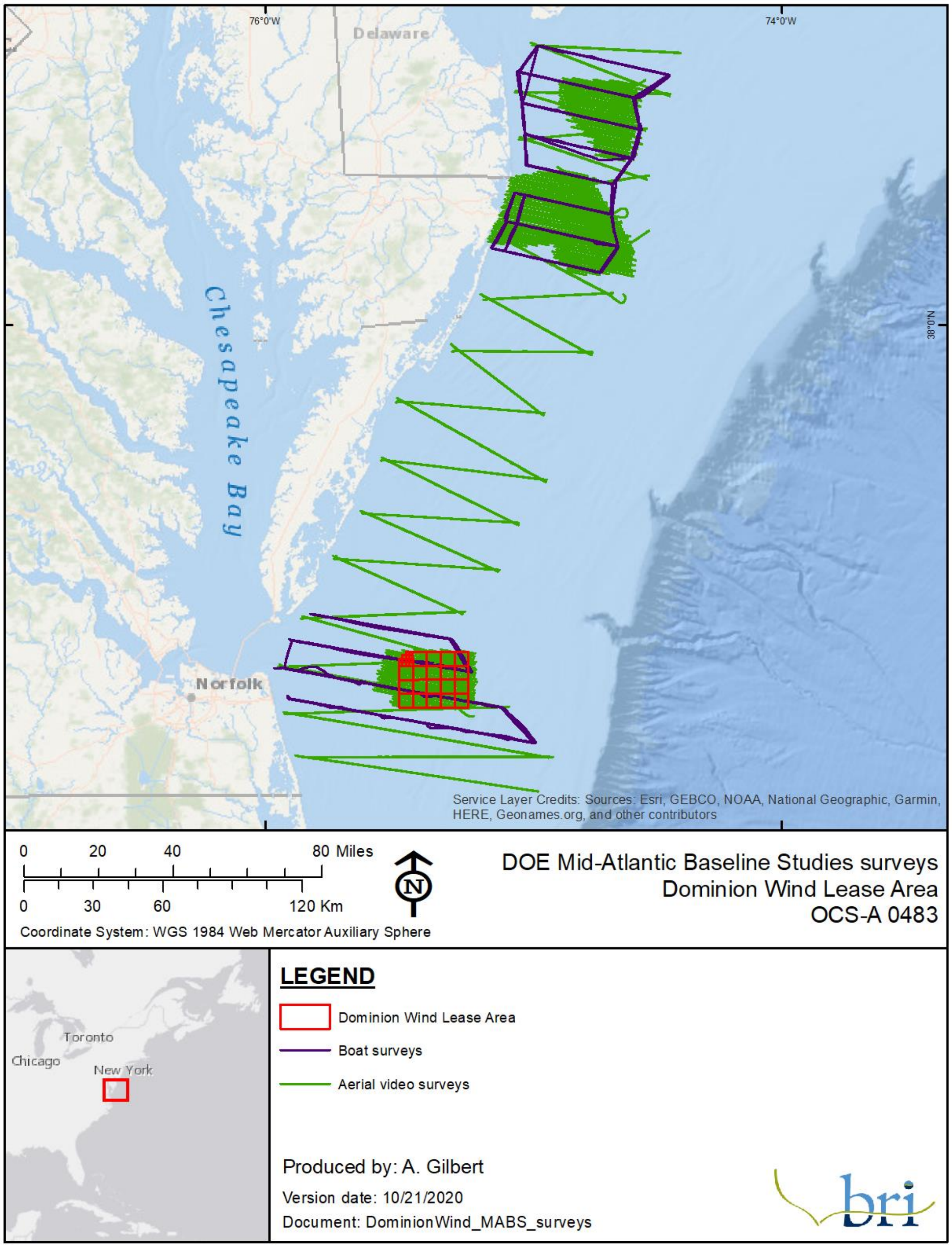

Figure 3-2. DOE Mid-Atlantic Baseline Studies digital aerial and boat survey transects.

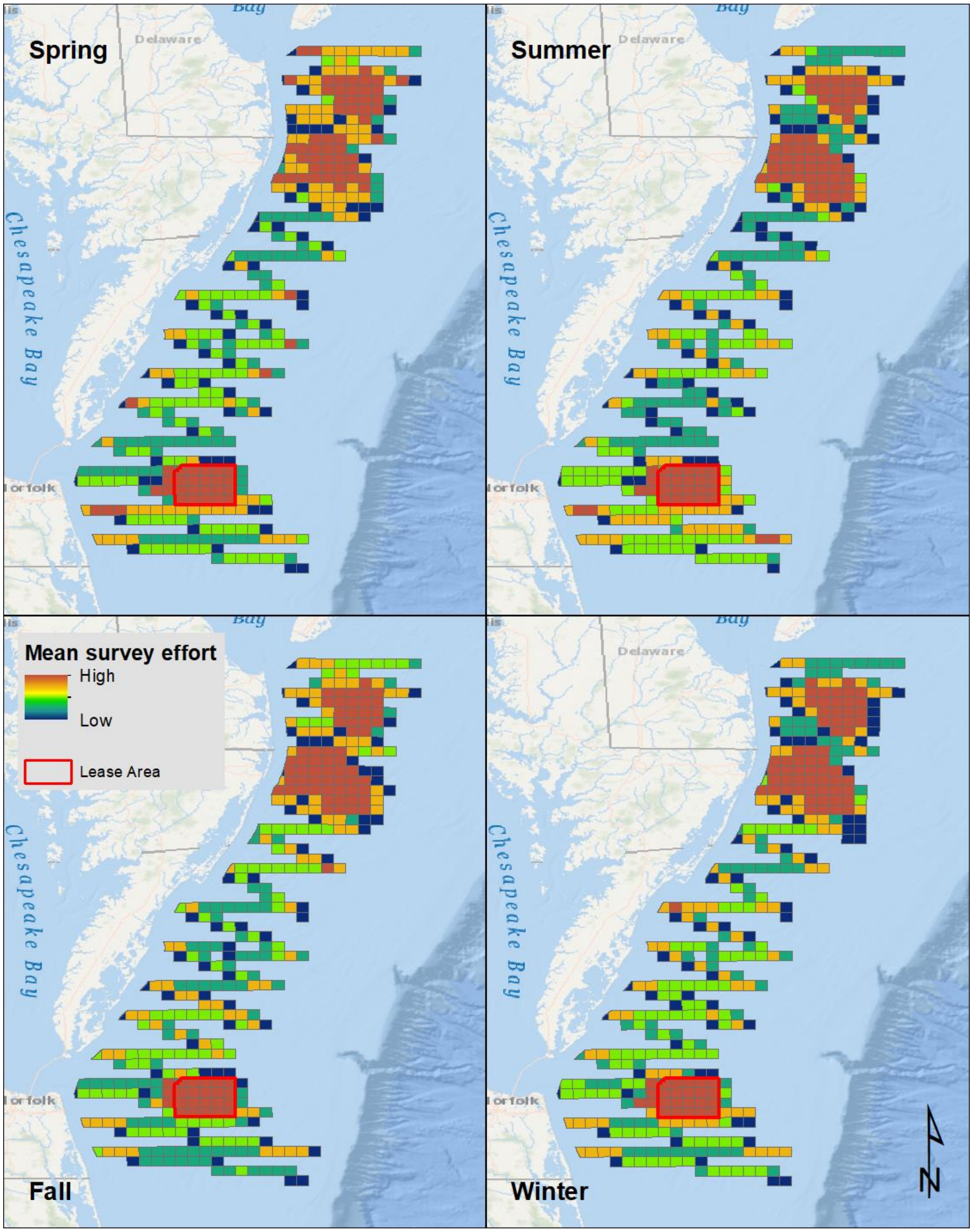

Figure 3-3. DOE Mid-Atlantic Baseline Studies digital aerial survey effort within the Lease Area and across the broader region.

3.2.3.1.2 The MDAT Marine Bird Abundance and Occurrence Models (Version 2)

Seasonal predictions of density were developed to support Atlantic marine renewable energy planning. Distributed as MDAT bird models (Curtice et al. 2016, Winship et al. 2018), they describe regional-scale patterns of relative abundance. Updates to these models (Version 2) are available directly from Duke

University's Marine Geospatial Ecology Lab MDAT model web page[2]. The MDAT analysis integrated survey data (1978–2016) from the Atlantic Offshore Seabird Dataset Catalog[3] with a range of environmental variables to produce long-term average annual and seasonal models (Figure 3-4). These models were specifically developed to support marine spatial planning in U.S. Atlantic waters. In Version 2 (used here), relative abundance and distribution models were produced for 47 avian species using marine waters from Florida to Maine; this resource thus provides an excellent regional context for local relative densities estimated from the digital aerial surveys described above.

The MDAT and MABS information sources each have strengths and weaknesses. The MABS data were collected in a standardized, comprehensive way, and the data are on average more recent, so they describe recent distribution patterns in the Lease Area and surroundings. However, these surveys covered a fairly small area relative to the Northwest Atlantic distribution of most marine bird species, and the limited number of surveys conducted in each season means that individual observations (or lack of observations, for rare species) may in some cases carry substantial weight in determining seasonal exposure. These aerial surveys also produced "unidentified" observations (e.g., "unknown large gull" or "unknown small tern") which prove difficult for evaluating species-specific exposures; for this reason, these data were analyzed at higher taxonomic groupings.

In contrast to baseline surveys, the MDAT models are based on data collected at much larger geographic and temporal scales. These data were also collected using a range of survey methods. The larger geographic scale is helpful for determining the importance of the Lease Area to marine birds relative to other available locations in the Northwest Atlantic and is thus essential for determining overall exposure. However, these models are based on data from decades of surveys and long-term climatological averages of dynamic covariates; given changing climate conditions, these models may no longer accurately reflect current distribution patterns. Model outputs that incorporate environmental covariates to predict distributions across a broad spatial scale may also vary in the accuracy of those predictions at a local scale.

In order to analyze MDAT models at the taxonomic group level, individual species models were first combined into combined species taxonomic group models. Modeled density is long-term average relative density therefore aggregating species into group models required normalizing model output and then combining. The recommendation for normalization is to divide the relative density values by the sum total relative density value, normalizing the data to between 0 and 1 (Winship et al. 2018). Normalization for all species-season MDAT models was performed prior to combining into taxonomic groups. Taxonomic group MDAT models were created from the list of species within a defined taxonomic group, if that species was present in either MABS aerial video or boat surveys, providing evidence that the species occurs in the local area. Species present within each group are shown in the map caption for each taxonomic group-season combination.

[2] http://seamap.env.duke.edu/models/mdat/
[3] https://coast.noaa.gov/digitalcoast/data/atloffshoreseabird.html

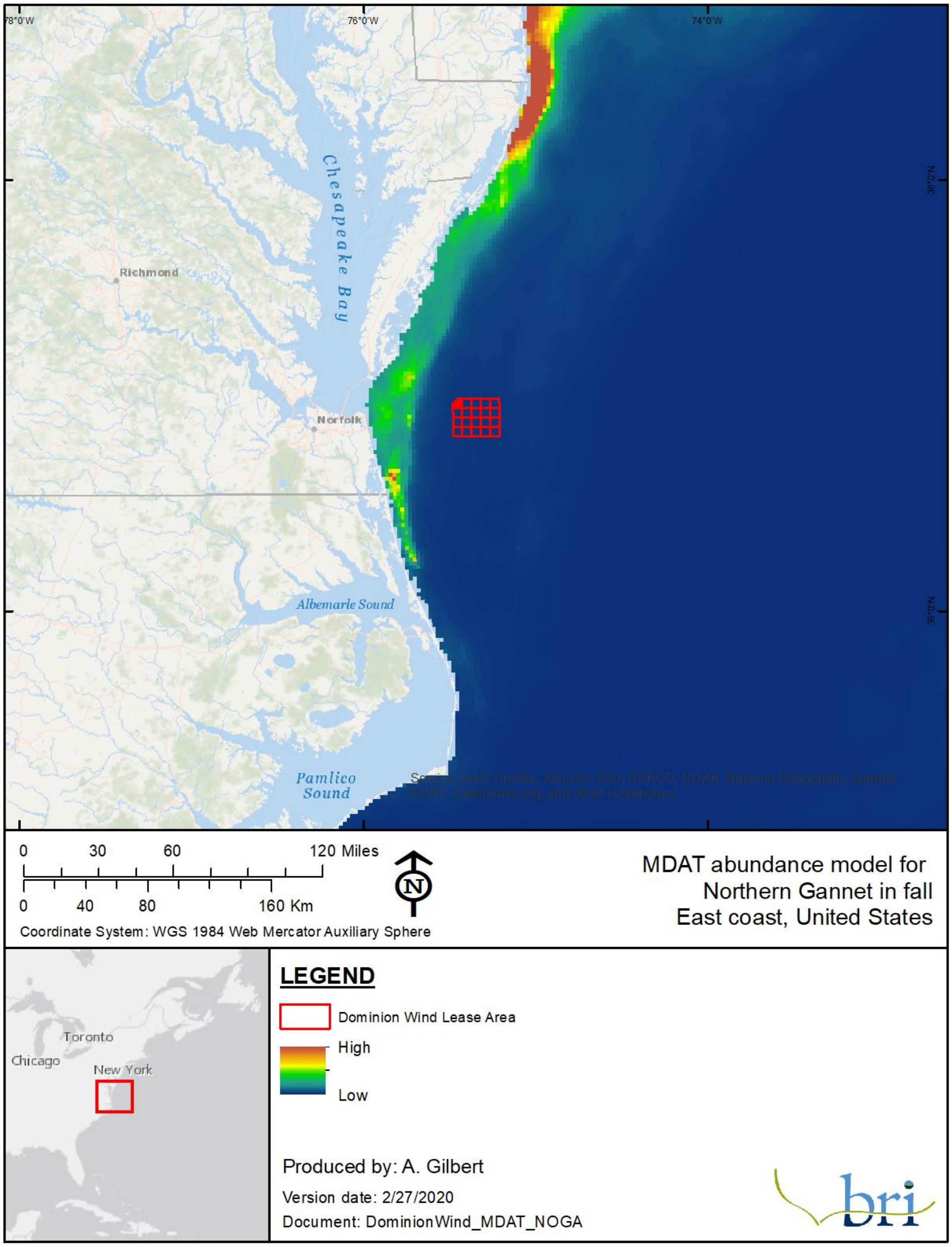

Figure 3-4. Example Marine-life Data and Analysis Team (MDAT) abundance model for Northern Gannet in fall.

3.2.3.1.3 Northwest Atlantic Seabird Catalog

The Northwest Atlantic Seabird Catalog (the 'Catalog') is the most comprehensive database for offshore and coastal bird surveys conducted in Atlantic shelf waters of the U.S. from Maine to Florida. The Seabird Catalog database contains records from 1938–2017, integrating more than 180 datasets and >700,000 observation records along with associated effort information (K. Coleman, personal communication). The database is currently managed by the National Oceanic and Atmospheric Administration (NOAA). With BOEM's approval, NOAA provided the current database to BRI for this assessment. All relevant data from the Catalog were mapped to determine the occurrence of rare species within the Lease Area. Flight heights were also derived from observations in the Catalog.

3.2.3.1.4 Secondary Sources

3.2.3.1.4.1 Mid-Atlantic Diving Bird Tracking Study

A satellite telemetry tracking study in the mid-Atlantic was developed and supported by BOEM and the USFWS with objectives aimed at determining fine scale use and movement patterns of three species of marine diving birds during migration and winter over the course of five years (2012–2016), (Spiegel et al. 2017). These species – the Red-throated Loon (*Gavia stellata*), Surf Scoter (*Melanitta perspicillata*), and Northern Gannet (*Morus bassanus*) – are all considered species of conservation concern and exhibit various traits that make them vulnerable to offshore wind development. Nearly 400 individuals were tracked using satellite transmitters including some tagged Surf Scoters as part of the Atlantic and Great Lakes Sea Duck Migration Study by Sea Duck Joint Venture partners[4]. Results provide a better understanding of how these diving birds use offshore areas of the mid-Atlantic OCS and beyond (Stenhouse et al. 2020).

3.2.3.1.4.2 Migrant Raptor Studies

To facilitate research efforts on migrant raptors (i.e., migration routes, stopover sites, space use relative to WEAs, wintering/summer range, origins, contaminant exposure), BRI has deployed satellite transmitters on fall migrating raptors at three different raptor migration research stations along the north Atlantic coast (DeSorbo et al. 2012, 2018c, 2018a). Research stations include Block Island, Rhode Island, Monhegan Island, Maine, and Cutler, Maine.

Satellite-tagged Peregrine Falcons (n=41) and Merlins (n=16) provided information on fall migration routes along the Atlantic flyway. Positional data was filtered to remove poor quality locations using the Douglas Argos Filtering tool (Douglas et al. 2012) available online on the Movebank data repository[5] where these data are stored and processed.

3.2.3.1.4.3 Tracking movements of vulnerable terns and shorebirds in the Northwest Atlantic using nanotags

Since 2013, BOEM and the USFWS have supported a study using nanotags and an array of automated VHF telemetry stations to track the movements of vulnerable terns and shorebirds. The study was designed to assess the degree to which these species use offshore federal waters during breeding, pre-migratory staging periods, and on their migrations. In a pilot study in 2013, they attached nanotags to Common Terns (*Sterna hirundo*) and American Oystercatchers (*Haematopus palliatus*) and set up eight automated radio-telemetry stations (Loring et al. 2017). Having proved the methods successful, the study was expanded to 16 automated stations in 2014, and from 2015–2017, tagging efforts included ESA-listed Piping Plovers (*Charadrius melodus*) and Roseate Terns (*Sterna dougallii*). This study provided new information on the offshore movements and flight altitudes for these species gathered from a total of 33 automated telemetry stations, including areas of Massachusetts, New York, New Jersey, Delaware, and

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[4] https://seaduckjv.org/science-resources/atlantic-and-great-lakes-sea-duck-migration-study/

[5] https://www.movebank.org/

Virginia (Loring et al. 2019). Although the Lease Area was beyond the range of the onshore receiver stations, this study provides important regional data.

3.2.3.1.4.4 Tracking movements of rufa *Red Knots in U.S. Atlantic Outer Continental Shelf Waters*

The eastern North American population of Red Knot (*Calidris canutus*) is designated as a subspecies (*C. c. rufa*). Building from a previous tracking study, *rufa* Red Knots were fitted with digital VHF transmitters during their 2016 southbound migration at stopover locations in both Canada and along the U.S. Atlantic coast. Individuals were tracked using radio-telemetry stations within the study area that extended from Cape Cod, Massachusetts, to Back Bay, Virginia. Modeling techniques were developed to describe the frequency and offshore movements over federal waters and specific WEAs within the study area. The primary study objectives were to (1) develop models related to offshore movements for *rufa* Red Knots and assess the exposure to each WEA during southbound migration, and (2) examine WEA exposure and migratory departure movements in relation to various meteorological conditions (Loring et al. 2018).

3.2.3.1.4.5 Sea Duck Tracking Studies

The Atlantic and Great Lakes Sea Duck Migration Study, a multi-partner collaboration, was initiated by the Sea Duck Joint Venture (SDJV) in 2009 with the goals of (1) fully describing full annual cycle migration patterns for four species of sea ducks (Surf Scoter, Black Scoter, White-winged Scoter, and Long-tailed Duck), (2) mapping local movements and estimating length-of-stay during winter for individual radio-marked ducks in areas proposed for placement of wind turbines, (3) identifying near-shore and offshore habitats of high significance to sea ducks to help inform habitat conservation efforts, and (4) estimating rates of annual site fidelity to wintering areas, breeding areas, and molting areas for all four focal species in the Atlantic flyway. To date, over 500 transmitters have been deployed in the U.S. and Canada by various project partners, including the Biodiversity Research Institute, Canadian Wildlife Service, USGS Patuxent Wildlife Research Center, University of Rhode Island, Rhode Island Department of Environmental Management, U.S. Fish and Wildlife Service, Sea Duck Joint Venture, and the University of Montreal. These collective studies have led to increased understanding of annual cycle migration patterns of sea ducks, as well as the potential for interactions with and impacts from proposed offshore wind energy development (Loring et al. 2014; Meattey et al. 2018; 2019; SDJV 2015).

Additionally, BOEM and USFWS partnered with the SDJV during 2012–2016 to deploy transmitters in Surf Scoters as part of a satellite telemetry tracking study in the mid-Atlantic, with objectives aimed at determining fine scale use and movement patterns of three species of marine diving birds during migration and winter (Spiegel et al. 2017).

3.2.3.1.4.6 Great Blue Heron GPS Tracking Study

A Great Blue Heron (*Ardea herodias*) tracking study was performed by the Maine Department of Inland Fisheries and Wildlife (MDIFW) from 2016–2020 in order to study the daily movements, habitat use, colony fidelity, migration routes, and wintering locations of Maine's breeding herons (https://www1.maine.gov/wordpress/ifwheron/2016/07/29/tracking-maines-great-blue-herons-online/). Solar GPS/GSM tags were deployed on nine individuals in Maine, five captured in the spring of 2016, two in the summer of 2018, one in fall 2018, and one in summer 2019 (https://www1.maine.gov/wordpress/ifwheron/author/ddauria/). Tag data were downloaded from the online movement data repository, Movebank (www.movebank.org). Tags record data up to every 5 minutes and include altitude data as height above ellipsoid which was corrected to the orthometric height (in meters) by subtracting the GEIOD12B geoid model height (https://geodesy.noaa.gov/GEOID/GEOID12B/) at each point location from the ellipsoid height given by the transmitter (Dolinski 2019). Only the middle 95% of the data was kept to exclude extreme outliers.

3.2.3.2 Exposure Mapping

Maps were developed to display local and regional context for exposure assessments. A three-panel map was created for each taxa-season combination that includes regional MDAT and/or local baseline survey data (see Part V). Any taxa-season combination which did not at least have either MDAT model or baseline survey data (i.e., blank maps) were left out of the final map set. An example map for sea ducks in winter is provided below (Figure 3-5).

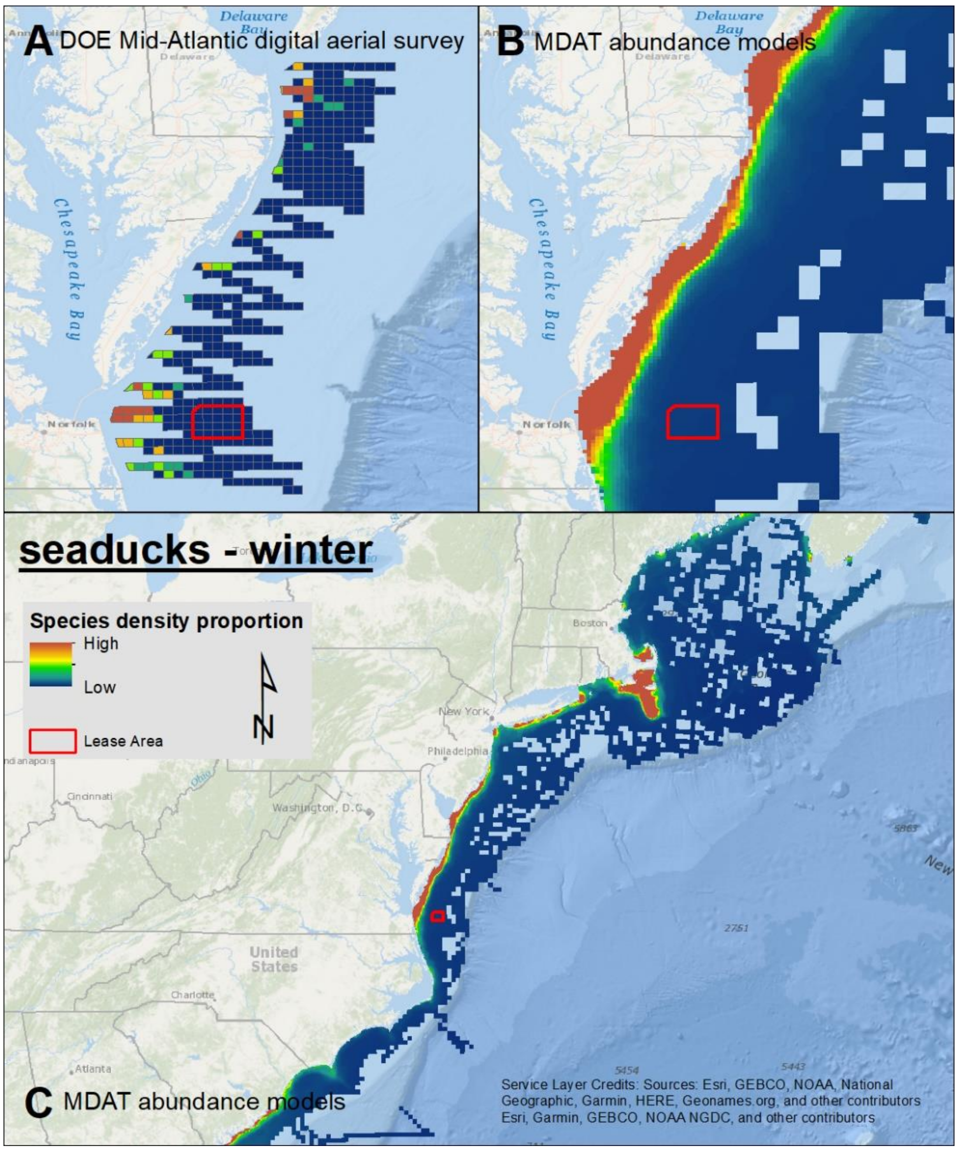

Figure 3-5. Example taxa-season (sea ducks in winter) combination map of relative density proportions locally and regionally. Panel (A) presents the DOE digital aerial survey data as proportions of total effort-corrected counts. Panels B and C include data from MDAT models presented at different scales: baseline survey data and the northwest Atlantic.

The first map panel (A) presents the DOE digital aerial survey data as proportions of total effort-corrected counts. The proportion of the total effort-corrected counts (total counts per sq. km) was calculated for each BOEM designated OCS[6] Lease Block[7], across all surveys in a given season. This method was useful as it scaled all effort-corrected count data from 0-1 to standardize data visualizations among taxonomic groups. Exposure was ranked from low-to-high for each taxonomic group based on weighted quantiles of these count proportions. Quantiles were weighted by the count proportions because data were skewed towards zero. OCS Lease Blocks with zero counts were always the lowest, and blocks with more than one observation were divided into 4 weighted quantiles.

The next two map panels (B and C) include data from MDAT models presented at different scales; Panel B shows the modeled densities in the same area as the DOE digital aerial surveys, while Panel C shows the density output over the entire northwest Atlantic. Density data are scaled in a similar way to the DOE digital aerial survey data, so that the low-high designation for density is similar for both datasets. However, there are no true zeroes in the model outputs, and thus no special category for them in the MDAT data. All MDAT models were masked to remove areas of zero effort within a season. These zero-effort areas do have density estimates, but generally are of low confidence, so they were excluded from mapping and analysis to reduce anomalies in predicted taxonomic group densities and to strengthen the analysis. Additionally, while the color scale for the MDAT data is approximately matched to that used for the DOE digital aerial survey data, the values that underlie them are different (the MDAT data are symbolized using an ArcMap default color scale, which uses standard deviations from the mean to determine the color scale rather than quantiles). Maps should be viewed in a broadly relative way between local and regional assessments and even across taxonomic groups.

3.2.3.3 Exposure Assessment Metrics

To assess bird exposure at the local (i.e., Mid-Atlantic Bight) and regional scales (i.e., U.S. Atlantic waters), the Lease Area was compared to other similarly sized areas in each dataset for each season and taxonomic group. Using the MDAT data, masked to remove zero-effort predicted cells, the predicted seasonal density surface for a given taxonomic group was aggregated into a series of rectangles that were approximately the same size as the Lease Area, and the mean density estimate of each rectangle was calculated. This process compiled a dataset of density estimates for all species surveyed, for areas the same size as the Lease Area. The 25th, 50th, and 75th weighted quantiles of this dataset were calculated, and the quantile into which the density estimate for the Lease Area fell for a given taxonomic group and season combination was identified. Quantiles were weighted by using the proportion of the total density across the entire modeled area that each sample represented. Thus, quantile breaks represent proportions of the total seabird density rather than proportions of the raw data. A categorical score was assigned to the Lease Area for each season-species: 0 (Minimal) was assigned when the density estimate for the Lease

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[6] Outer Continental Shelf (OCS) is defined by the Department of the Interior (https://www.bsee.gov/newsroom/library/glossary) as "All submerged lands seaward and outside the area of lands beneath navigable waters. Lands beneath navigable waters are interpreted as extending from the coastline 3 nautical miles into the Atlantic Ocean, the Pacific Ocean, the Arctic Ocean, and the Gulf of Mexico excluding the coastal waters off Texas and western Florida. Lands beneath navigable waters are interpreted as extending from the coastline 3 marine leagues into the Gulf of Mexico off Texas and western Florida."

[7] OCS Lease Blocks are defined (https://catalog.data.gov/dataset/outer-continental-shelf-lease-blocks-atlantic-region-nad83) as "small geographic areas within an Official Protraction Diagram (OPD) for leasing and administrative purposes. These blocks have been clipped along the Submerged Lands Act (SLA) boundary and along the Continental Shelf Boundaries. Additional details are available from: https://www.boem.gov/BOEM-Newsroom/Library/Publications/1999/99-0006-pdf.aspx"

Area was in the bottom 25%; 1 (Low) when it was between 25% and 50%; 2 (Medium) when it was between 50% and 75%; and 3 (High) when it was in the top quartile (>75%).

A similar process was used to categorize each taxonomic group-season combination using the baseline survey data. The mean relative density for the Lease Area (a collection of 29 partial or full OCS Lease Blocks) was calculated. To compare the Lease Area to other locations within the survey region, the nearest 29 OCS Lease Blocks to each OCS Lease Block surveyed outside the Lease Area in each season (winter, *n*=394; spring, *n*=387; summer, *n*=384; and fall, *n*=389) were identified and the relative density of each 29 OCS Lease Block groups was calculated. Thus, a dataset of relative densities for all possible Lease Area-sized OCS Lease Block groups was generated within the survey region using the baseline survey data. This data set was used to assign scores to all taxonomic group-season combinations, based on the same quartile categories described for the MDAT models above. If a score for a taxonomic group-season combination was not available using the baseline survey data (local assessment), and because the avian surveys made every effort to survey all species, then the local assessment score was assigned a 0 since no birds were sighted for that taxonomic group-season combination.

3.2.3.4 Taxonomic Group Exposure Scoring

To determine the relative exposure for a given taxonomic group and season in the Lease Area compared to all other areas, the MDAT quartile score and baseline survey data quartile score were added together to create a final exposure metric that ranged from 0 to 6. The density information at both spatial scales was equally weighed, and thus represent both the local and regional importance of the Lease Area to a given taxonomic group during a given season. However, if a taxonomic group-season combination was not available for the MDAT regional assessment, then the score from the local assessment (baseline survey data) was accepted as the best available information for that taxonomic group-season, and it was scaled to range from 0 to 6 (e.g., essentially doubled to match the final combined score).

The final exposure score was categorized as ***minimal*** (a combined score of 0), ***low*** (combined score of 1–2), ***medium*** (combined score of 3–4), or ***high*** (combined score of 5–6; Table 3-4). In general terms, taxonomic group-season combinations labeled as ***minimal*** had low densities at both the local and regional scales. ***Low*** exposure was assessed for taxonomic groups with below-average densities at both spatial scales, or above-average density at one of the two scales and low density at the other scale. ***Medium*** exposure describes several different combinations of densities; one or both scales must be at least above-average density, but this category can also include taxonomic group-season combinations where density was high for one scale and low for another. ***High*** exposure describes when both scales are high density, or one is high and the other is above average. Both local and regional exposure scores were viewed as equal in importance in the assessment of exposure.

Table 3-4. Definitions of exposure levels developed for the COP for each taxonomic group and season. The listed scores represent the exposure scores from the local DOE digital aerial survey data and the regional MDAT on the left and right, respectively.

Exposure Level	Definition	Scores
Minimal	Lease Area densities at both local and regional scales are below the 25th percentile.	0, 0
Low	Lease Area local and/or regional density is between the 25th and 50th percentiles.	1, 1
	OR	
	Lease Area local density is between the 50th and 75th percentiles and regional density is below the 25th percentile, or vice versa.	2, 0
Medium	Lease Area local or regional density is between the 50th and 75th percentiles.	2, 2
	OR	
	Lease Area local density is between the 50th and 75th percentiles and regional density between the 25th and 50th percentiles, or vice versa.	2, 1
	OR	
	Lease Area local density is greater than the 75th percentile and regional density is below the 25th percentile, or vice versa.	3, 0
	OR	
	Lease Area local density is greater than the 75th percentile of all densities and regional density is between the 25th and 50th percentiles of all densities (or vice versa).	3, 1
High	Lease Area densities at both local and regional scales are above the 75th percentile.	3, 3
	OR	
	Local densities are greater than the 75th percentile and regional densities are between the 50th and 75th percentiles, or vice versa.	3, 2

3.2.3.5 Aggregated Annual Exposure Scores

To understand the total exposure across the annual cycle for each taxonomic group, all the seasonal scores were summed to obtain an annual score from 0–12. These annual scores were mapped to exposure categories of ***minimal*** (0–2), ***low*** (3–5), ***medium*** (6–8), and ***high*** (9–12). The annual exposure category for a taxonomic group represents the seasonally integrated risk across the annual cycle.

Finally, because these scores are all relative to seasonal distribution, estimates of count density were provided within the Lease Area and over the entire survey area for each species from the baseline survey data. Uncommon taxonomic groups with few detections in the Lease Area may be somewhat over-rated for exposure using this method, while common taxonomic groups with relatively few detections in the Lease Area may be effectively under-rated in terms of total exposure to the Project. Density estimates of count per sq. km are presented to provide context for the exposure scores.

3.2.3.6 Interpreting Exposure Scores

The final exposure scores for each taxonomic group and season, as well as the aggregated annual scores, should be interpreted as a measure of the relative importance of the Lease Area for a taxonomic group, as compared to other surveyed areas in the region and in the northwest Atlantic. It does not indicate the absolute number of individuals likely to be exposed. Rather, the exposure score attempts to provide regional and population-level context for each taxonomic group.

A ***low*** or ***minimal*** exposure score means that the taxonomic group was predicted to occur at lower densities in the Lease Area than in other locations. A ***minimal*** exposure score should not be interpreted to mean there are no individuals of that taxonomic group in the Lease Area. In fact, common taxonomic groups may receive a ***minimal*** exposure score even if there are still substantial numbers of individuals in the Lease Area, so long as their predicted densities *outside* are comparatively higher. A ***high*** exposure score indicates that the observed and predicted densities of the taxonomic group in the Lease Area were high relative to densities of that taxonomic group in other surveyed areas. This quantitative annual exposure score was then considered with additional species-specific information, along with expert opinion, to place each taxonomic group within a final exposure category (described below in section 3.2.3.7).

3.2.3.7 Exposure Categories

The quantitative assessment of exposure (described above), other locally available data, existing literature, and species accounts were utilized to develop a final qualitative exposure determination. Final exposure level categories used in this assessment are described in Table 3-5:

Table 3-5. Assessment criteria used for assigning species to final exposure levels.

Final Exposure Level	Definition
Minimal	Minimal seasonal exposure scores in all seasons or minimal score in all but 1 season **AND/OR** Based upon the literature—and, if available, other locally available tracking or survey data—little to no evidence of use (e.g., no record in Project Area) of the offshore environment for breeding, wintering, or staging, and low predicted use during migration
Low	Low exposure scores in 2 or more seasons, or Medium exposure score in 1 season **AND/OR** Based upon the literature—and, if available, other locally available tracking or survey data—low evidence of use of the Lease Area or offshore environment during any season
Medium	Medium exposure scores in 2 or more seasons, or High exposure score in 1 season **AND/OR** Based upon the literature—and, if available, other locally available tracking or survey data—moderate evidence of the Lease Area or use of the offshore environment during any season
High	High exposure scores in 2 or more seasons **AND/OR** Based upon the literature—and, if available, other locally available tracking or survey data—high evidence of use of the Lease Area or offshore environment, and the offshore environment is primary habitat during any season

3.2.4 Vulnerability Framework

Researchers in Europe and the U.S. have assessed the vulnerability of birds to offshore wind farms and general disturbance by combining ordinal scores across a range of key variables (Furness et al. 2013a; Wade et al. 2016; Kelsey et al. 2018; Fliessbach et al. 2019; Willmott et al. 2013). The purpose of these indices was to prioritize species in environmental assessments (Desholm 2009), and provide a relative rank of vulnerability (Willmott et al 2013). Importantly, the past assessments and the one conducted here, are intended to support decision-making by ranking the relative likelihood that a species will be sensitive to offshore wind farms but should not be interpreted as an absolute determination that there will or will not be collision mortality or habitat loss. In addition, for many species there remains significant uncertainty (see discussion below) on critical inputs into vulnerability score (e.g., avoidance rates). Therefore, the results should be interpreted as a guide to species that have a higher likelihood of risk and be used to prioritize the species that should be the focus of post-construction monitoring.

The existing vulnerability methods assess individual-level vulnerability to collision and displacement independently, then incorporate population-level vulnerability to develop a final *species-specific* vulnerability score. These past efforts provide useful rankings across a region but are not designed to assess the vulnerability of birds to a particular wind farm or certain turbine designs. Collision risk models (e.g., Band 2012) do estimate site-specific mortality, but are substantially influenced by assumptions about avoidance rates (Chamberlain et al. 2006) and do not assess vulnerability to displacement. Thus, there is a need to develop a *project-specific* vulnerability score for each species that is inclusive of both collision and displacement and has fewer assumptions.

The scoring process in this assessment builds from the existing methods, incorporates the specifications of the turbine models being considered by the Project, utilizes local bird conservation status, and limits the vulnerability score to the species observed in the local surveys. The results from this scoring method may differ for some species from the qualitative determinations made in other COP assessments. For species, or species group, for which inputs are lacking, the literature is used to qualitatively determine a vulnerability ranking using the criteria in Table 3-6. Below is a description of the scoring approach.

Table 3-6. Assessment criteria used for assigning species to each behavioral vulnerability level.

Behavioral Vulnerability Level	Definition
Minimal	0-0.25 ranking for collision or displacement risk in vulnerability scoring **AND/OR** No evidence of collisions or displacement in the literature. Unlikely to fly within the rotor-swept zone (RSZ).
Low	0.26-0.5 ranking for collision or displacement risk in vulnerability scoring **AND/OR** Little evidence of collisions or displacement in the literature. Rarely flies within the RSZ.
Medium	0.51-0.75 ranking for collision or displacement risk in vulnerability scoring **AND/OR** Evidence of collisions or displacement in the literature. Occasionally flies within the RSZ.
High	0.76-1.0 ranking for collision or displacement risk in vulnerability scoring **AND/OR** Significant evidence of collisions or displacement in the literature. Regularly flies within the RSZ.

3.2.4.1 Population Vulnerability (PV)

There are many factors that contribute to how sensitive a population is to mortality or habitat loss related to the presence of a wind farm; these include vital rates, existing population trends, and relative abundance of birds (Goodale and Stenhouse 2016). In this avian risk assessment, the relative abundance of birds is accounted for by the exposure analysis described above. The vulnerability assessment creates a population vulnerability score by using Partners in Flight (PiF) "continental combined score" (CCSmax), a local "state status" (SSmax), and adult survival score (AS; Equation 1). Survival is included as an independent variable that is not accounted for in the CCSmax. This approach is based upon methods used by Kelsey et al. (2018) and Fliessbach et al. (2019).

Each factor included in this assessment (CCSmax, SSmax, and AS) is weighted equally and receives a categorical score of 1–5 (Table 3-7). The final population level vulnerability scores are rescaled to a 0–1 scale, divided into quartiles, and are then translated into four final vulnerability categories (Table 3-6). Since using quartiles creates hard cut-off points and there is uncertainty present in all inputs (see discussion on uncertainty below), using only scores can potentially misrepresent vulnerability (e.g., a 0.545 PV score leading to a ***medium*** category). To account for these issues, the scores are considered along with information in existing literature. If there is evidence in the literature that conflicts with the vulnerability score, then the score will be appropriately adjusted (up or down) according to documented empirical evidence. For example, if a PV score was assessed as ***low***, but a paper indicated an increasing population, the score would be adjusted up to include a range of ***low–medium***.

$$PV = CCSmax + SSmax + AS \qquad \text{Equation 1}$$

Specifics for each factor in PV are as follows:

- *CCSmax* is included in scoring because it integrates various factors PiF uses to indicate global population health. It represents the maximum value for breeding and non-breeding birds developed by PiF, and combines the scores for population size, distribution, global threat status, and population trend (Panjabi et al. 2019). The CCSmax score from PiF was rescaled to a 1–5 scale to achieve consistent scoring among factors.

- *SSmax* is included in scoring to account for local conservation status, which is not included in the CCSmax. Local conservations status is generally determined independently by states and accounts for the local population size, population trends, and stressors on a species within a particular state. It was developed following methods by Adams et al. (2016) in which the State conservation status for the relevant adjacent states is placed within five categories (1 = no ranking, to 5 = endangered), and then, for each species, the maximum state ranking is selected.

- *AS* is included in the scoring because species with higher adult survival rates are more sensitive to increases in adult mortality (Desholm 2009; Adams et al. 2016). The five categories are based upon those used in several vulnerability assessments (Kelsey et al. 2018; Fliessbach et al. 2019; Willmott et al. 2013), and the species-specific values were used from Willmott et al. (2013).

Table 3-7. Data sources and scoring of factors used in the vulnerability assessment

Vulnerability Component	Factor	Definition and Source	Scoring
Population Vulnerability (PV)	*CCSmax*	Partners in Flight continental combined score: http://pif.birdconservancy.org/ACAD/Database.aspx	1 = Minor population sensitivity 2 = Low population sensitivity 3 = Medium population sensitivity 4 = High population sensitivity 5 = Very-High population sensitivity
	SSmax	State status from states adjacent to Project; Adams et al. 2016	1 = No Ranking* 2 = State/Federal Special Concern 3 = State/Federal Threatened 4 = State/Federal Endangered 5 = State & Federal T&E Species
	AS	Adult survival score: scores and categories taken from Willmott et al. 2013	1 = <0.75 2 = 0.75 to 0.80 3 = >0.80 to 0.85 4 = >0.85 to 0.90 5 = >0.90
Collision Vulnerability (CV)	*RSZt*	Turbine-specific percentage of flight heights in rotor swept zone (RSZ). Flight heights modeled from NW Seabird Catalog. Categories from Kelsey et al. 2018	1 = < 5% in RSZ 3 = 5–20% in RSZ 5 = > 20% in RSZ
	MAc	Avoidance rates and scoring categories from Willmott et al. 2013 and Kelsey et al. 2018	1 = >40% avoidance 2 = 30 to 40% avoidance 3 = 18 to 29% avoidance 4 = 6 to 17% avoidance 5 = 0 to 5% avoidance
	NFA & DFA	Nocturnal Flight Activity (NFA) and Diurnal Flight Activity (DFA). NFA scores were taken from Willmot et al. 2013; DFA was calculated using locally available aerial surveys that records if birds are sitting or flying.	1 = 0–20% 2 = 21–40% 3 = 41–60% 4 = 61–80% 5 = 81–100%

Vulnerability Component	Factor	Definition and Source	Scoring
Displacement Vulnerability (DV)	*MAd*	Macro-avoidance rates that would decrease collision risk from Willmott et al. 2013 and Kelsey et al. 2018	1 = 0–5% avoidance 2 = 6–17% avoidance 3 = 18–29% avoidance 4 = 30–40% avoidance 5 = > 40% avoidance
	HF	The degree to which a species is considered a habitat generalist (i.e., can forage in a variety of habitats) or a specialist (i.e., requires specific habitat and prey type). HF score and categories taken from Willmott et al. 2013	0 = species does not forage in the Atlantic Outer Continental Shelf 1 = species uses a wide range of habitats over a large area and usually has a wide range of prey available to them 2 to 4 = grades of behavior between scores 1 and 5 5 = species with habitat- and prey-specific requirements that do not have much flexibility in diving-depth or choice of prey species

*Note actual definitions for state conservation ranking may be adjusted to follow individual state language.

3.2.4.2 *Collision Vulnerability (CV)*

Collision vulnerability assessments can include a variety of factors including nocturnal flight activity, diurnal flight activity, avoidance, proportion of time within the rotor swept zone (RSZ), maneuverability in flight, and percentage of time flying (Furness et al. 2013a; Kelsey et al. 2018; Willmott et al. 2013). The assessment process conducted here follows Kelsey et al. (2018) and includes proportion of time within the RSZ (RSZt), a measure of avoidance (MAc), and flight activity (NFA and DFA; Equation 2). Each factor was weighted equally and given a categorical score of 1–5 (Table 3-7). The final collision vulnerability scores were rescaled to a 0–1 scale, divided into quartiles, and then translated into four final vulnerability categories (Table 3-6). As described in the PV section, the score is then considered along with information available in existing literature; if there is sufficient evidence to deviate from the quantitative score, a CV categorical range is assigned for each species.

$$CV = RSZt + MAc + (NFA + DFA)/2 \qquad \textit{Equation 2}$$

Specifics for each factor in CV are as follows:

- RSZt is included in the score to account for the probability that a bird may fly through the RSZ. Flight height data was selected from the Northwest Atlantic Seabird Catalog. Flight heights calculated from digital aerial survey methods were excluded because the method has not been validated (Thaxter et al. 2015) and the standard flight height data used in European collision assessments (Masden 2019) is modeled primarily from boat-based survey (Johnston et al. 2014a). However, it is believed that boat-based visual estimates of flight height may be biased low and estimates are limited by observations conditions (Johnston and Cook 2016; Johnston et al. 2014a; Harwood et al. 2018) which would tend to underestimate risk. For this reason, we include as much reliable data as possible and generate models of flight height to best assess flight height distributions and limit biases.

  Many of the boat-based datasets provided flight heights as categorical ranges for which the mid value of the range in meters were determined, as well as the lower and upper bounds of the category. Upper bounds that were given as >"X" ft (or m) were capped at 400 m to estimate upper bounds. A few datasets provided exact flight height estimates which resulted in upper and lower ranges being the same as the mid value. A total of 100 randomized datasets were generated per species using the uniform distribution to select possible flight height values between lower and upper flight height bounds. Similar to methods from Johnston et al. (2014), flight heights were modeled using a smooth spline of the square root of the binned counts in 15 m bins. The integration of the smooth spline model count within each 1 m increment was calculated and the mean and standard deviation of all 100 models were calculated across all 1 m increments. The proportion of animals within each RSZ zone was estimated by summing the 1 m count integrations and dividing by the total estimate count of animals across all RSZ zones, then values were converted to a 1–5 scale based upon the categories used by Kelsey et al. (2018; Table 3-7). The RSZ was defined by minimum and maximum turbine options being considered by the Project (two different power units at two different tower heights; Table 3-8). The analysis was conducted in R Version 4.0.2.[8] Of note, there are several important uncertainties in flight height estimates: flight heights from boats can be skewed lower; flight heights are generally recorded during daylight and in fair weather; and flight heights may change when turbines are present.

Table 3-8. Turbine options used in the vulnerability analysis

Turbine Option	Color in flight height figures	Lower blade tip height (m)	Upper blade tip height (m)
1	green	25	245
2	gold	34	265

- MAc is included in the score to account for macro-avoidance rates that would decrease collision risk. Macro-avoidance is defined as a bird's ability to change course to avoid the entire wind farm area (Kelsey et al. 2018), versus meso-avoidance (avoiding individual turbines), and micro-avoidance (avoiding turbine blades; Skov et al. 2018). The scores used in the assessment were based on Willmott et al. (2013), who conducted a literature review to determine known macro-avoidance rates and then converted them to a 1–5 score based upon the categories in Table 3-7. The MAc indicates that this factor is used in the CV versus the MAd, which was used in the DV score (described below). For the assessment conducted here, Willmott et al. (2013) avoidance rates were updated to reflect the most recent empirical studies (Krijgsveld et al. 2011; Cook et al. 2012; 2018; Vanermen et al. 2015; Skov et al. 2018), and indexes (Furness et al. 2013a; Wade et al. 2016; Kelsey et al. 2018; Bradbury et al. 2014; Garthe and Hüppop 2004; Adams et al. 2016). For the empirical studies, the average avoidance was used when a range was provided in a paper. For the indices, the scores were converted to a continuous value using the median of a scores range; only one value was entered for related indices (e.g., Adams et al. 2016, Kelsey et al 2018). When multiple values were available for a species, the mean value was calculated. For some species, averaging the avoidance rates across both the empirical studies and indices led to some studies being counted multiple times. Indices were included to capture how the authors interpreted the avoidance studies and determined avoidance rates for species where data was not available. There are several important uncertainties in determining avoidances rates: the studies

[8] R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/

were all conducted in Europe; the studies were conducted at wind farms with turbines much smaller than are proposed for the Project; the methods used to record avoidance rates varied and included surveys, radar, and observers; the analytical methods used to estimate avoidance rates also varied significantly between studies; and the avoidance rate for species where empirical data is not available were assumed to be similar to closely-related species.

- NFA and DFA include scores of estimate percentage of time spent flying at night (NFA) and during the day (DFA) based upon the assumption that more time spent flying would increase collision risk. The NFA scores were taken directly from the scores, based upon literature review, from Willmott et al. (2013). The DFA score were calculated from the MABS baseline survey data that categorized if a bird was sitting or flying for each bird observation. Per Kelsey et al. (2018) the NFA and DFA scores were equally weighted and averaged.

3.2.4.3 Displacement Vulnerability (DV)

Rankings of displacement vulnerability account for two factors: 1) disturbance from ship/helicopter traffic and the wind farm structures (MAd); and 2) habitat flexibility (HF) (Furness et al. 2013, Kelsey et al. 2018). This assessment combines these two factors, weights them equally, and categorizes them from 1–5 (Equation 3; Table 3-7). Note: While Furness et al. (2013) down-weighed the DV score by dividing by 10 (they assumed displacement would have lower impacts on the population), the assessment conducted here maintains the two scores on the same scale. Empirical studies indicate that for some species, particularly sea ducks, that avoidance behavior may change through time and that several years after projects have been built some individuals may forage within the wind farm. The taxonomic specific text indicates if there is evidence that displacement may be partially temporary. The final displacement vulnerability scores are rescaled to a 0–1 scale, divided into quartiles, and translated into four final vulnerability categories (Table 3-6). As described in the PV section, the score is then considered along with the literature; if there is sufficient evidence to deviate from the quantitative score, a DV categorical range is assigned for each species.

$$DV = MAd + HF \qquad \text{Equation 3}$$

Specifics for each factor in DV are as follows:

- *MAd* is included to account for behavioral responses from birds that lead to macro-avoidance of wind farms, and that have the potential to cause effective habitat loss if the birds are permanently displaced (Fox et al. 2006). The MAd scores used in the assessment were based on Willmott et al. 2013, but updated to reflect the most recent empirical studies (Krijgsveld et al. 2011; Cook et al. 2012; Vanermen et al. 2015; Skov et al. 2018; Cook et al. 2018), and indexes (Furness et al. 2013a; Wade et al. 2016; Kelsey et al. 2018; Garthe and Hüppop 2004; Adams et al. 2016; Bradbury et al. 2014). See MAc above for further details. The scores are the same as the MAc scores described above, but, following methods from Kelsey et al. (2018), are inverted so that a high avoidance rate (> 40%) is scored as a 5. Since the > 40% cutoff is a low threshold, many species can receive a high 5 score; there is a large range within this high category that includes species documented to have moderate avoidance rates (e.g., terns) and species with near complete avoidance (e.g., loons).

- *HF* accounts for the degree to which a species is considered a habitat generalist (i.e., can forage in a variety of habitats) or a specialist (i.e., requires specific habitat and prey type). The assumption is that generalists are less likely to be affected by displacement, whereas specialists are more likely to be affected (Kelsey et al. 2018). The values for HF used in this assessment were taken from Willmott et al. (2013). Note that Willmott et al. (2013) used a 1–5 scale plus a "0" to indicate that a species does not forage in the Atlantic OCS.

3.2.4.4 Final Risk Determination

The CV, DV, and PV calculations are all used to make a final evaluation on population level risk. First the CV and DV categories are combined with the exposure assessment to develop a preliminary risk determination. Rather than multiplying the CV and DV by PV score, as is done in some vulnerability assessments (Furness et al. 2013a), the PV score is used to adjust the risk score up or down based on the following rules: ***minimal*** = adjustment down in risk; ***low*** to ***medium*** = no adjustment; and ***high*** = adjusted up. In the case of a risk range (e.g., b), an adjustment down would eliminate the high of the range and an adjustment up would eliminate the low end of the range. This approach down weights the influence of PV in the risk assessment to account for the broad uncertainty in understanding population dynamics.

3.2.5 Uncertainty

Uncertainty is recognized in this assessment for both exposure and vulnerability. Given the natural variability of ecosystems and recognized knowledge gaps, assessing how anthropogenic actions will affect the environment inherently involves a degree of uncertainty (Walker et al. 2003). Broadly defined, uncertainty is incomplete information about a subject (Masden et al. 2015) or a deviation from absolute determinism (Walker et al. 2003). In the risk assessment conducted here, uncertainty is broadly recognized as a factor in the process, and is accounted for by including, based upon the best available data, a range for the exposure, vulnerability, and population scores when appropriate.

For offshore wind avian assessments, uncertainty primarily arises from two sources: predictions of bird use of the Lease Area and the region (i.e., exposure) – horizontally and vertically; and our understanding of how birds interact with turbines (i.e., vulnerability). While uncertainty will always be present in any assessment of offshore wind, and acquiring data on bird movements during hours of darkness and in poor weather is difficult, overall knowledge on bird use of the marine environment has improved substantially in recent years through local survey efforts (e.g., DOE digital aerial surveys), revised regional modeling efforts (i.e., MDAT models), and individual tracking studies (e.g., falcons, terns, Piping Plover, Red Knot, diving birds). For many species, multiple data sources may be available to make an exposure assessment, such as survey and individual tracking data. If the data sources show differing patterns in use of the wind farm area, then a range of exposure is provided (e.g., minimal–low) to account for all available data and to capture knowledge gaps and general uncertainty about bird movements.

Similarly, knowledge has been increasing on the vulnerability of birds to offshore wind facilities in Europe (e.g., Skov et al. 2018). Vulnerability assessments have either incorporated uncertainty into the scoring process to calculate a range of ranks (Kelsey et al. 2018; Willmott et al. 2013), or have developed separate stand-alone tables (Wade et al. 2016). In order to keep the scoring process as simple as possible, this assessment does not directly include uncertainty in the scoring, but rather uses the uncertainty assessment conducted by Wade et al. (2016) as a reference and references all available literature. Like exposure, if there is evidence in the literature, or from other data sources, that conflicts with the vulnerability score, the score will be adjusted up or down, as appropriate, to include a range that extends into the next category. This approach accounts for knowledge gaps and general uncertainty about vulnerability of birds to wind facilities.

Table 3-9. From Wade et al. (2016): "Uncertainty inherent in data underlying the generation of four vulnerability factors for 38 seabird species. Uncertainty Scores equate to five Uncertainty Categories with greater scores indicating lower uncertainty: very high (score 1), high (score 2), moderate (score 3), low (score 4) and very low uncertainty (score 5). These categories and scores are on an ordinal scale where the numerical values have no significance beyond allowing a ranking to be established. Species rankings and scores were generated relative to data considered in each of the four vulnerability factors."

Species	Uncertainty Level: % of time at altitudes overlapping with turbine blades	Uncertainty Score	Uncertainty Level: Displacement caused by structures	Uncertainty Score	Uncertainty Level: Displacement caused by vessels and/or helicopters	Uncertainty Score	Uncertainty Level: Use of tidal races	Uncertainty Score	Overall Uncertainty Score (max 20)
European storm-petrel	Very high	1	Very high	1	High	2	Very high	1	5
Leach's storm-petrel	Very high	1	Very high	1	High	2	Very high	1	5
Sooty shearwater	Very high	1	Very high	1	High	2	Very high	1	5
Arctic skua	Moderate	3	Very high	1	Very high	1	Very high	1	6
Common goldeneye	Very high	1	Very high	1	High	2	High	2	6
Greater scaup	Very high	1	Very high	1	High	2	High	2	6
Manx shearwater	High	2	Very high	1	High	2	Very high	1	6
Slavonian grebe	Very high	1	High	2	High	2	Very high	1	6
White-tailed eagle	Very high	1	High	2	High	2	Very high	1	6
Great-crested grebe	High	2	High	2	High	2	Very high	1	7
Long-tailed duck	Very high	1	High	2	High	2	High	2	7
Roseate tern	Very high	1	High	2	High	2	High	2	7
Great skua	Moderate	3	High	2	High	2	Very high	1	8
Little tern	Very high	1	Moderate	3	Very high	1	Moderate	3	8
Velvet scoter	High	2	Very high	1	Moderate	3	High	2	8
Black-headed gull	Moderate	3	Moderate	3	High	2	Very high	1	9
Northern fulmar	Low	4	High	2	High	2	Very high	1	9
Arctic tern	Moderate	3	Moderate	3	High	2	High	2	10
Great northern diver	High	2	High	2	Very high	1	Very low	5	10
Little auk	Very high	1	Low	4	Low	4	Very high	1	10
Black-throated diver	High	2	Moderate	3	High	2	Low	4	11
Common gull	Low	4	Low	4	High	2	Very high	1	11
Common eider	Moderate	3	Moderate	3	Moderate	3	Moderate	3	12
Sandwich tern	Low	4	Low	4	High	2	High	2	12
Black guillemot	Very high	1	High	2	Very low	5	Very low	5	13
European shag	High	2	Low	4	High	2	Very low	5	13
Great black-backed gull	Low	4	Very low	5	Moderate	3	Very high	1	13
Great cormorant	Moderate	3	Very low	5	High	2	Moderate	3	13
Black-legged kittiwake	Very low	5	Very low	5	High	2	High	2	14
Common tern	Very low	5	Low	4	High	2	Moderate	3	14
Herring gull	Very low	5	Very low	5	Moderate	3	Very high	1	14
Lesser black-backed gull	Very low	5	Very low	5	Moderate	3	Very high	1	14
Northern gannet	Very low	5	Very low	5	High	2	High	2	14
Red-throated diver	Low	4	Low	4	High	2	Low	4	14
Common scoter	Low	4	Very low	5	Low	4	High	2	15
Atlantic puffin	Moderate	3	Moderate	3	Very low	5	Very low	5	16
Razorbill	Low	4	Very low	5	Very low	5	Low	4	18
Common guillemot	Low	4	Very low	5	Very low	5	Very low	5	19

3.3 Results: Overview

3.3.1 Potential effects by construction stage

Construction and Installation: Birds can potentially be displaced by construction activities or collide with construction equipment when they interact with construction vessels or WTGs being installed. Spatially, bird exposure to the Lease Area will be similar during all development stages, but exposure to construction activities are considered to be temporary (Fox and Petersen 2019). During construction, there may be temporary disturbance of sediment during cable installation, but the disturbance will be confined to a relatively small area (at depth), and permanent loss of foraging habitat for seabirds is unlikely. During construction, a short-term impact-producing factor to birds includes the lighting of construction vessels that may attract birds. However, risk of increased collision due to attraction to lighting during nighttime construction activities is considered to be temporary (Fox et al. 2006) and is unlikely to affect populations; and thus, lighting is not discussed in detail as an individual hazard. In this assessment, potential effects from construction are assessed simultaneously with operation.

Operations and Maintenance: During operations, the potential effects of offshore wind facilities on birds are habitat loss due to displacement, and mortality due to collision (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Milman 2016). The lighting associated with WTGs and the Offshore Substations may result in attraction of birds and increased risk of collision (Montevecchi 2006). These effects are variable by taxonomic group, but can be minimized by using best management practices, such as low-intensity strobe lights (BOEM 2020c). Lighting is not discussed in detail as an individual hazard but considered a factor that could increase collision risk. The presence of maintenance vessels and associated activities may temporarily displace birds, but are not expected to cause adverse effects (BOEM 2018a).

Decommissioning: While the specifics of decommissioning activities are not fully known at this time, the effects from decommissioning are expected to be the same or less than construction activities (Fox and Petersen 2019); thus, the potential impacts from decommissioning are not assessed independently.

The following sections describe the analytical methods and criteria used to assess exposure, the criteria used to assess vulnerability, and the how the exposure and vulnerability assessments were combined to assess potential effects.

3.3.2 Exposure

Migrant terrestrial and coastal species may follow the coastline during migration or choose more direct routes over expanses of open water. Many marine birds also make annual migrations or seasonal movements up and down the Atlantic coast (e.g., gannets, loon, and sea ducks), taking them directly through the mid-Atlantic region, particularly in spring and fall. The mid-Atlantic region also supports large populations of birds in summer, some of which breed in the area, such as coastal gulls and terns. Other summer residents, such as shearwaters, visit from the Southern Hemisphere (where they breed during the austral summer/boreal winter). In the fall, many of the summer residents leave the area and migrate south to warmer regions and are replaced by species that breed further north and winter in the mid-Atlantic region. This results in a complex ecosystem where the avian community composition shifts regularly, and temporal and geographic patterns are highly variable.

Three avian species listed under the Endangered Species Act (ESA) are present in the region: the Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus rufa*), and Roseate Tern (*Sterna dougallii*). Piping Plovers nest along Virginia beaches and will also migrate (spring and fall) through the region to and from northern breeding sites. Red Knots pass through the region during migration in transit to far northern breeding sites and use some stopover areas in Virginia to refuel along the way. Roseate Terns formerly bred along the coast of Virginia, but now only pass through on their way north to breeding sites in New York and New England states. Other federally-recognized species include the Black-capped Petrel, currently proposed for listing under the ESA, and the Bald Eagle and Golden Eagle, both protected under the BGEPA – none of which are likely to occur in the Lease Area.

The assessment, below, includes the following for each species group: a description of the spatiotemporal context of exposure, exposure assessment, relative behavioral vulnerability assessment including flight height data, and a final risk determination. Marine birds are further divided into family groups. Species listed under the Bald and Golden Eagle Protection Act and the ESA are assessed individually. A summary table is provided at the end of the assessment.

3.4 Results: Non-marine migratory birds

3.4.1 Coastal Waterbirds

3.4.1.1 Spatiotemporal Context

Coastal waterbirds use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. In this group, species are included that are generally restricted to freshwater or that use saltmarshes, beaches and other strictly coastal habitats, and that are not captured in other groupings (e.g., grebes and waterfowl). Some grebe species migrate to and winter on saltwater, where they generally stay inshore in relatively shallow and/or sheltered coastal waters but may also be found offshore in shallower regions or over shoals (Stout and Nuechterlein 1999). Waterfowl comprises a broad group of geese and ducks, most of which spend much of the year in terrestrial or coastal wetland habitats (Baldassarre and Bolen 2006). The diving ducks generally winter on open freshwater, as well as brackish or saltwater. Species that regularly winter on saltwater, including mergansers, scaup, and goldeneyes, usually restrict their distributions to shallow, very nearshore waters (Owen and Black 1990). The IPaC database did not identify any coastal waterbird species in the Lease Area or surrounding waters. A subset of the diving ducks, however, have an exceptionally strong affinity for saltwater, either year-round or outside of the breeding season; these species are known as the “sea ducks” and are described in detail in the Marine Bird section (below).

3.4.1.2 Exposure Assessment

Exposure for coastal waterbirds was assessed using species accounts, DOE digital aerial survey data, and literature. Exposure is considered to be ***minimal*** because most coastal waterfowl spend a majority of the year in freshwater aquatic systems and near-shore marine systems, and there is little to no use of the Lease Area during any season (Figure 3-6). Due to the minimal exposure rating, a vulnerability and risk assessment was not conducted.

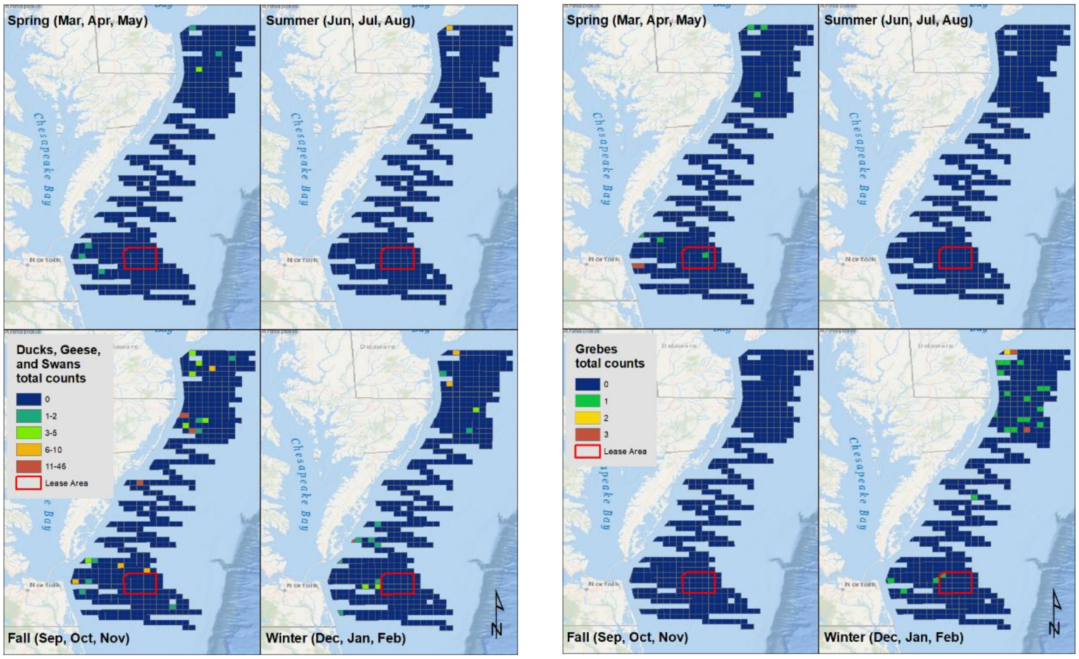


Figure 3-6. Coastal ducks, geese, and swans (left) and grebes (right) observed, by season, during the DOE digital aerial and boat-based surveys. Note the different scales used in the series of maps of each group.

3.4.2 Shorebirds

3.4.2.1 Spatiotemporal Context

Shorebirds are coastal breeders and foragers and generally avoid straying out over deep waters during breeding. Few shorebird species breed locally on the U.S. Atlantic coast; most shorebirds that pass through the region are northern or Arctic breeders that migrate along the U.S. east coast on their way to and from wintering areas in the Caribbean islands, or Central or South America. Of the shorebirds, only the two phalaropes (Red Phalarope and Red-necked Phalarope) are generally considered marine species (Rubega et al. 2020; Tracy et al. 2020). Very little is known regarding the migratory movements of these species, although they are known to travel well offshore. Two shorebird species that are federally protected under the ESA occur in the region – the Piping Plover and the Red Knot – and these are addressed in detail below (Table 3-10).

Table 3-10. Shorebirds of federal conservation concern occurring in Virginia, and their conservation status (E = Endangered; T = Threatened).

Common Name	Scientific Name	State Status	Federal Status
Red Knot	*Calidris canutus rufa*	T	T
Piping Plover	*Charadrius melodus*	T	T

3.4.2.2 Exposure Assessment

Exposure was assessed using species accounts and DOE digital aerial survey data. Spatial and temporal exposure to construction and operation is considered to be ***minimal*** because few were observed offshore and none in the Lease Area (Figure 3-7). A recent tracking study conducted in inland Canada indicates that shorebirds need 1.2–8.7 mi (2–14 km) to climb above a 541 ft (165 m) turbine (Howell et al. 2019). Since the inshore edge of the Lease Area is 27 mi (44 km) from the nearest coast, most migrating shorebirds are likely above 1,000 ft (304 m) at the time that they reach the Lease Area, though some uncertainties remain regarding migratory flight heights. Due to the minimal exposure, a vulnerability and risk assessment was not conducted for non-ESA shorebird species.

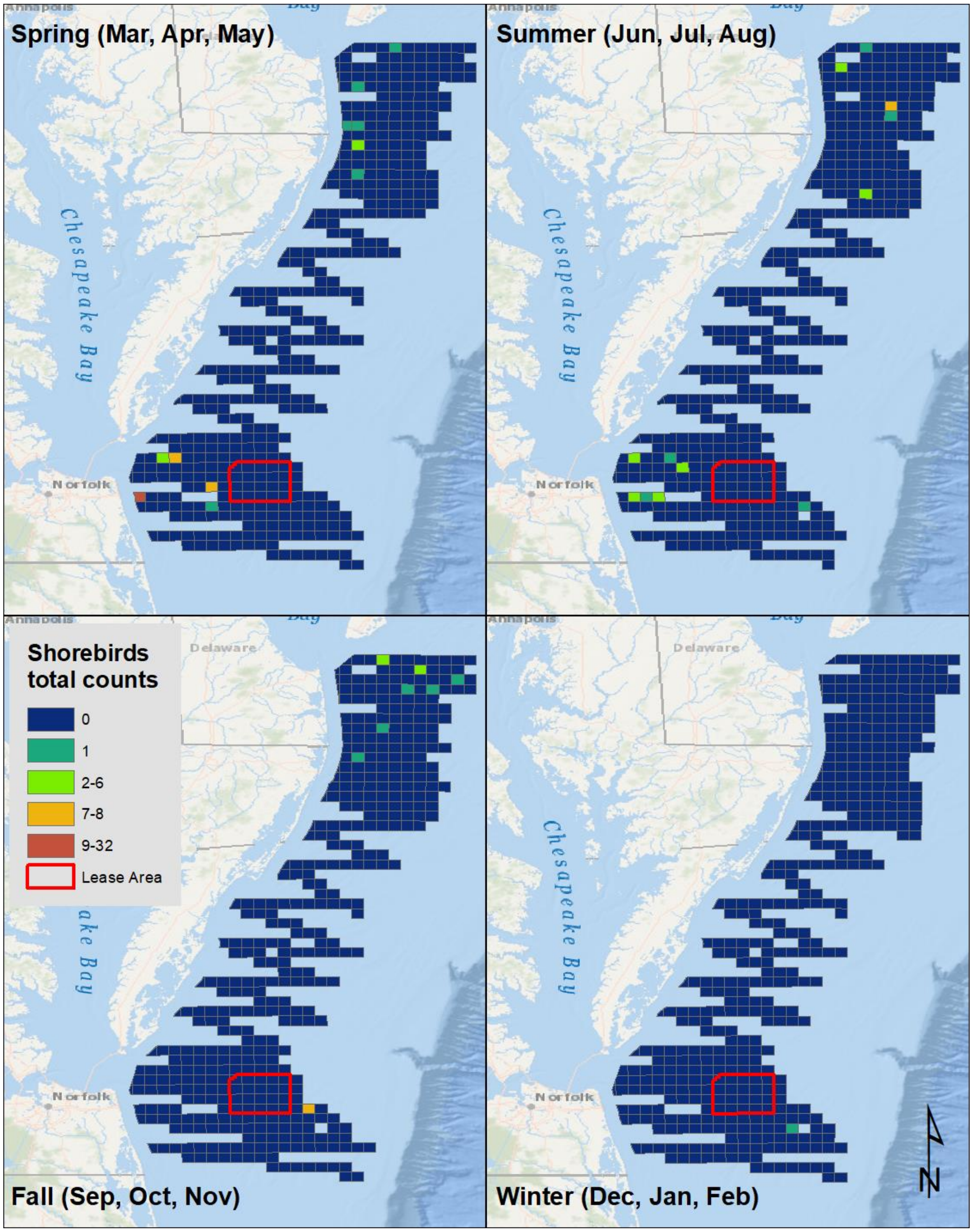


Figure 3-7. Shorebirds observed, by season, during the DOE digital aerial and boat-based surveys.

3.4.2.3 Endangered Shorebird Species

3.4.2.3.1 Piping Plover

3.4.2.3.1.1 Spatiotemporal context

The Piping Plover (*Charadrius melodus*) is a small shorebird that nests on beaches and wetlands along the Atlantic coast of North America, the Great Lakes, and in the Midwestern plains (Elliott-Smith and Haig 2020). The species winters in the coastal southeastern U.S. and Caribbean (Elliott-Smith and Haig 2004, U.S. Fish and Wildlife Service 2009, BOEM 2014). Due to a number of threats, the Atlantic subspecies (*C. m. melodus*) is listed as *Threatened* under the ESA[9], and is heavily managed on the breeding grounds to promote population recovery (Elliott-Smith and Haig 2020). The winter range of the species is imperfectly understood, particularly for U.S. Atlantic breeders and for wintering locations outside the U.S., but the Atlantic subpopulation appears to primarily winter along the southern Atlantic coast and the Gulf coast of Florida (Elliott-Smith and Haig 2004, U.S. Fish and Wildlife Service 2009, Burger et al. 2011).

Piping Plovers make nonstop long-distance migratory flights (Normandeau Associates Inc. 2011), or offshore migratory "hops" between coastal areas (Loring et al. 2017). As such, at least some individuals of this species likely traverse the Lease Area because the birds favor short direct ocean crossings rather than following coastal routes (Figure 3-9; Loring et al. 2019). Migration occurs primarily during nocturnal periods, with the average takeoff time appearing to be around 5–6 pm (Loring et al. 2017; Loring et al. 2019).

Piping Plovers are listed as *Threatened* in Virginia, and are present during spring and fall migratory periods, and during the breeding season (U.S. Fish and Wildlife Service 2018). Observations peak in May as local breeders arrive and spring migrants pass through on their way north, and increase again in August during fall migration (Figure 3-8).

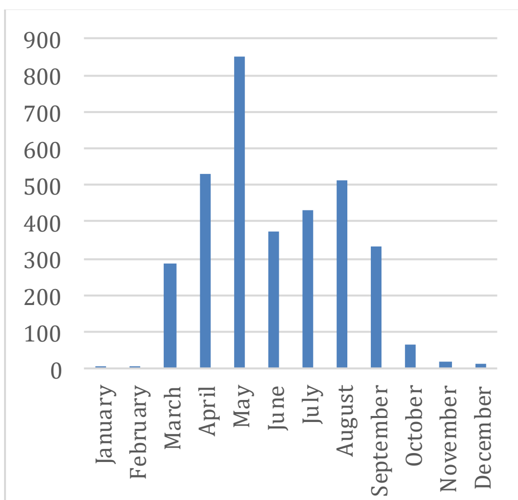
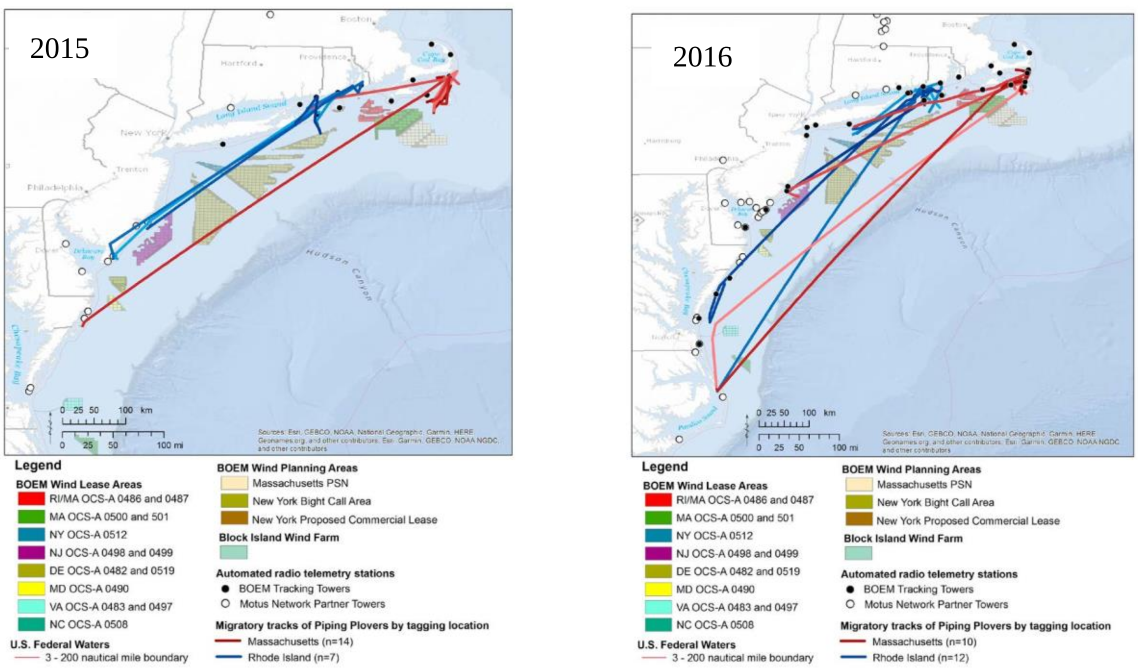


Figure 3-8. eBird records of Piping Plover in Virginia

[9] https://www.fws.gov/northeast/pipingplover/

3.4.2.3.1.2 Exposure Assessment

Exposure was assessed using species accounts and the results of individual tracking studies. Due to their proximity to shore during breeding, Piping Plover exposure to the Project is limited to migration. (NOTE: for this section, exposure was considered only for the offshore component of the Lease Area. Exposure for the onshore portion of the Project is discussed in Part IV). A nanotag study tracked migrating Piping Plovers captured in Massachusetts and Rhode Island from 2015–2017, but the coverage of the coastal receiver stations did not extend into the Lease Area. Estimated migratory track lines of birds carrying transmitters suggest that some individual may pass within the vicinity of the Lease Area (Loring et al. 2019; Figure 3-9). The exposure estimates are considered a minimum estimate because of lost tags and incomplete coverage of the offshore environment by land-based receivers. In addition, probability densities developed from the tracking data indicated no overlap with the Lease Area (Loring et al. 2019). There were no records in the Northwest Atlantic Seabird Catalog of Piping Plovers in the vicinity of the Lease Area. Overall, there is no habitat for the species in the Lease Area, and the expected exposure to individuals of this species is limited to migration. Since exposure is limited to migration, exposure is considered ***low***.



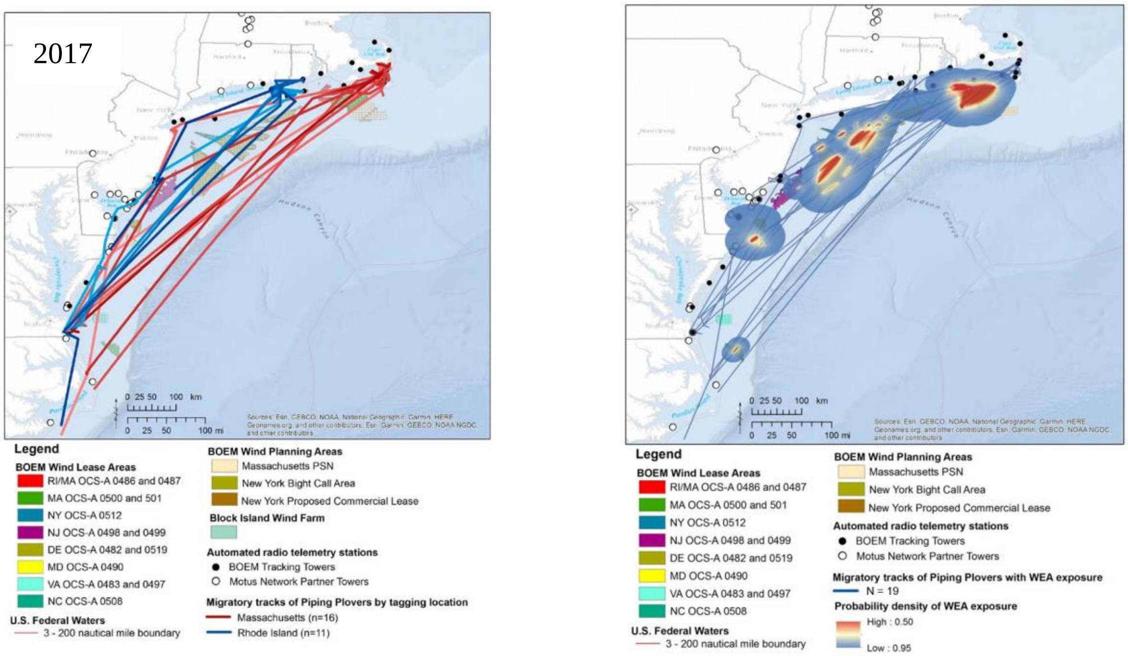


Figure 3-9. Modeled migratory track of Piping Plovers by year and composite probability density across Wind Energy Areas for all years of the study (Loring et al. 2019).

3.4.2.3.1.3 Relative Behavioral Vulnerability Assessment

The migratory flight heights of Piping Plovers tagged with nanotags were generally above 820 ft (250 m)[10], with 15.2% of birds estimated to fly through a range of 82–820 ft (25–250 m) in WEAs (Loring et al. 2019). Offshore radar studies have recorded shorebirds flying at 3,000 to 6,500 ft (1,000 to 2,000 m; Richardson 1976, Williams and Williams 1990 *in* Loring et al. 2019), while nearshore radar studies have recorded lower flight heights of 330 ft (100 m). Flight heights can vary with weather; during times of poor visibility the birds may fly lower within the RSZ (Dirksen et al. 2000 *in* Loring et al. 2019). Since these birds generally migrate at flight heights above the RSZ, potential exposure to collisions with turbines, construction equipment, or other structures is reduced. They also have good visual acuity and maneuverability in the air (Burger et al. 2011), and there is no evidence to suggest that they are particularly vulnerable to collisions. The Final Vineyard Wind 1 Biological Assessment prepared by BOEM for USFWS estimated that Piping Plover mortality from collision would be zero and that the likelihood of collision fatalities would be “insignificant and discountable” (BOEM 2019). For these reasons, Piping Plovers have ***minimal*** to ***low*** vulnerability to collision with construction equipment.

While there is little data on displacement for this species, avoidance behavior is not likely to lead to habitat loss offshore; thus, Piping Plovers are considered to have ***minimal*** vulnerability to displacement during turbine construction, and are unlikely to be significantly affected by offshore Project activities, including boat traffic, unless that boat traffic occurs very near beaches or intertidal feeding areas.

3.4.2.3.1.4 Risk

The exposure of Piping Plovers to the Lease Area will be limited to migration, they have minimal to low vulnerability to collision, and minimal vulnerability to displacement; for these reasons, individual level

[10] The Project’s WTGs have an expected minimum RSZ of 82–804 ft [25–245 m] and maximum RSZ of 115–869 ft [35–265 m]

impacts during construction and operation are expected to be ***minimal*** to ***low***. While these birds are Federally and state listed, they received a medium population vulnerability score because they have a low rank in adult survival. Therefore, the final risk score was not adjusted.

3.4.2.3.2 Red Knot

3.4.2.3.2.1 Spatiotemporal context

The Red Knot (*Calidris canutus*) is a medium-sized shorebird with a long migrations, undertaking non-stop flights of up to 5,000 mi (8,000 km) on their trans-equatorial travels (Baker et al. 2020). The Atlantic flyway subspecies (*C. c. rufa*) is listed as *Threatened* under the ESA, primarily because this population declined by approximately 70% from 1981 to 2012, to less than 30,000 individuals (Burger et al. 2011, Baker et al. 2013)[11]. The Red Knot is listed as *Threatened* in Virginia. This species breeds in the High Arctic, wintering in the southeastern U.S. and Caribbean, Northern Brazil, and Tierra del Fuego–Argentina (Baker et al. 2020). These populations share several key migration stopover areas along the U.S. Atlantic coast, particularly in Delaware Bay and coastal islands of Virginia (Burger et al. 2011). Population status is thought to be strongly influenced by adult survival and recruitment rates, as well as food availability on stopover sites, and conditions on the breeding grounds (Baker et al. 2020).

Based on a recent telemetry study, Red Knots would be present in the Lease Area only during migratory periods (BOEM 2016; Loring et al. 2018). The fall migration period is generally July–October, but birds may pass through as late as November (Loring et al. 2018). Migration routes appear to be highly diverse, with some individuals flying out over the open ocean from the northeastern U.S. directly to stopover/wintering sites in the Caribbean and South America, while others make the ocean "jump" from farther south, or follow the U.S. Atlantic coast for the duration of migration (Baker et al. 2020). Of the birds that winter on the southeast U.S. coast and/or the Caribbean (considered short-distance migrants), a small proportion may pass through the Lease Area during migration, and are thus at higher likelihood of exposure than the segment of the population wintering in South America, for example, that set out further north and make longer offshore migrations flights (Loring et al. 2018). While at stopover locations, Red Knots make local movements (e.g., commuting flights between foraging locations related to tidal changes), but are thought to remain within 3 mi (5 km) of shore (Burger et al. 2011).

3.4.2.3.2.2 Exposure Assessment

Exposure was assessed using species accounts and individual tracking data. Red Knot exposure to the Lease Area is limited to migration. The Northwest Atlantic Seabird Catalog did not contain any records of Red Knots in the vicinity of the Lease Area. In a recent telemetry study, two of 388 tagged Red Knots were estimated to pass between the Lease Area and shore in the Fall of 2016 (Figure 3-10; Loring et al. 2018), but it is important to note that the receiver stations in this study were not able to effectively cover the Lease Area because it was beyond the detection range of the land-based stations. Migration flights are generally undertaken at night, but in fair weather conditions, which may reduce risk of collision (Loring et al. 2018). Overall, there is no habitat for the species in the Lease Area, and the expected exposure to individuals of this species is ***minimal*** to ***low***.

[11] https://www.fws.gov/verobeach/StatusoftheSpecies.html

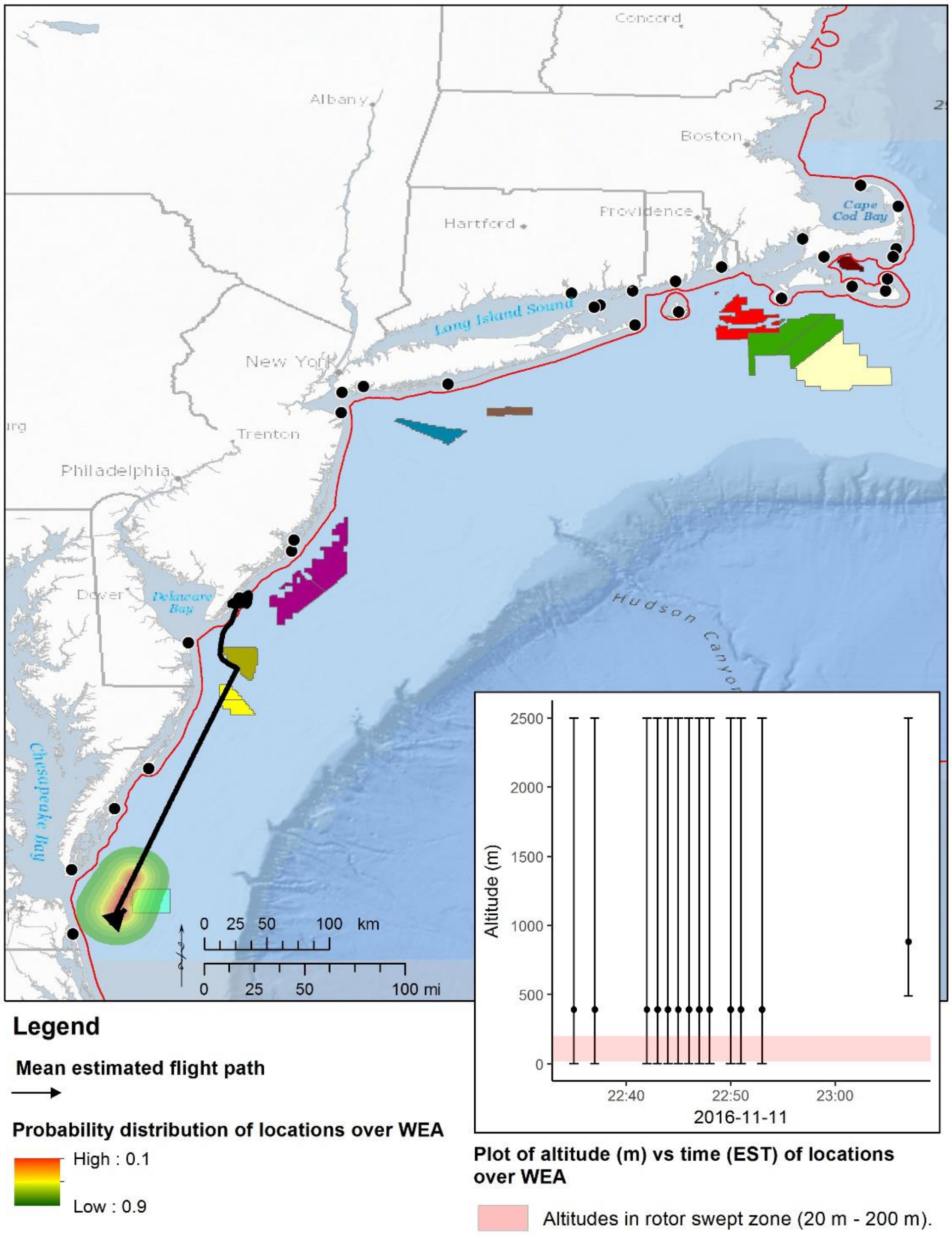


Figure 3-10. Estimated flight path of a Red Knot tracked with a nanotag that was estimated to have passed inshore of the Lease Area. Probability bands illustrate spatial error around locations, indicating low to medium potential exposure to BOEM Lease Area 0483 (Loring et al. 2018).

3.4.2.3.2.3 Relative Behavioral Vulnerability Assessment

During long-distance flights, Red Knots are generally considered to migrate at flight heights well above the RSZ (Burger et al. 2012), reducing exposure to collisions with turbines, construction equipment, or other structures. Flight heights during long-distance migrations are thought to normally be 3,000–10,000 ft (1,000–3,000 m), except during takeoff and landing at terrestrial locations (Burger et al. 2011); however, Red Knots likely adjust their altitude to take advantage of local weather conditions, including flying at lower altitudes in headwinds (Baker et al. 2020), or during periods of poor weather and high winds (Burger et al. 2011). Flight heights during migration are thought to be well above the RSZ for the group of Red Knots that are long-distance migrants, but there is potential for exposure to collision for shorter-distance migrants that may traverse the Project vicinity within the RSZ, particularly during the fall (Loring et al. 2018). During shorter coastal migration flights, Red Knots are more likely to fly within the RSZ (Loring et al. 2018), but they have good visual acuity and maneuverability in the air, and there is no evidence to suggest that they are particularly vulnerable to collisions. The Final Vineyard Wind 1 Biological Assessment prepared by BOEM for USFWS estimated that Red Knot mortality from collision would be zero and that the likelihood of collision fatalities would be “insignificant and discountable” (BOEM 2019). For these reasons, Red Knots have ***low*** vulnerability to collision with construction equipment or turbines.

While there is little data on displacement for this species, avoidance behavior offshore is not likely to lead to habitat loss; thus, Red Knots are considered to have ***minimal*** vulnerability to displacement during turbine construction and are unlikely to be significantly affected by Project activities, including boat traffic, unless that boat traffic occurs very near beaches or stopover feeding areas.

3.4.2.3.2.4 Risk

Given that Red Knot exposure will be limited to migration and that these birds have minimal to low vulnerability to collision and displacement, individual level impacts during construction and operation are expected to be ***minimal*** to ***low***. While the birds are federally and state listed, they received a medium population vulnerability score because of low score in adult survival. Therefore, the final risk score was not adjusted.

3.4.3 Wading Birds

3.4.3.1 Spatiotemporal Context

Most long-legged wading birds (such as herons and egrets) breed and migrate in coastal and inland areas. Like the smaller shorebirds, wading birds are coastal breeders and foragers and generally avoid straying out over deep waters (Kushlan and Hafner 2000). Most long-legged waders breeding along the U.S. Atlantic coast migrate south to the Gulf coast, the Caribbean islands, or Central or South America, thus they are capable of crossing large areas of ocean and may traverse the Lease Area during spring and fall migration periods. The IPaC database does not indicate any wading birds in the Lease Area or adjacent waters.

3.4.3.2 Exposure Assessment

Exposure was assessed using species accounts and DOE digital aerial survey data. Exposure to construction and operation is considered to be ***minimal*** to ***low*** because wading birds spend a majority of the year in freshwater aquatic systems and near-shore marine systems. There were few observations of species within this group offshore during surveys (Figure 3-11). There were 13 observations of wading birds in the DOE boat survey data: 12 were Great Blue Herons (*Ardea herodias*), and one was a Great Egret (*Ardea alba*) which was found in the Lease Area. One Great Blue Heron was found in Lease Area in the fall. Of 14 wading bird observations in the DOE aerial survey data, 12 were Great Blue Herons. Recent results from Great Blue Heron’s tracked with satellite transmitters indicates that these birds tend to fly inshore of the Lease Area, but that some individuals travel farther offshore (Figure 3-12).

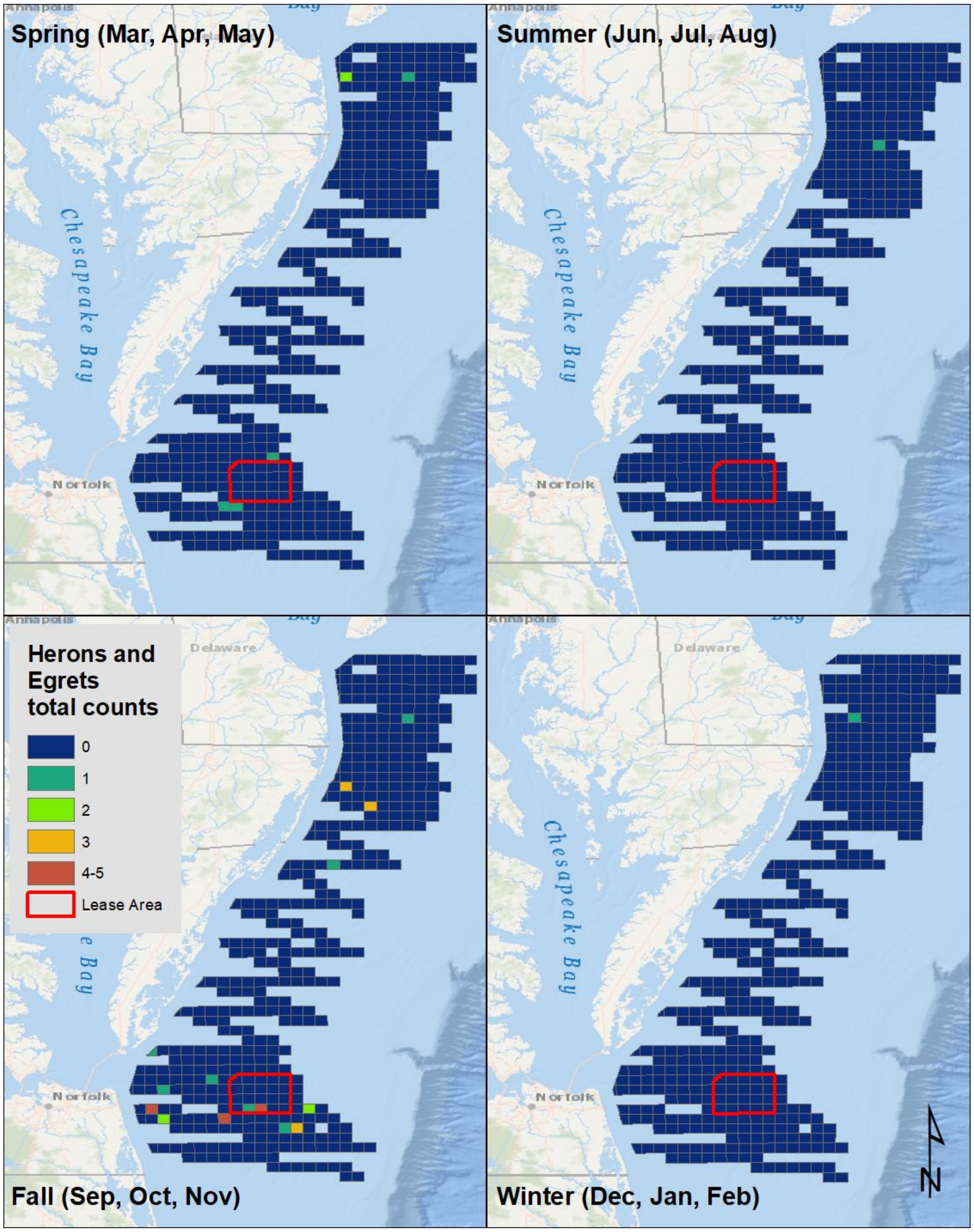


Figure 3-11. Herons and egrets observed, by season, during the DOE digital aerial and boat-based surveys. The species positively identified were Great Blue Heron, Great Egret, and Snowy Egret (*Egretta thula*).

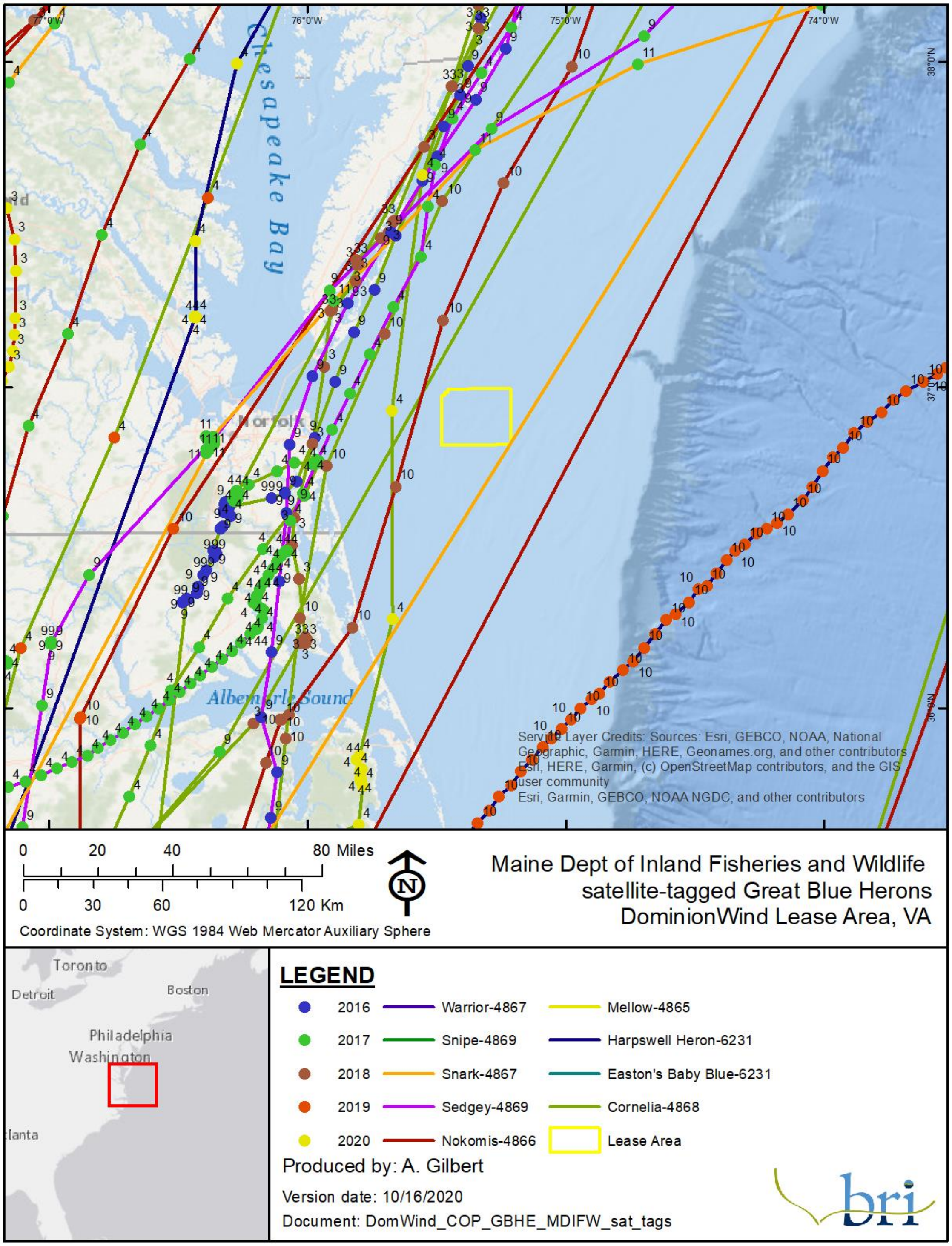


Figure 3-12. Track lines of Great Blue Herons captured in Maine and equipped with satellite transmitters provided by Maine Department of Inland Fisheries and Wildlife.

3.4.3.3 Relative Behavioral Vulnerability Assessment

While little is known about migratory behavior of herons, recent studies have documented long-distance migratory flights and use of the offshore environment during these periods. Purple Herons (*Ardea purpurea*) satellite-tagged prior to fledging in Europe were documented migrating distances over 2,485 miles (4,000 km) in less than a week, including one individual that made a 3,480 miles (5,600 km) non-stop flight over mostly ocean (Van Der Winden et al. 2010). A recent telemetry study found that 43% of flight altitudes of Great Blue Herons occurred within the height range (79–511 ft [24–156 m]) of terrestrial wind turbines in Maine (Dolinski 2019). Birds migrating offshore, however, may fly at higher altitudes to take advantage of favorable tail winds. For example, herons tracked via radar migrating over the Strait of Messina in southern Italy had mean flight heights of 820.9 m (Mateos-Rodríguez and Liechti 2012). While there remains uncertainty on heron vulnerability, they have been identified as having a potential for collision sensitivity (Willmott et al. 2013); the tracking data from six individuals indicates, that within the Atlantic OCS, they have the potential to fly in the RSZ 44–45% (Figure 3-13); and there have been some individual mortalities detected at terrestrial wind projects (AWWI 2019). There does not, however, appear to be many reported records of wading birds colliding with WTGs at terrestrial wind farms. The birds are not expected to be vulnerable to displacement because the offshore environment is not providing primary foraging habitat. For these reasons, collision vulnerability is considered to be ***low*** and displacement ***minimal***.

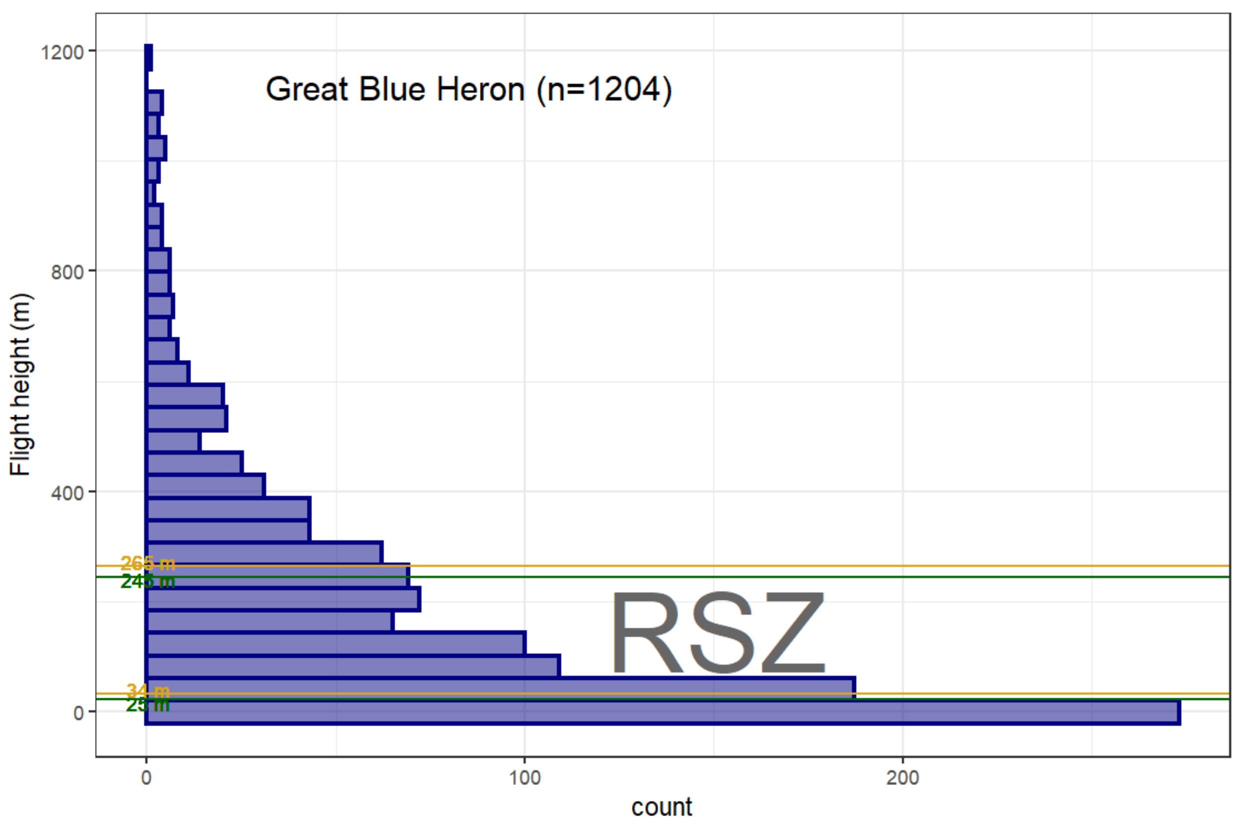


Figure 3-13. Flight heights (m) of Great Blue Herons satellite-tagged in Maine, flying over the Atlantic OCS, in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25–245 m) and maximum (gold 34–265 m) turbine options.

3.4.3.4 Risk Analysis

Given that wading bird exposure will be limited to migration and that these birds have minimal to low vulnerability to collision and displacement, population level impacts during construction and operation are expected to be ***minimal*** to ***low***.

3.4.4 Raptors

3.4.4.1 Spatiotemporal Context

Limited data exists documenting the use of offshore habitats by diurnal and nocturnal raptors in North America. The degree to which raptors might occur offshore will be dictated in large part by their morphology and flight strategy (i.e., flapping vs. soaring), which influences species' ability or willingness to cross large expanses of open water where thermal formation is poor (Kerlinger 1985). Interactions between raptors and offshore structures are likely to be predominantly limited to migration. Of the raptors in eastern North America, the eagles, *Buteo* hawks, and large *Accipiter* hawks (i.e., Northern Goshawk [*Accipiter gentilis*]) are rarely observed offshore (DeSorbo et al. 2012; DeSorbo et al. 2018). The Sharp-shinned Hawk (*A. striatus*), Cooper's Hawk (*A. cooperii*), Northern Harrier (*Circus hudsonius*), American Kestrel (*Falco sparverius*), and Osprey (*Pandion haliaetus*) have all been observed at offshore islands regularly during migration, but generally in low numbers (DeSorbo et al. 2012; DeSorbo et al. 2018). Of the common owl species, the larger species (Barred Owl [*Strix varia*] and Great-horned Owl [*Bubo virginianus*]) are generally considered to avoid the offshore environment. Northern Saw-whet Owls (*Aegolius acadicus*) have been documented at coastal islands in Maine and Rhode Island during migration (DeSorbo et al. 2012), and these owls winter in the mid-Atlantic region (Rasmussen et al. 2008). Long-eared Owls (*Asio otus*) also migrate along the coast and winters in the mid-Atlantic (Marks et al. 1994).

Among the raptors, falcons are the most likely to be encountered in offshore settings (Cochran 1985; DeSorbo et al. 2012; DeSorbo et al. 2018). The Merlin (*Falco columbarius*) is the most abundant diurnal raptor observed at offshore islands during fall migration (DeSorbo et al. 2012; DeSorbo et al. 2018). Peregrine Falcons (*F. peregrinus*) fly hundreds of kilometers offshore during migration, and have been observed on vessels and oil drilling platforms considerable distances from shore (McGrady et al. 2006; Johnson et al. 2011; Voous 1961; DeSorbo et al. 2015). Recent individual tracking studies in the eastern U.S. indicate that migrating Peregrine Falcons (predominantly hatching year birds), likely originating from breeding areas in the Canadian Arctic and Greenland, commonly used offshore habitats during fall migration (Figure 3-16; DeSorbo et al. 2015, 2018c), while breeding adults from New Hampshire either used inland migration routes or were non-migratory (DeSorbo et al. 2018).

Ospreys exhibit a wing morphology that enables open water crossings (Kerlinger 1985) and some individuals birds will fly offshore (Bierregaard 2019); however, satellite telemetry data from Ospreys breeding in New England and the mid-Atlantic suggest these birds generally follow coastal or inland migration routes and are unlikely to be exposed the Lease Area (Figure 3-16). Eagles are federally protected under the Bald and Golden Eagle Protection Act and are addressed separately in detail below.

3.4.5 Exposure Assessment

Exposure for raptors was assessed using species accounts, DOE digital aerial survey data, and individual tracking data. No raptors were observed in the Lease Area in the DOE digital aerial surveys (Figure 3-14). Individual tracking data and species accounts indicate that falcons may pass through offshore waters of Virginia, and there is potential that falcons could be exposed to the Lease Area. Therefore, the exposure level was considered ***low***. Falcons may be attracted to turbines as offshore perching and hunting sites, which may increase temporal exposure during migration.

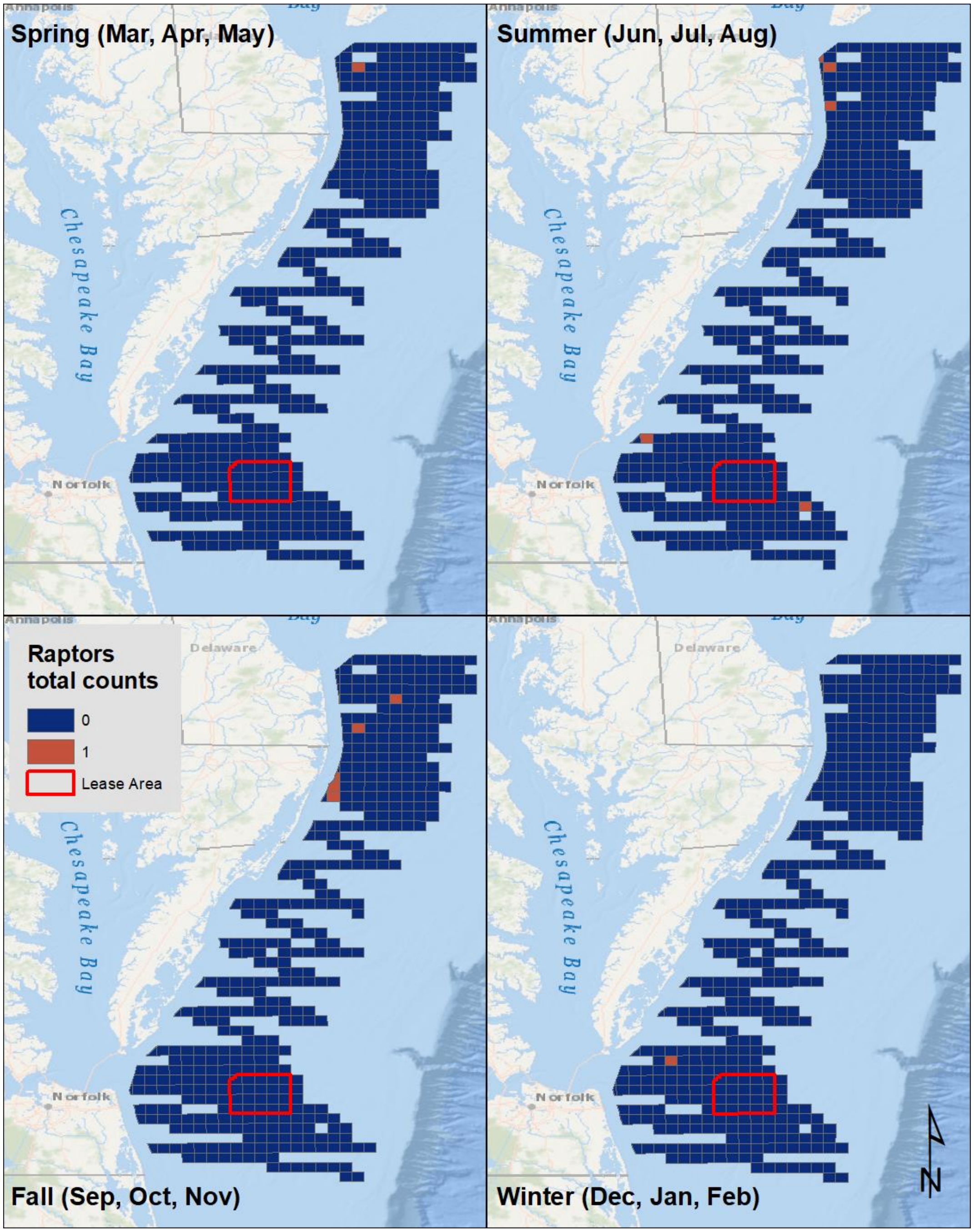


Figure 3-14. Raptors observed, by season, during the DOE digital aerial and boat-based surveys

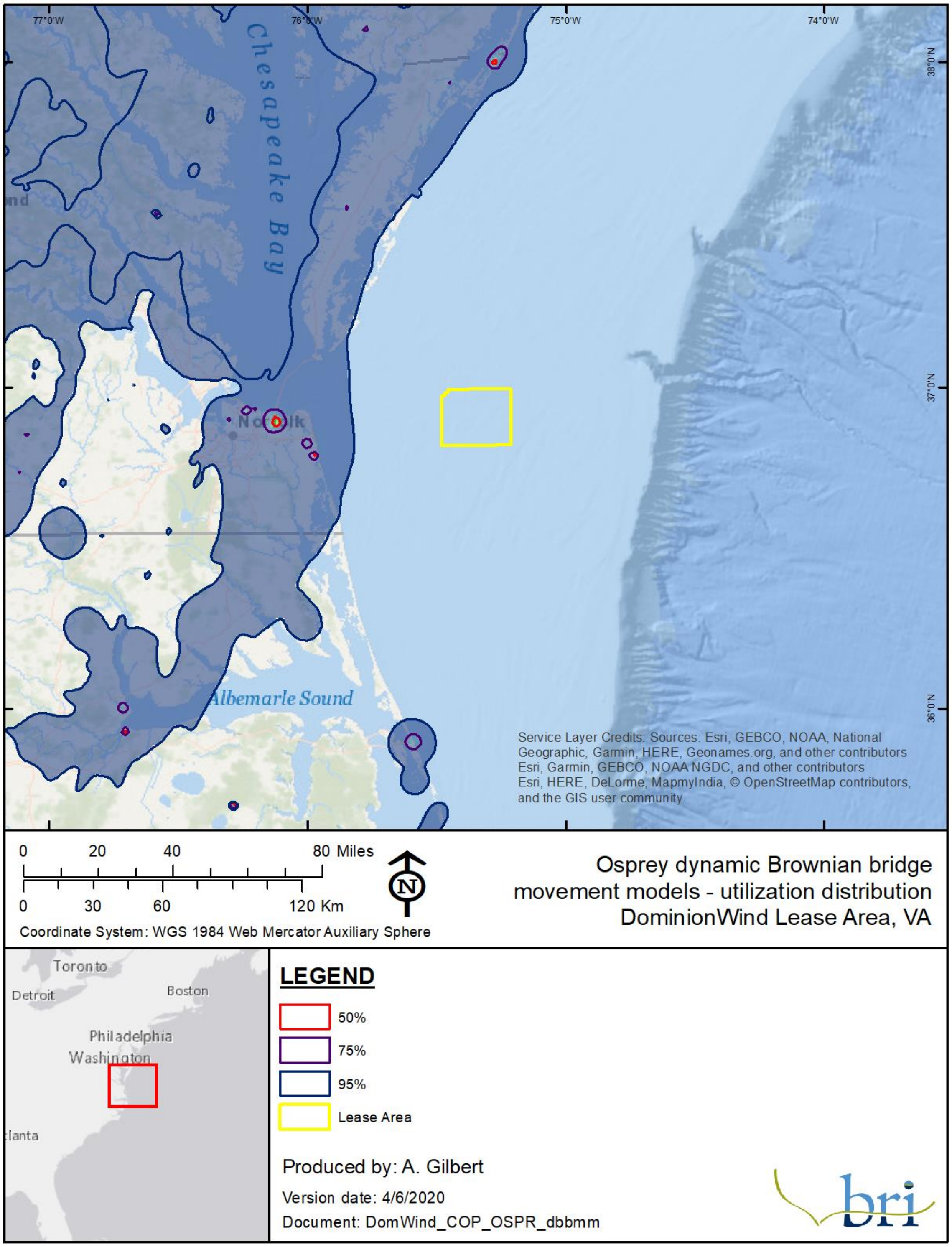


Figure 3-15. Dynamic Brownian bridge movement models for Osprey (n=127) that were tracked with satellite transmitters; the contours represent the percentage of the use area across the UD surface and represent various levels of use from 50 (core use) to 95 percent (home range).

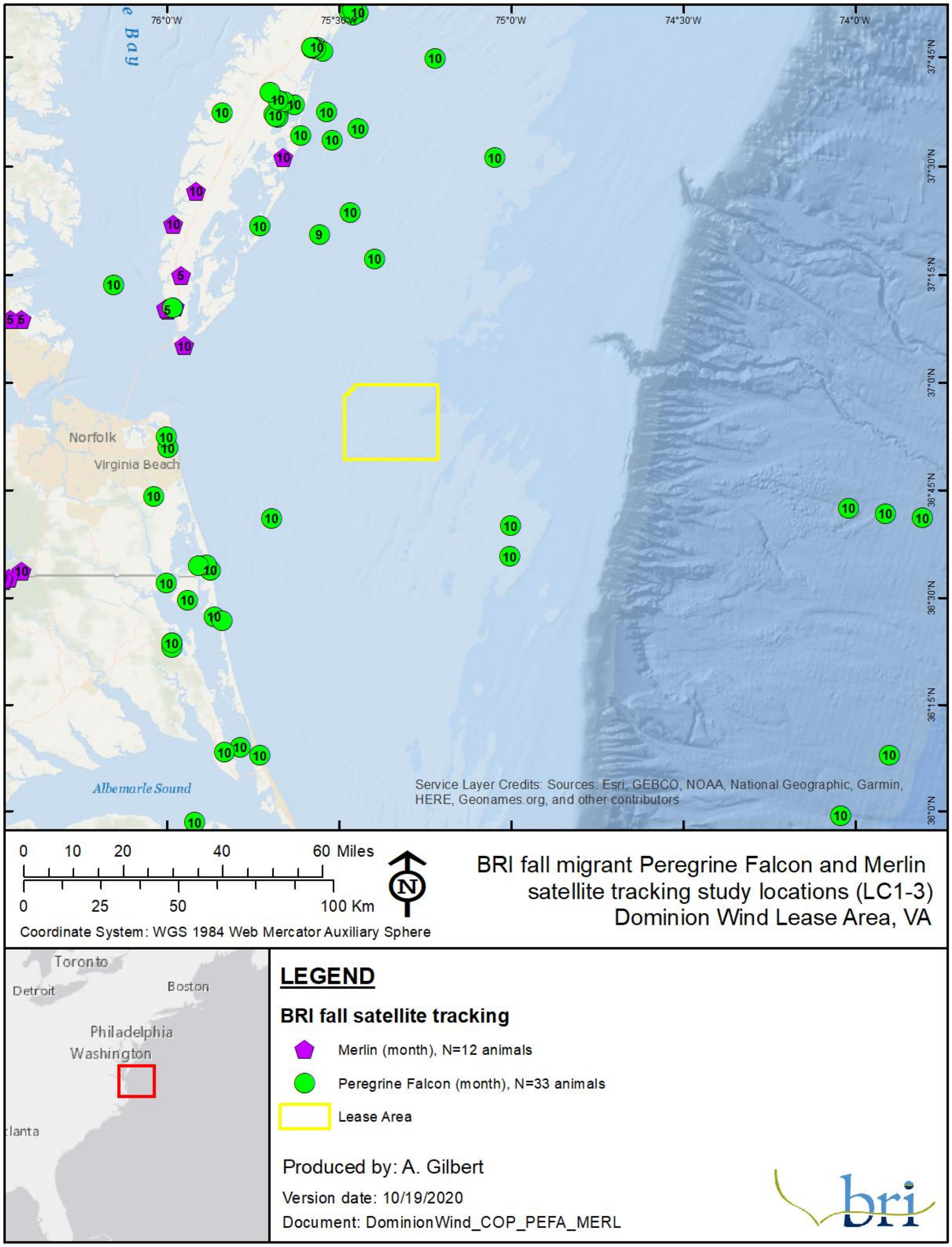


Figure 3-16. Location estimates from satellite tracked Peregrine Falcons and Merlins from three raptor research stations along the Atlantic coast, 2010–2018. Research stations include Block Island, Rhode Island, and Monhegan Island and Cutler, Maine. The number shown in points represents the month in which the location estimate was fixed.

3.4.5.1 Relative Behavioral Vulnerability Assessment

Raptors are commonly attracted to high perches for resting, roosting, or to survey for potential prey. A radar and laser rangefinder study found evidence indicating that multiple migrating raptor species were attracted to offshore wind turbines in Denmark (Skov et al. 2016) and falcons were observed regularly hunting and perching at an offshore wind farm in the Netherlands (Krijgsveld et al. 2011). Peregrine Falcons and kestrels have been observed landing on the platform deck of offshore wind turbines (Skov et al. 2016; Hill et al. 2014); however, Peregrine Falcon mortalities have not been documented at European offshore wind developments. Jensen et al. (2014) considered Peregrine Falcons to have low collision risk vulnerability at the proposed Horns Rev 3 wind development based on visual observations and radar data collated from two nearby existing wind farms. There are accounts of Peregrine Falcon mortalities associated with terrestrial-based wind turbines in Europe (Hötker et al. 2006; Meek et al. 1993; Dürr 2011) and one in New Jersey (Mizrahi et al. 2009). Breeding adults and several young Peregrine Falcons were killed after colliding with a three-turbine terrestrial wind energy facility located close their urban nest site in Massachusetts (T. French, MassWildlife, personal communication). Carcasses were not detected in post-construction mortality studies at several projects with falcon activity (Bull et al. 2013; DiGaudio and Geupel 2014; Hein et al. 2013). American Kestrel carcasses have been found in post-construction monitoring of much smaller terrestrial turbines (1.8 MW) in Washington State (Erickson et al. 2008), but American Kestrel mortality has been demonstrated to decrease as turbine size increases (Smallwood 2013). Evidence of nocturnal soaring, perching and feeding under lighted structures in terrestrial and offshore settings has been noted in Peregrine Falcons (Cochran, 1975; Johnson et al., 2011; Kettel et al., 2016; Voous, 1961), and these behaviors increase the exposure risk in this species. However, observations of raptors at the Anholt Offshore Wind Farm in the Baltic Sea (20 km from the coast) indicate avoidance behavior (13–59% of birds observed depending on the species), which has the potential to cause a barrier for migrants in some locations, but also may reduce collision risk; the percentage of Merlins and Common Kestrels (*Falco tinnunculus*) showing macro/meso avoidance behavior was 14/36% and 46/50%, respectively (Jacobsen et al. 2019).

Based on the above evidence, falcon vulnerability to collision during construction and operation is considered to be ***low*** to ***medium***, and vulnerability to displacement is ***minimal*** to ***low***. Since there is little data available on raptor response during construction, the behavioral vulnerability is considered the same for each development stage.

3.4.5.2 Risk Analysis

Risk of potential impacts to non-falcon raptor populations is considered ***minimal*** due to their minimal exposure rating. Risk of population level impacts to falcons is considered ***low*** because falcons have low exposure and low to medium vulnerability. For this species group, a population vulnerability assessment was not conducted. However, considerable uncertainty exists about what the proportion of migrating falcons, particularly Peregrine Falcons, might be attracted to offshore wind energy projects for perching, roosting and foraging, and the extent to which individuals might avoid turbines or collide with them.

3.4.5.3 Bald Eagles and Golden Eagles

3.4.5.3.1.1 Spatiotemporal Context

Both Bald Eagles and Golden Eagles are federally protected under the Bald and Golden Eagle Protection Act (BGEPA). The Bald Eagle is broadly distributed across North America, and generally nests and perches in association with water (lakes, rivers, bays) in both freshwater and marine habitats, often remaining within roughly 1,640 ft (500 m) of the shoreline (Buehler 2020).

The Golden Eagle (*Aquila chrysaetos*) is generally associated with open habitats, particularly in the western U.S., but satellite-tracked individuals wintering in the eastern U.S. have also been documented to use forested regions heavily (Katzner et al. 2012). Golden Eagles commonly winter in the southern Appalachians and are regularly observed in the mid-Atlantic U.S., spanning coastal plain habitat in Virginia, Delaware, North Carolina, South Carolina, and other southeastern states.

The general morphology of both Bald Eagles and Golden Eagles dissuades long-distance movements in offshore settings (Kerlinger 1985). These two species generally rely upon thermal formation, which develop poorly over the open ocean, during long-distance movements.

3.4.5.3.1.2 Exposure

Exposure was assessed using species accounts, tracking studies, and knowledge of eagle wing morphology. Golden Eagle exposure to the Lease Area is expected to be ***minimal*** due to their limited distribution in the eastern U.S., and reliance on terrestrial habitats. Bald Eagle exposure to the Lease Area is also expected to be ***minimal*** because the Lease Area is not located along any likely or known Bald Eagle migration route, and they tend not to fly over large waterbodies.

Although there is little research on eagle interactions with offshore developments, eagles are expected to have ***minimal*** vulnerability to collision and displacement to offshore wind farms. Bald Eagles and Golden Eagles are not expected to forage over the Lease Area or use the area during migration.

3.4.5.3.1.3 Risk Analysis

Since exposure is expected to be minimal for both eagle species, the individual level impacts during construction and operation are expected to be ***minimal***. A population vulnerability assessment was not done for eagles because they have minimal exposure and vulnerability.

3.4.6 Songbirds

3.4.6.1 Spatiotemporal Context

Songbirds almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine system except during migration. Many North American breeding songbirds migrate to the tropical regions. On their migrations, neotropical migrants generally travel at night and at high altitudes where favorable winds can aid them along their trip.

Songbirds regularly cross large bodies of water (Bruderer and Lietchi 1999, Gauthreaux and Belser 1999), and there is some evidence that species migrate over the northern Atlantic (Adams et al. 2015). Some birds may briefly fly over the water while others, like the Blackpoll Warbler (*Setophaga striata*), can migrate over vast expanses of ocean (Faaborg et al. 2010, DeLuca et al. 2015, 2019).

Landbird migration may occur across broad geographic areas, rather than in narrow “flyways” as have been described for some waterbirds (Faaborg et al. 2010). Evidence for a variety of species suggests that overwater migration in the Atlantic is much more common in fall (than in spring), when the frequency of overwater flights increases perhaps due to consistent tailwinds from the northwest (e.g. see Morris et al. 1994, Hatch et al. 2013, Adams et al. 2015, DeLuca et al. 2015).

The Blackpoll Warbler is the species that is most likely to fly offshore during migration (Faaborg et al. 2010, DeLuca et al. 2015). Migrating songbirds have been detected at or in the vicinity of smaller offshore wind developments in Europe (Kahlert et al. 2004, Krijgsveld et al. 2011, Pettersson and

Fågelvind 2011) and may have greater passage rates during the middle of the night (Huppop and Hilgerloh 2012). While, the IPaC database did not have any records of songbirds, songbirds were observed during the boat surveys and evidence from the literature indicates some songbirds migrate offshore in Virginia.

3.4.6.2 Exposure Assessment

Exposure for songbirds was assessed using species accounts, DOE Digital aerial survey data, and literature. Exposure to construction and operation is considered to be ***minimal*** to ***low*** because songbirds have limited spatial and temporal exposure, they do not use the offshore marine system as habitat, and there is little evidence of songbird use of the Lease Area outside of the migratory periods. While not designed specifically to detect small songbirds, the baseline surveys had 11 detections of passerines within the Lease Area (Figure 3-17).

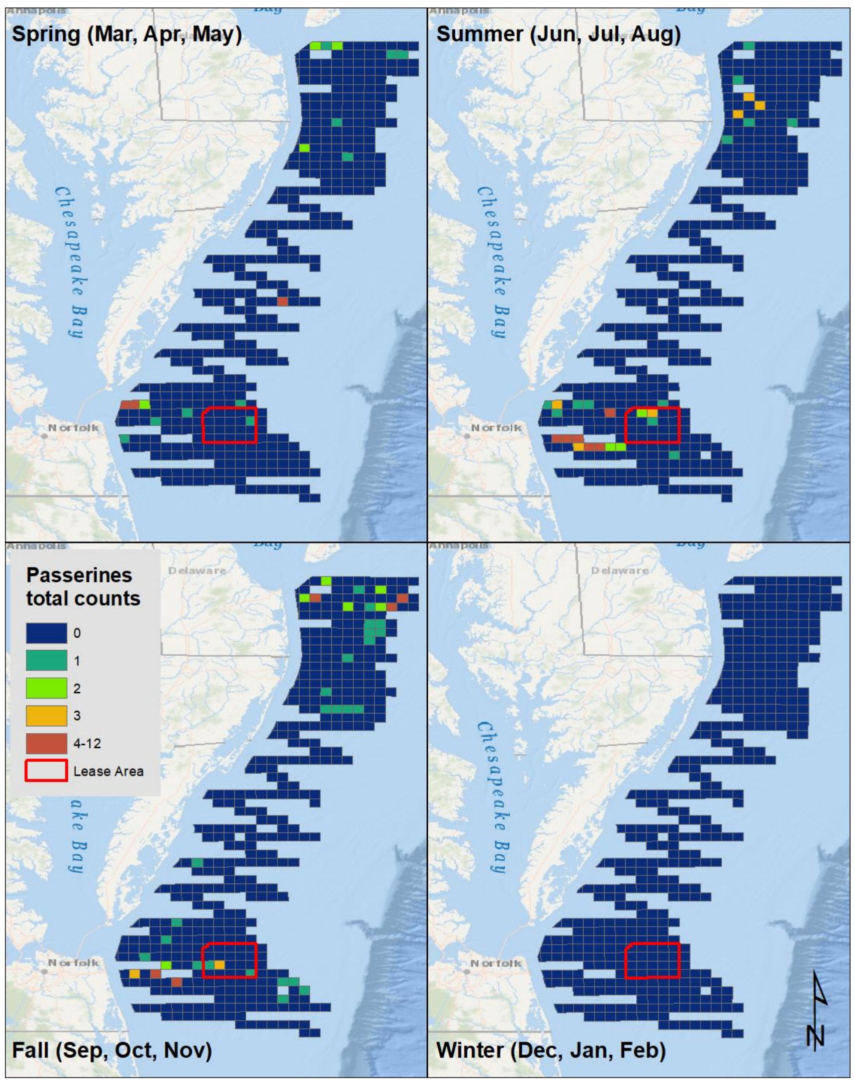


Figure 3-17. Songbirds (passerines) observed, by season, during the DOE digital aerial and boat-based surveys. While these surveys are not optimized to detect songbirds, they do provide information on diurnal offshore use.

3.4.6.3 Relative Behavioral Vulnerability Assessment

If exposed to offshore wind turbines, some songbirds may be vulnerable to collision. In some instances, songbirds may be able to avoid colliding with offshore wind turbines (Petersen et al. 2006), but they are known to collide with illuminated terrestrial and marine structures (Fox et al. 2006). Movement during low visibility periods creates the highest collision risk conditions (Hüppop et al. 2006). While terrestrial avian fatality rates range from 3–5 birds per MW per year (AWWI 2016), direct comparisons between mortality rates recorded at terrestrial and offshore wind developments should be made with caution because collisions with offshore wind turbines could be lower either due to differing behaviors or lower exposure (NYSERDA 2015). At Nysted, Denmark, in 2,400 hours of monitoring with an infrared video camera, only one collision of an unidentified small bird was detected (Petersen et al. 2006). At the Thanet Offshore Wind Farm, thermal imaging did not detect any songbird collisions (Skov et al. 2018).

Songbirds typically migrate at heights between 295–1,969 ft (90–600 m; NYSERDA 2010), but can fly lower during inclement weather or when there are headwinds. In a study in Sweden, nocturnal migrating songbirds flew on average at 1,083 ft (330 m) above the ocean during the fall and 1,736 ft (529 m) during the spring (Pettersson 2005). Based upon the above evidence, the risk to songbirds is limited to collision with wind turbines, and songbird vulnerability to collision during construction and operation is considered to be ***low*** to ***medium***.

3.4.6.4 Risk Analysis

This analysis suggests that the potential population-level impacts to songbirds is ***minimal*** to ***low*** because, while these birds have low to medium vulnerability to collision, they have minimal to low exposure, both spatially and temporally. Despite this recognized vulnerability, and for overall context, the mortality of songbirds from all terrestrial wind turbines in the U.S. and Canada combined is predicted to have only a small effect on passerine populations (Erickson et al. 2014).

3.5 Results: Marine birds

Marine bird distributions are generally more pelagic and widespread than coastal birds. A total of 83 marine bird species are known to regularly occur off the eastern seaboard of the U.S. (Nisbet et al. 2013). Many of these marine bird species use the Lease Area during multiple time periods, either seasonally or year-round, including loons, storm-petrels and shearwaters, gannets, gulls, terns, and auks; however, the Lease Area is generally located in low marine bird abundance due to its distance from shore (Figure 3-18). The IPaC database indicated that jaegers, gulls, loons, storm-petrels, and Northern Gannets, may be present in the Lease Area and adjacent waters.

In the following sections, the assessments for major taxonomic groups of marine birds is reviewed, including discussion of their exposure (summarized in Table 3-11), their densities inside and outside of the Lease Area (Table 3-12), and their vulnerability (summarized in Table 3-13). At the end of this offshore section, Table 3-32 provides the species-specific densities by season as a supplement.

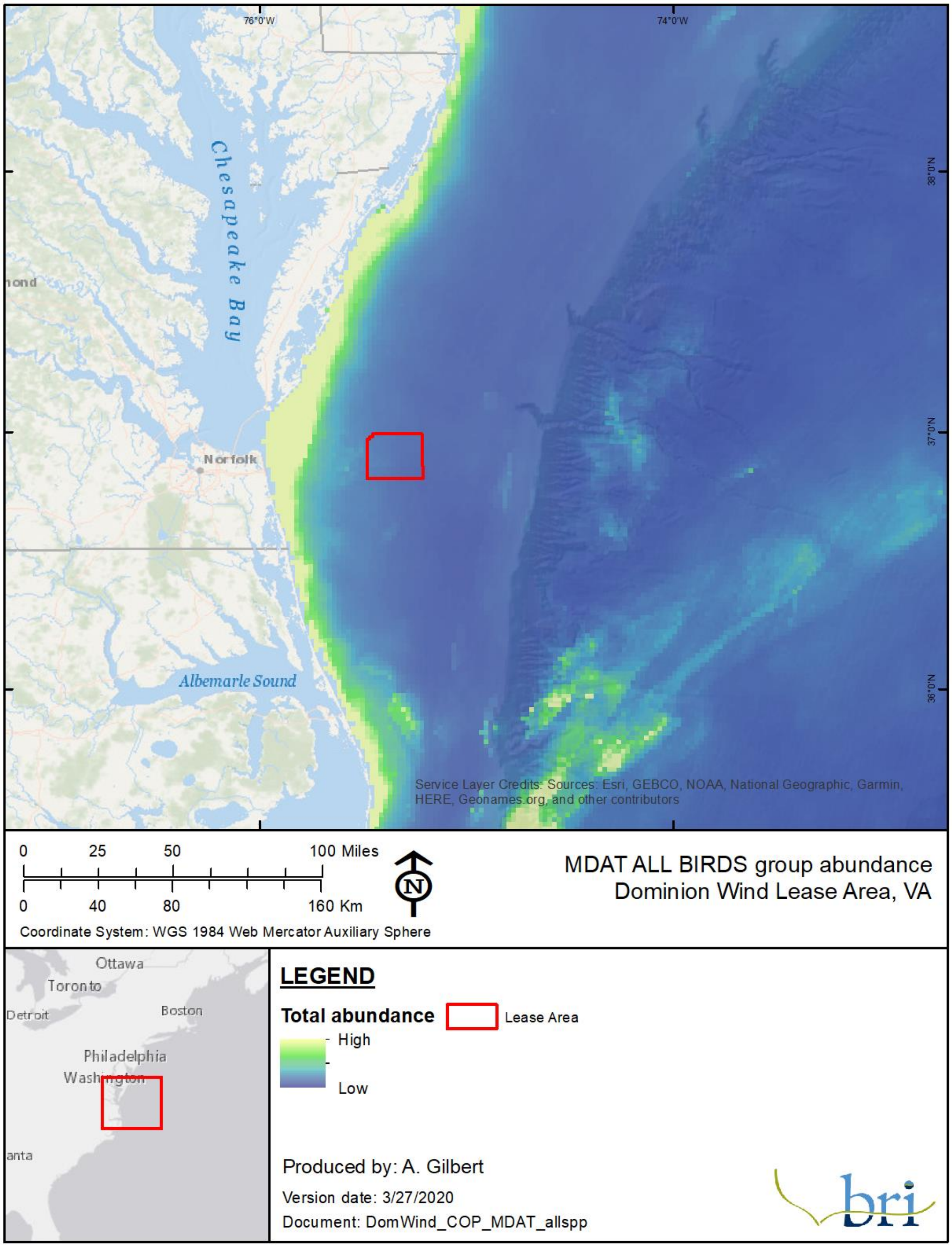


Figure 3-18. **Bird abundance estimates (all birds) from the MDAT models.**

Table 3-11. Annual exposure scores for each marine bird taxonomic group in the DOE digital aerial survey data and MDAT data set. Species-specific scores are detailed in the individual taxonomic group sections.

Taxonomic Group	Winter	Spring	Summer	Fall	Annual Score[1]
Sea Ducks	minimal	minimal	minimal	low	minimal
Skuas and Jaegers	minimal	low	low	minimal	minimal
Auks	low	minimal	minimal	minimal	minimal
Gulls	low	minimal	minimal	minimal	minimal
Terns	minimal	minimal	minimal	minimal	minimal
Loons	low	medium	minimal	minimal	low
Storm-Petrels	minimal	low	medium	medium	medium
Shearwaters and Petrels	minimal	minimal	minimal	minimal	minimal
Gannet	low	medium	minimal	minimal	low
Cormorants	low	minimal	minimal	minimal	minimal
Pelicans	minimal	minimal	minimal	minimal	minimal

Table 3-12. Densities (count/km[2] of survey transect) within the Lease Area and the DOE digital aerial survey area for each species or taxonomic grouping.

Species	Mean density (total count/sq. km)	
	Lease Area	DOE mid-Atlantic aerial survey area
Sea Ducks		
Black Scoter	0	1.411
Surf Scoter	0	0.119
Unidentified scoter	0	0.986
White-winged Scoter	0	0.001
Skuas and Jaegers		
Parasitic Jaeger	0	0
Pomarine Jaeger	0.001	0
Unidentified Jaeger	0	0
Auks		
Atlantic Puffin	0.003	0
Dovekie	0.001	0
Razorbill	0	0.001
Unidentified auk	0.015	0.032
Unidentified large auk (Razorbill or Murre)	0.002	0.003
Unidentified small auk (Puffin/Dovekie)	0.015	0.01
Small Gulls		
Bonaparte's Gull	0.101	0.128
Sabine's Gull	0	0
Unidentified small gull	0.011	0.009
Unidentified small gull/tern	0.074	0.117
Medium Gulls		
Laughing Gull	0.001	0.007
Ring-billed Gull	0	0
Unidentified medium gull	0.002	0.005
Large Gulls		
Great Black-backed Gull	0.012	0.018
Herring Gull	0.001	0.008

Species	Mean density (total count/sq. km)	
	Lease Area	DOE mid-Atlantic aerial survey area
Lesser Black-backed Gull	0.001	0.001
Unidentified large gull	0.012	0.015
All Gulls		
Unidentified Gull	0.062	0.065
Small Terns		
Black Tern	0	0.002
Unidentified small tern	0	0.002
Medium Terns		
Common Tern	0	0
Royal Tern	0	0
Unidentified medium tern	0.001	0.007
Large Terns		
Caspian Tern	0	0.001
Unidentified large tern	0.002	0.007
All Terns		
Unidentified tern	0.004	0.035
Loons		
Common Loon	0.086	0.046
Red-throated Loon	0.008	0.013
Unidentified loon	0.406	0.456
Storm-Petrels		
Wilson's Storm-Petrel	0.035	0.004
Unidentified storm-petrel	0.007	0.004
Shearwaters and Petrels		
Cory's Shearwater	0	0.001
Great Shearwater	0.002	0.003
Manx Shearwater	0.001	0
Northern Fulmar	0	0
Sooty Shearwater	0	0
Unidentified large shearwater	0	0
Unidentified petrel	0	0
Unidentified shearwater	0	0.002
Gannet		
Northern Gannet	1.126	0.667
Cormorants		
Double-crested Cormorant	0	0.001
Pelicans		
Brown Pelican	0	0.004

Table 3-13. Summary of vulnerability scores. In the group summary below, vulnerability scores for each species are detailed.

Taxonomic Group	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Opt. 1	Opt. 2		
Sea ducks	low	low	high	low
Phalaropes	low	low	medium	low
Skuas and jaegers	medium	medium	low	low
Auks	minimal	minimal	high	low
Gulls				
Large gulls	medium	medium	medium	low
Medium gulls	medium	low	medium	low
Small gulls	low	low	medium	low
Terns				
Large terns	medium	medium	medium	medium
Medium terns	low	low	medium	medium
Small terns	low	low	medium	medium
Loons	low	low	high	medium
Storm-petrels	low	low	medium	low
Shearwaters and petrels	low	low	medium	medium
Gannets	low	low	medium	medium
Cormorants	medium	medium	low	minimal
Pelicans	low	low	medium	medium

3.5.1 <u>Sea Ducks</u>

3.5.1.1 Spatiotemporal Context

Sea ducks are northern or Arctic breeders that use the U.S. Atlantic OCS heavily in winter. Most sea ducks forage on mussels and/or other benthic invertebrates, and generally winter in shallow inshore waters or out over large offshore shoals where they can access prey.

3.5.1.2 Exposure Assessment

Exposure was assessed using species accounts, tracking data, DOE digital aerial survey data, and MDAT models. Except for limited use by Black Scoter in the spring, sea ducks tracked with satellite transmitters show little to no use of the Lease Area (Figure 3-19 to Figure 3-21). A persistence analysis conducted on Surf Scoters tracked with satellite transmitters also showed little to no use of the Lease Area (Stenhouse et al. 2020). Exposure is considered to be ***minimal*** because the sea duck annual exposure score was minimal to low (Table 3-14), the average counts of sea duck within the Lease Area were lower than the DOE digital aerial survey area (Table 3-12), and the literature indicates that sea duck exposure will be primarily limited to migration or travel between wintering sites.

Table 3-14. Seasonal exposure rankings for the sea ducks group.

Season	Local Rank	Regional Rank	Total Rank	Exposure Score
Winter	0	0	0	minimal
Spring	0	0	0	minimal
Summer	0	·	0	minimal
Fall	0	1	1	low

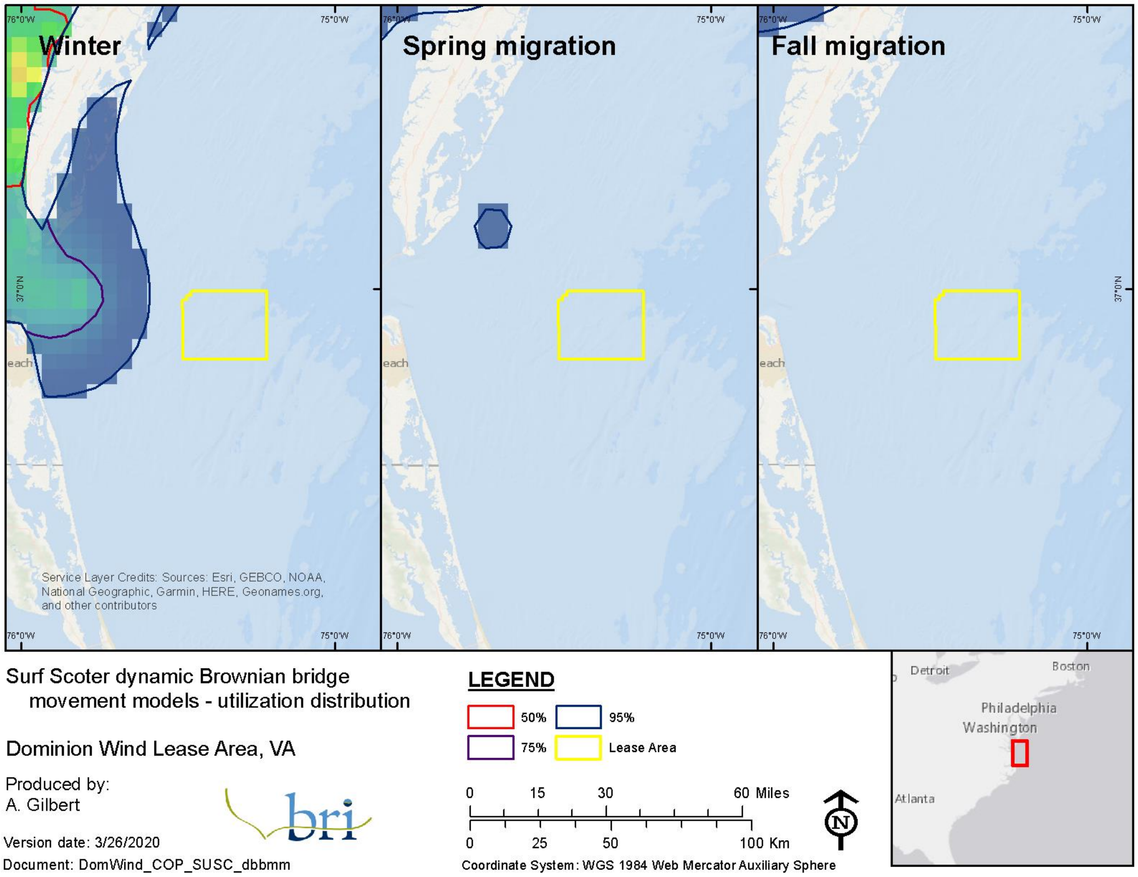


Figure 3-19. Dynamic Brownian bridge movement models for Surf Scoter (n = 78, 87, 83 [winter, spring, fall]) that were tracked with satellite transmitters. Utilization contour levels (50%, 75%, 95%) were calculated for the mean utilization distribution (UD) surface; a probability density surface showing the relative use of an area by the population of animals in this study over the period of study. The contours represent the percentage of the use area across the UD surface and represent various levels of use from 50% (core use) to 95% (home range). Data provided by BOEM: see section 3.2.3.1.4.1 (p. 44).

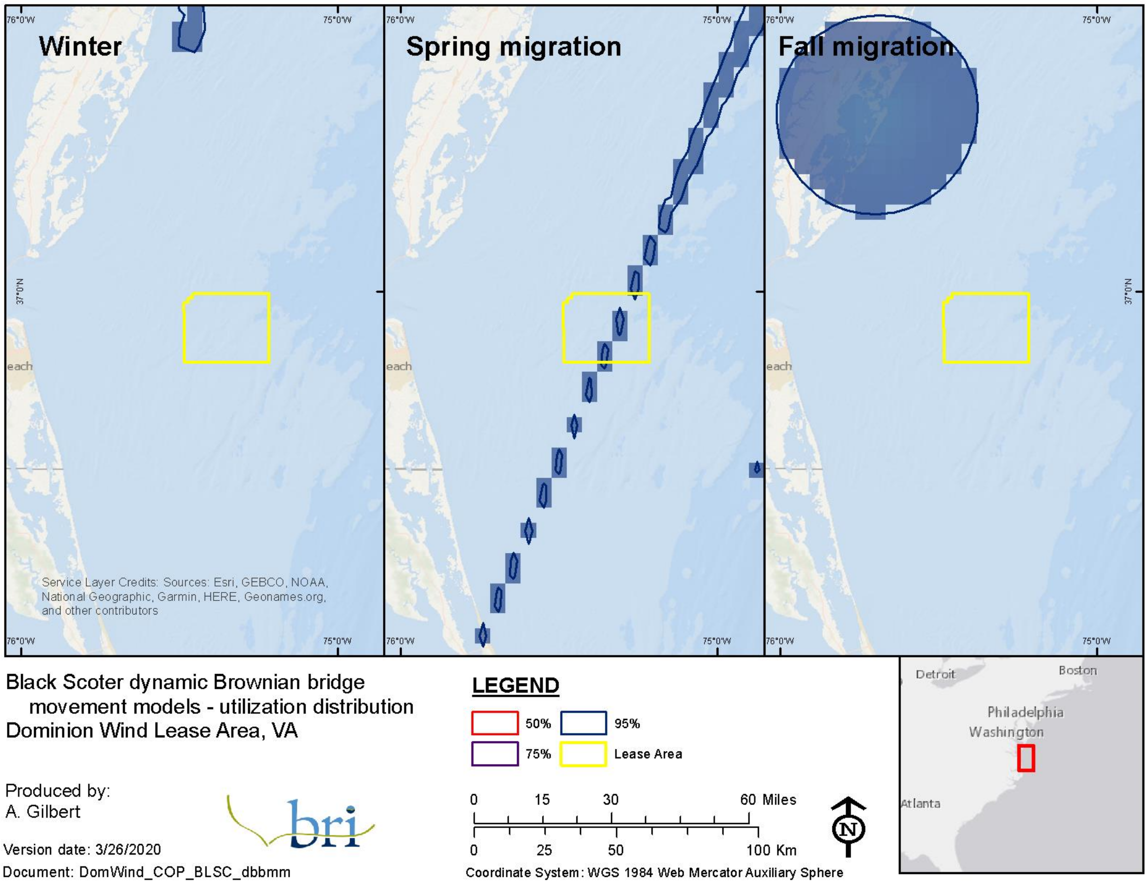


Figure 3-20. Dynamic Brownian bridge movement models for Black Scoter (n = 61, 76, 80 [winter, spring, fall]) that were tracked with satellite transmitters. Utilization contour levels (50%, 75%, 95%) were calculated for the mean utilization distribution (UD) surface; a probability density surface showing the relative use of an area by the population of animals in this study over the period of study. The contours represent the percentage of the use area across the UD surface and represent various levels of use from 50% (core use) to 95% (home range). Data provided by multiple sea duck researchers: see section 3.2.3.1.4.5 (p. 45).

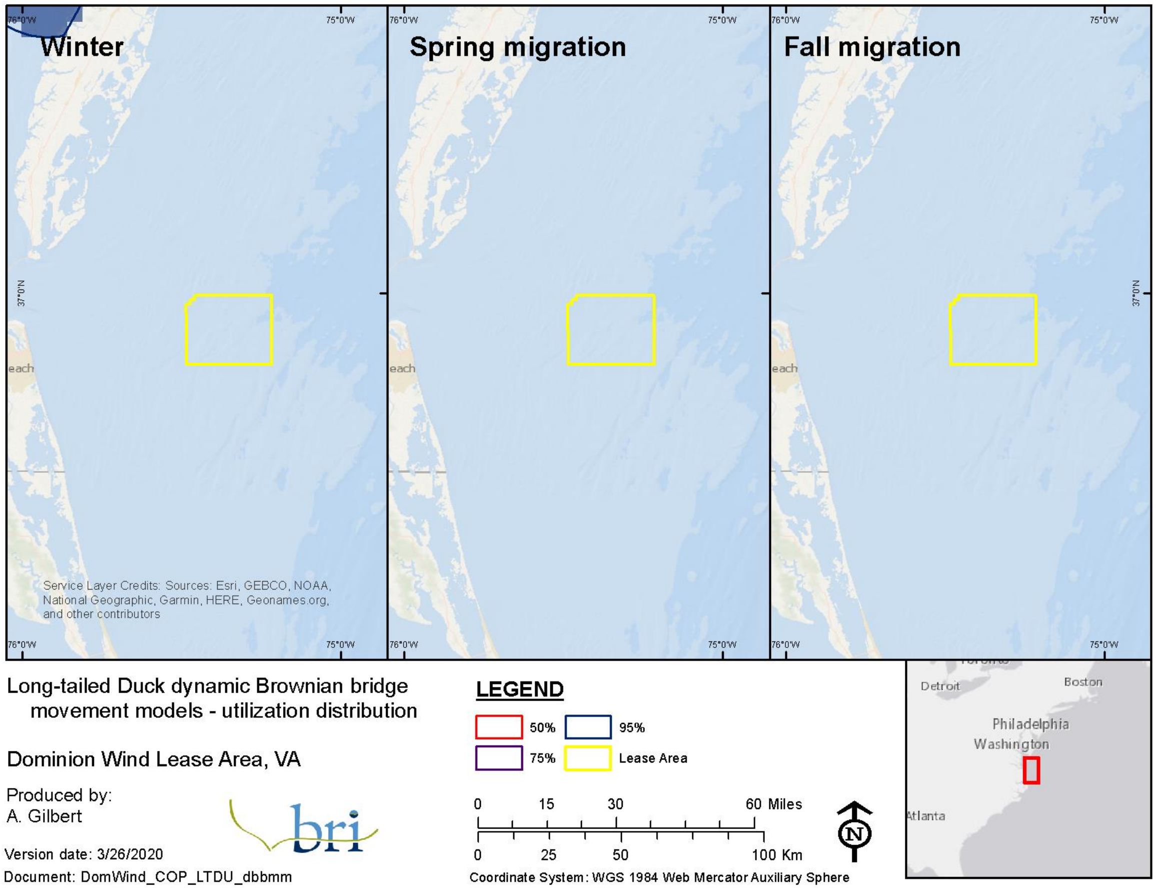


Figure 3-21. Dynamic Brownian bridge movement models for Long-tailed Duck (n = 49, 60, 37 [winter, spring, fall]) that were tracked with satellite transmitters. Utilization contour levels (50%, 75%, 95%) were calculated for the mean utilization distribution (UD) surface; a probability density surface showing the relative use of an area by the population of animals in this study over the period of study. The contours represent the percentage of the use area across the UD surface and represent various levels of use from 50% (core use) to 95% (home range). Data provided by multiple sea duck researchers: see section 3.2.3.1.4.5 (p. 45).

3.5.1.3 Relative Behavioral Vulnerability Assessment

Sea ducks, particularly scoters, have been identified as being vulnerable to displacement (MMO 2018), although ultimately, this has been shown to be temporary for some species. Sea ducks are generally not considered vulnerable to collision (Furness et al. 2013), remaining primarily below the RSZ (during the day sea ducks were estimated to fly 1.7–3.2% of the time within the RSZ depending on species and turbine option; Figure 3-22). Avoidance behavior has been documented for Black Scoter (*Melanitta americana*), Common Eider (*Somateria mollissima*; Desholm and Kahlert 2005; Larsen and Guillemette 2007), and Greater Scaup (*Aythya marila*; Dirksen and van der Winden 1998 *in* Langston 2013). Avoidance behavior of wind projects can lead to permanent or semi-permanent displacement, resulting in effective habitat loss (Petersen and Fox 2007; Percival 2010; Langston 2013). The high vulnerability of displacement, coupled with extensive use of the Atlantic coast during migration and wintering increases the potential for cumulative habitat loss for sea ducks (Goodale et al. 2019). However, for some species this displacement may cease several years after construction as food resources, behavioral responses, or other factors change (Petersen and Fox 2007; Leonhard et al. 2013).

Based on the above evidence, the risk to sea ducks is primarily displacement from offshore wind developments. From the literature, sea duck vulnerability to temporary displacement is considered to be medium to high during construction and initial operation because sea ducks are known to display a strong avoidance to offshore wind developments; the displacement score was also ***medium*** to ***high*** (Figure 3-23). However, since there is evidence of birds returning to wind farms once they become operational, vulnerability to permanent displacement will vary by species and a lower range is added to displacement vulnerability. Since sea ducks generally fly below the RSZ and have strong avoidance behavior, collision vulnerability is ***low*** (Figure 3-29).

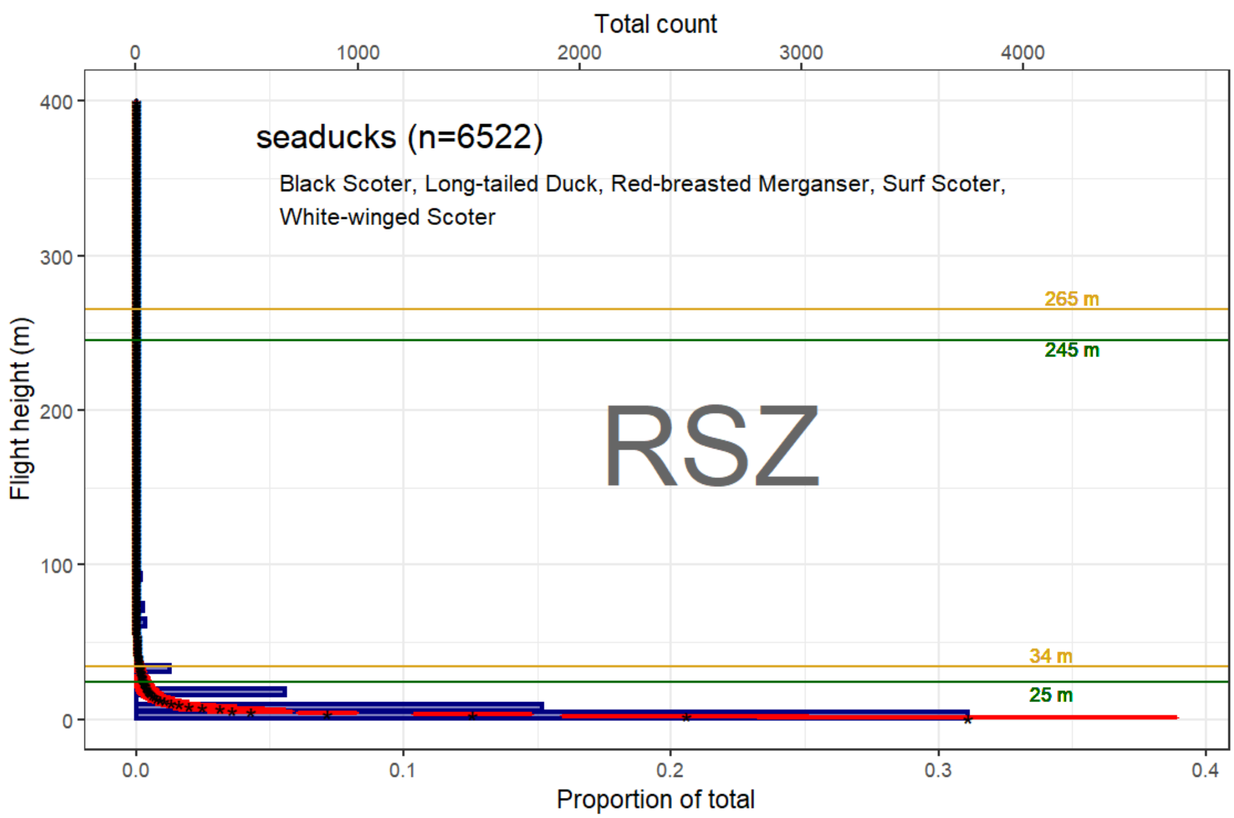


Figure 3-22. Flight heights of sea ducks (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25-245 m) and maximum (gold 34-265 m) turbine options.

Table 3-15. Summary of sea duck vulnerability. Based on the literature, displacement vulnerability was adjusted to include a lower range limit (green) to account for macro avoidance rates potentially decreasing with time.

Species	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Option 1	Option 2		
Surf Scoter	low (0.3)	low (0.3)	medium–high (0.9)	medium (0.67)
White-winged Scoter	low (0.37)	low (0.37)	medium–high (0.8)	medium (0.67)
Black Scoter	low (0.27)	low (0.27)	medium–high (0.9)	low (0.47)
Long-tailed Duck	low (0.33)	low (0.33)	medium–high (0.9)	low (0.4)
Red-breasted Merganser	medium (0.53)	low (0.4)	low–medium (0.5)	low (0.27)

3.5.1.4 *Risk Analysis*

This analysis suggests that the potential impacts to sea duck populations is ***minimal***. While the birds have medium to high vulnerability to displacement due to avoidance behaviors, overall, these birds have minimal exposure, both spatially and temporally. In addition, displacement from individual wind farms is unlikely to affect populations, because relatively few individuals are affected (Fox and Petersen 2019). Since sea ducks were assessed to have a low to medium population vulnerability score, the final risk score was not adjusted.

3.5.2 Auks

3.5.2.1 *Spatiotemporal Context*

The auk species present in the region of the proposed Project are generally northern or Arctic-breeders that winter along the U.S. Atlantic OCS. The annual abundance and distribution of auks along the eastern seaboard in winter is erratic, and is dependent upon broad climatic conditions and the availability of prey (Gaston and Jones 1998). In winters with prolonged harsh weather, which may prevent foraging for extended periods, these generally pelagic species often move inshore, or are driven considerably farther south than usual. The MDAT abundance models show that auks are concentrated offshore and south of Nova Scotia (see maps in Part V).

3.5.2.2 *Exposure Assessment*

Exposure was assessed using species accounts, DOE digital aerial survey data, and MDAT models. Exposure is considered to be ***minimal*** because annual exposure scores for auks ranged from minimal to low; the average counts of auks within the Lease Area were generally lower than those of the DOE digital aerial survey area (Table 3-16). Only counts of the Atlantic Puffin (*Fratercula arctica*), Dovekie (*Alle alle*), and unidentified small auks were similar to those of the DOE digital aerial survey area.

Table 3-16. Seasonal exposure rankings for auks.

Season	Local Rank	Regional Rank	Total Rank	Exposure Score
Winter	1	0	1	low
Spring	0	·	0	minimal
Summer	0	·	0	minimal
Fall	0	·	0	minimal

3.5.2.3 Relative Behavioral Vulnerability Assessment

Auks are considered to be vulnerable to displacement, but not collision. Due to sensitivity to disturbance from boat traffic and a high habitat specialization, many auks rank high in displacement vulnerability assessments (Furness et al. 2013; Wade et al. 2016; Dierschke et al. 2016). Studies in Europe have documented varying levels of displacement with rates ranging from no apparent displacement up to 70% (Ørsted 2018). Auks have a 45–68% macro-avoidance rate and a 99.2% total avoidance rate (Cook et al. 2012). For turbines smaller (66-492 ft [20-150 m]) than are being considered by the Project, Atlantic Puffins are estimated to fly 0.1% of the time at RSZ, Razorbills 0.4%, Common Murres 0.01%, and storm-petrels 2% (Cook et al. 2012). Common Murres decrease in abundance in the area of offshore wind developments by 71%, and Razorbills by 64% (Vanermen et al. 2015). Auk flight heights from the Northwest Atlantic Seabird Catalog indicate the birds during the day are flying within the RSZ 0.12%–0.16% % of the time depending upon the turbine option (Figure 3-23). The collision vulnerability for all turbine options and species was defined as ***minimal*** or ***low***; the displacement vulnerability score ranged from ***medium*** to ***high*** depending on the species (Table 3-17).

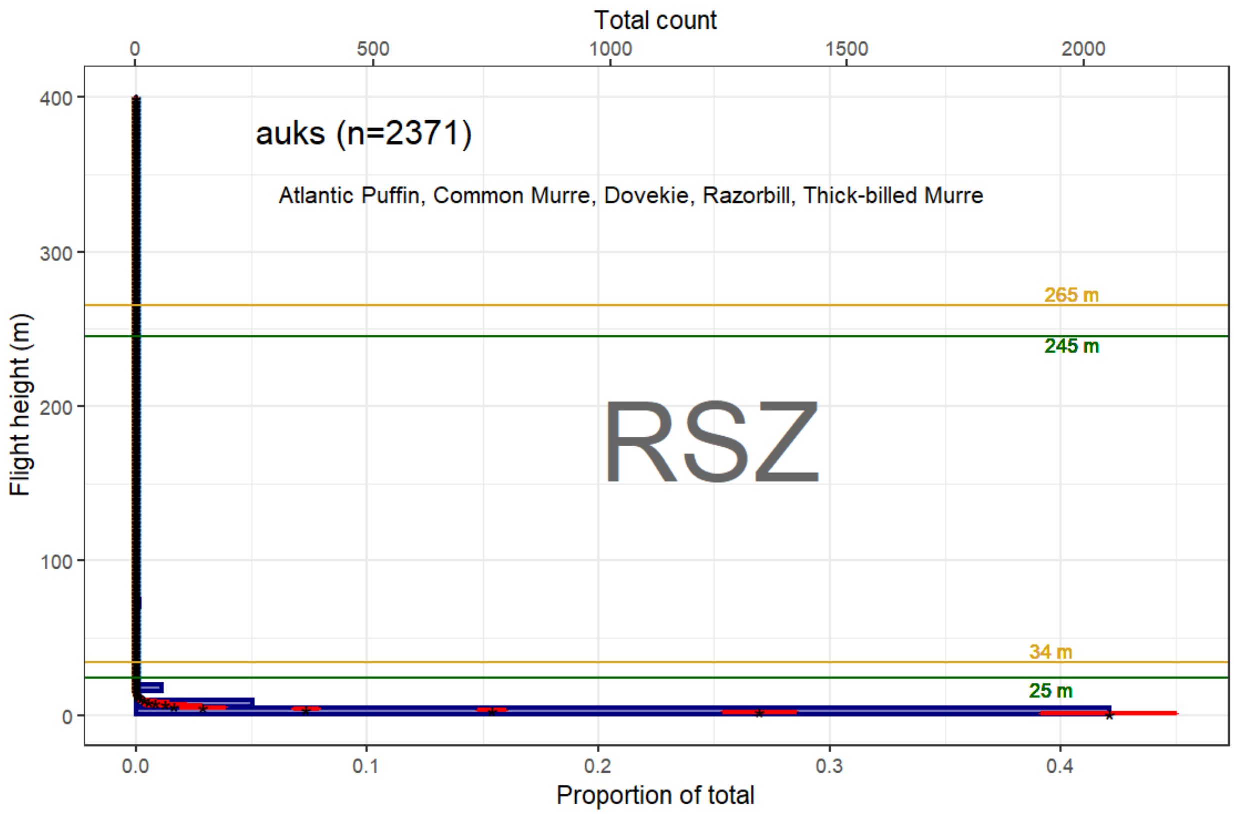


Figure 3-23. Flight heights of auks (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25-245 m) and maximum (gold 34-265 m) turbine options.

Table 3-17. Summary of auk vulnerability.

Species	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Option 1	Option 2		
Dovekie	low (0.27)	low (0.27)	medium (0.7)	low (0.4)
Common Murre	low (0.27)	low (0.27)	high (0.8)	low (0.4)
Thick-billed Murre	minimal (0.2)	minimal (0.2)	high (0.8)	low (0.47)
Razorbill	low (0.27)	low (0.27)	high (0.8)	medium (0.6)
Atlantic Puffin	minimal (0.2)	minimal (0.2)	high (0.8)	medium (0.53)

3.5.2.4 *Risk Analysis*

This analysis suggests that potential impacts to auk populations is minimal, because the birds have ***minimal*** exposure temporally and spatially. Since auks had a low to medium population vulnerability score, the final risk score was not adjusted.

3.5.3 Gulls, Skuas, and Jaegers

3.5.3.1 *Spatiotemporal Context*

There are multiple species of gulls, skuas, and jaegers that could be exposed to the Project, which were observed in the DOE digital aerial and boat-based surveys. There are multiple gull species that could potentially pass through the Lease Area. The regional MDAT abundance models show that these birds have a wide distribution ranging from near shore (gulls) to offshore (skuas and jaegers). Herring Gulls (*Larus argentatus*) and Great Black-backed Gulls (*L. marinus*) are resident in the region year-round, and are found further offshore outside of the breeding season (Winship et al. 2018). The skuas and jaegers are all high latitude breeders that regularly migrate through the northwest Atlantic region. Parasitic Jaegers (*Stercorarius parasiticus*) are often observed closer to shore during migration than the others species (Wiley and Lee 2020), and Great Skuas (*S. skua*) may pass along the U.S. Atlantic OCS outside the breeding season.

3.5.3.2 *Exposure Assessment*

Exposure was assessed using DOE digital aerial survey data, and MDAT models. Exposure is considered to be ***minimal*** to ***low*** depending on the species (Table 3-18).

Table 3-18. Seasonal exposure rankings for gull, skuas, and jaegers.

Taxonomic Group	Season	Local Rank	Regional Rank	Total Rank	Exposure Score
Skuas and Jaegers					
	Winter	0	·	0	minimal
	Spring	0	1	1	low
	Summer	1	0	1	low
	Fall	0	·	0	minimal
Small Gulls					
	Winter	0	2	2	low
	Spring	0	2	2	low
	Summer	0	·	0	minimal
	Fall	0	·	0	minimal
Medium Gulls					
	Winter	0	0	0	minimal
	Spring	0	0	0	minimal
	Summer	0	0	0	minimal

Taxonomic Group	Season	Local Rank	Regional Rank	Total Rank	Exposure Score
	Fall	0	0	0	minimal
Large Gulls					
	Winter	2	0	2	low
	Spring	0	0	0	minimal
	Summer	0	0	0	minimal
	Fall	0	0	0	minimal
All Gulls					
	Winter	1	1	2	low
	Spring	0	0	0	minimal
	Summer	0	0	0	minimal
	Fall	0	0	0	minimal

3.5.3.3 Relative Behavioral Vulnerability Assessment

Jaegers and gulls are considered to be vulnerable to collision but not displacement. Jaegers and gulls rank low in vulnerability to displacement assessments (Furness et al. 2013) and there is no evidence in the literature that they are displaced from offshore wind developments (Krijgsveld et al. 2011, Lindeboom et al. 2011). Little is known about how jaegers will respond to offshore wind turbines, but the birds generally fly below the potential RSZ (0–10 m above the sea surface). They could fly higher during kleptoparasitic chases (Wiley and Lee 1999). Gulls rank at the top of collision vulnerability assessments because they can fly within the RSZ (Johnston et al. 2014b), have been documented to be attracted to turbines (Vanermen et al. 2015), and individual birds have been documented to collide with turbines (Skov et al. 2018). The flight height of gulls, skuas, and jaegers in the Northwest Atlantic Seabird Catalog indicated that birds in this group fly within the RSZ 0.9-19.8% of the time, depending on species and turbine option (Figure 3-24). While the collision risk is thought to be greater for gulls, total avoidance rates are estimated to be 98% (Cook et al. 2012). At European offshore wind developments, gulls have been documented to be attracted to wind turbines, which may be due to attraction to increased boat traffic, new food resources, or new loafing habitat (i.e., perching areas; Fox et al. 2006, Vanermen et al. 2015), but interaction with offshore wind developments varies by season (Thaxter et al. 2015). Recent research suggests that some gull species may not exhibit macro-avoidance of wind farms, but will preferentially fly between turbines, suggesting meso-avoidance that would reduce overall collision risk (Thaxter et al. 2018). The collision vulnerability scores for these groups were ***low*** to ***medium***, with ***medium*** being the most common score. The displacement vulnerability score for all species was ***low*** to ***medium*** (Table 3-19).

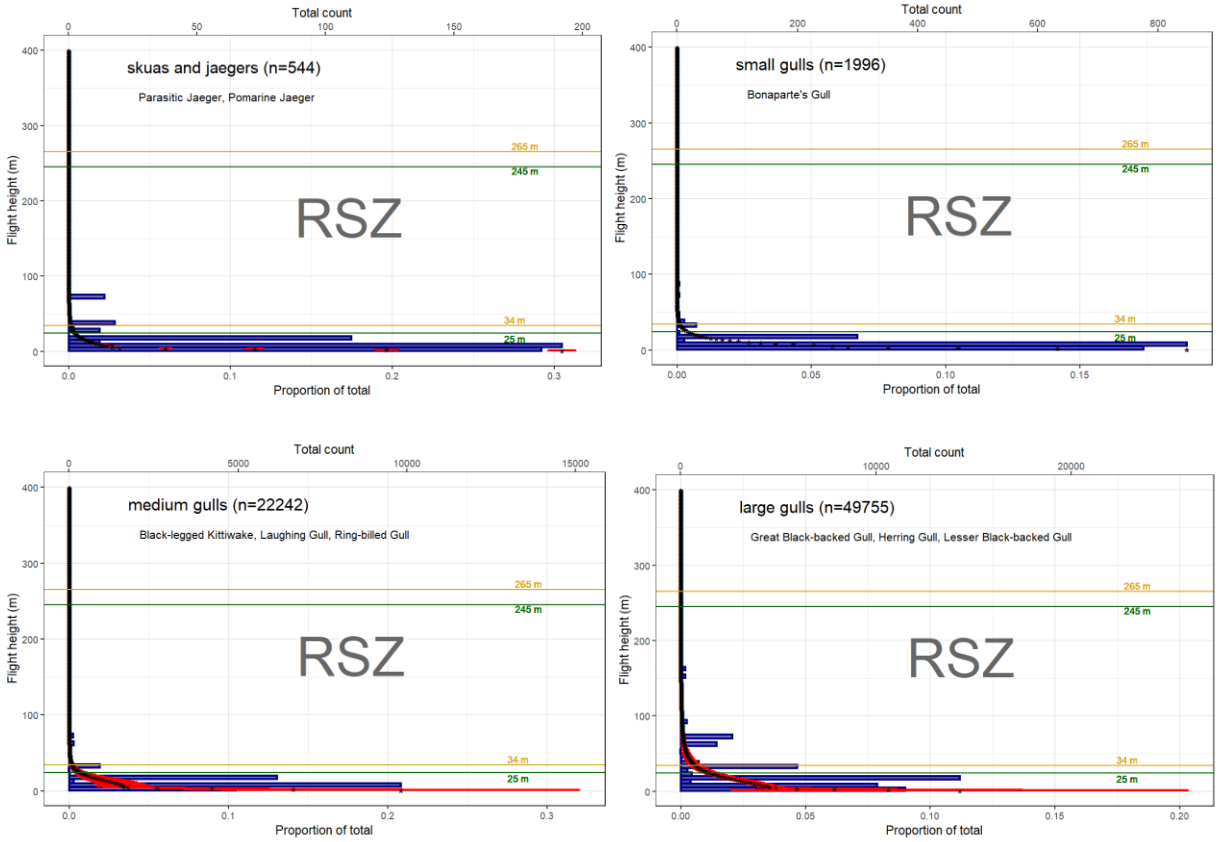


Figure 3-24. Flight heights of skuas and jaegers, and small, medium, and large gulls (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25-245 m) and maximum (gold 34-265 m) turbine options.

Table 3-19. Summary of gull, skua, and jaeger vulnerability.

Species	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Option 1	Option 2		
Small gulls				
Bonaparte's Gull	low (0.47)	low (0.47)	medium (0.5)	low (0.33)
Medium gulls				
Black-legged Kittiwake	low (0.43)	low (0.43)	medium (0.6)	low (0.4)
Laughing Gull	medium (0.6)	low (0.47)	medium (0.5)	low (0.47)
Ring-billed Gull	medium (0.67)	medium (0.53)	low (0.4)	low (0.33)
Large gulls				
Herring Gull	medium (0.7)	medium (0.57)	medium (0.5)	medium (0.53)
Lesser Black-backed Gull	· (·)	· (·)	· (·)	minimal (0.13)
Great Black-backed Gull	medium (0.63)	medium (0.5)	medium (0.7)	minimal (0.2)
Jaegers				
Pomarine Jaeger	medium (0.73)	medium (0.6)	low (0.3)	low (0.4)
Parasitic Jaeger	medium (0.6)	medium (0.6)	low (0.3)	low (0.4)

3.5.3.4 *Risk Analysis*

This analysis suggests that potential impacts to gull populations is ***minimal*** to ***low***, depending on the species. Overall, these species have minimal to low exposure and low to medium vulnerability to collision. Recent research suggests that they may exhibit meso-avoidance, and resident gull populations are robust and generally show high reproductive success (Pollet et al. 2012; Burger 2015; Good 2020; Nisbet et al. 2017). Since the gulls, jaegers, and skuas had minimal to medium population vulnerability scores, the final risk score was not adjusted. Great Black-backed Gulls and Lesser Black-backed Gull had a minimal population vulnerability score, so the final risk level for these species were adjusted down to ***minimal***.

3.5.4 Terns

3.5.4.1 *Spatiotemporal Context*

A total of seven tern species were observed in DOE digital aerial and boat-based surveys – the Black Tern [*Chlidonias niger*], Least Tern [*Sternula antillarum*], Common Tern [*Sterna hirundo*], Forster's Tern [*S. forsteri*], Roseate Tern [*S. dougallii*], Royal Tern [*Thalasseus maximus*], and Caspian Tern [*Hydroprogne caspia*]). Terns generally restrict themselves to coastal waters during breeding, although some species reach farther offshore and may pass through the Lease Area during migration. The Roseate Tern is listed at both state and Federal levels, and this species is addressed in detail below.

Table 3-20. Federal and state listing status of terns.

Common Name	Scientific Name	VA State Status	Federal Status
Least Tern	*Sternula antillarum*		SC
Black Tern	*Chlidonias niger*		
Roseate Tern	*Sterna dougallii*	E	E
Common Tern	*Sterna hirundo*		
Forster's Tern	*Sterna forsteri*		
Royal Tern	*Thalasseus maximus*		
Caspian Tern	*Hydroprogne caspia*		

3.5.4.2 *Exposure Assessment*

Exposure was assessed using species accounts, DOE digital aerial survey data, and MDAT models. A recent tracking study used nanotags to track Common Terns and Roseate Terns tagged in New York and Massachusetts (Loring et al. 2019). While the movement models are not representative of the entire breeding and posting period for many individuals, due to incomplete spatial coverage of the receiving stations and tag loss, one of 257 Common Terns and none of the 145 Roseate Terns tracked were estimated to pass through the Lease Area (Loring et al. 2019). Exposure is considered to be ***minimal*** because the annual exposure score for terns as a group was minimal (Table 3-21) and the mean densities within the Lease Area were lower than the DOE digital aerial survey area (Table 3-12). Within the tern group, exposure scores were minimal for all subgroups – small terns, medium terns, and large terns.

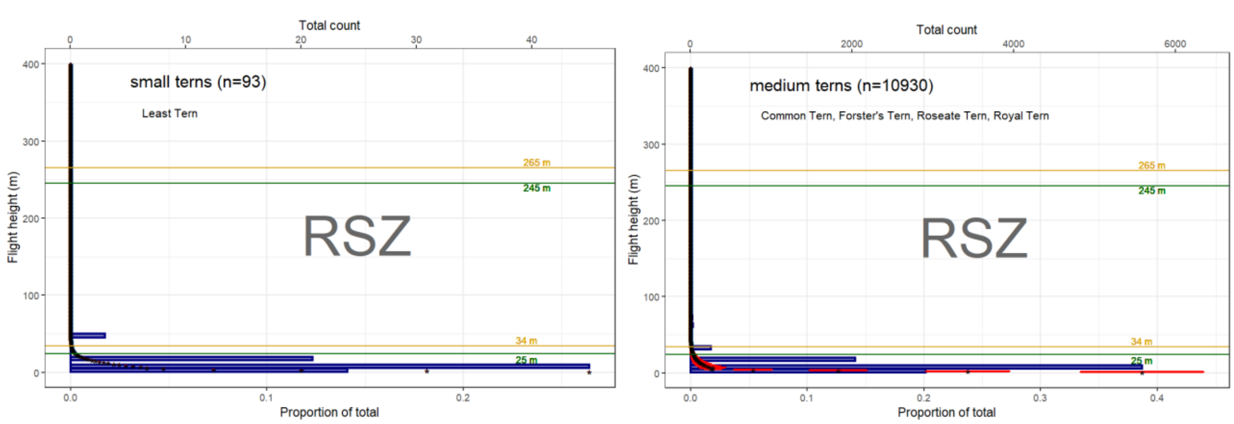
Table 3-21. Seasonal exposure rankings for terns.

Season	Local Rank	Regional Rank	Total Rank	Exposure Score
Winter	0	·	0	minimal
Spring	0	0	0	minimal
Summer	0	0	0	minimal
Fall	0	·	0	minimal

3.5.4.3 Behavioral Vulnerability Assessment

Terns are considered to be vulnerable to collisions but not displacement. Terns rank in the middle of collision vulnerability assessments (Garthe and Hüppop 2004; Furness et al. 2013), fly 2.8–12.7% of the time at rotor swept heights of turbines smaller than those being used by the Project (66–492 ft [20–150 m]), have a 30–69.5% macro avoidance rate (Cook et al. 2012), and have been demonstrated to avoid rotating turbines (Vlietstra 2007). Tern flight heights recorded in the Northwest Atlantic Seabird Catalog indicate that during the day, terns fly within the RSZ of the large turbines being considered by the Project 0.44-10.70% of the time (Figure 3-25). A recent nanotag study estimated that Common Terns primarily flew below the RSZ (<82 ft [25 m]) and that the frequency of Common Terns flying offshore within the RSZ (82–820 ft [25–250 m]) ranged from 0.9–9.8 % (Loring et al. 2019). While the nanotag flight height estimated birds flying below 164 ft (50 m), radar and observational studies provide evidence that terns in some instances can initiate migration at altitudes of 3,000–10,000 ft (1,000–3,000 m; Loring et al. 2019). The probability of tern mortality as a result of collision with wind turbines is predicted to decline as the distance between the colony and the turbine/s increases (Cranmer et al. 2017). Common Terns and Roseate Terns tended to avoid the airspace around a 660 kW turbine (Massachusetts Maritime Academy in the U.S.) when the turbine was rotating and usually avoided the RSZ (Vlietstra 2007). This finding is corroborated by mortality monitoring of small to medium turbines (200 and 600 kW) in Europe, where mortality rates rapidly declined with distance from the colony (Everaert et al. 2007). Most observed tern mortalities in Europe have occurred at turbines <98 ft (30 m) from nests (Burger et al. 2011). Furthermore, the Final Vineyard Wind 1 Biological Assessment prepared by BOEM for USFWS estimated that Roseate Tern mortality from collision would be zero and that the likelihood of collision fatalities would be “insignificant and discountable” (BOEM 2019).

The collision vulnerability score for terns ranges from ***low*** to ***medium*** depending upon the species and turbine options; the displacement score ranges from ***medium*** to ***high*** depending on the species. Terns fall into the high (5) category for macro avoidance because of a 69.5% avoidance rate determined at Horns Rev (Cook et al. 2012), which had small 2 MW turbines (Petersen et al. 2006), and Willmott et al. (2013) categorized tern avoidance as greater than 40%. A lower range was added to the displacement vulnerability score for the following reasons: terns receive a low disturbance score in Wade et al. (2016); terns were determined to have a 30% macro avoidance of turbines at Egmond aan Zee (Cook et al. 2012); terns have high uncertainty scores; and displacement in terns has not been well studied (Table 3-22).



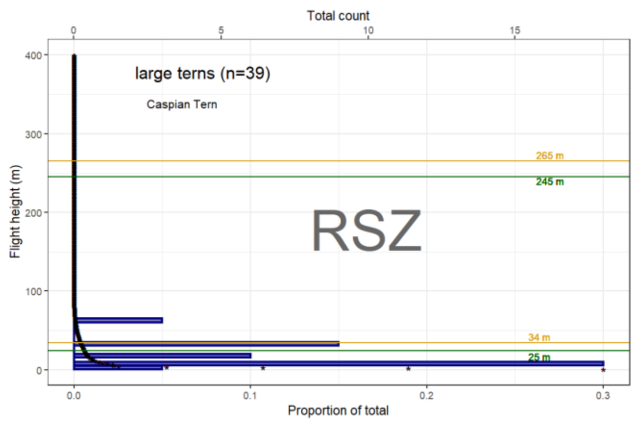


Figure 3-25. Flight heights of small, medium, and large terns (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25-245 m) and maximum (gold 34-265 m) turbine options.

Table 3-22. Summary of tern vulnerability. Based upon the literature on terns, collision and displacement vulnerability was adjusted to include a lower range limit (green).

Species	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Option 1	Option 2		
Small terns				
Least Tern	low (0.33)	low (0.33)	low–medium (0.5)	medium (0.73)
Medium terns				
Roseate Tern	· (·)	· (·)	medium–high (0.8)	high (0.87)
Common Tern	low (0.3)	low (0.3)	medium–high (0.8)	medium (0.6)
Forster's Tern	low (0.43)	low (0.43)	low–medium (0.5)	medium (0.53)
Royal Tern	low (0.43)	low (0.43)	low–medium (0.5)	medium (0.67)
Large terns				
Caspian Tern	medium (0.6)	medium (0.6)	low–medium (0.5)	medium (0.6)

3.5.4.4 Risk Analysis

This analysis suggests that the risk of potential effects to tern populations is ***minimal***, because these birds have minimal exposure, both spatially and temporally. The terns (excluding Roseate tern) had a medium population vulnerability score, and the final risk score was not adjusted.

3.5.4.5 Federally Endangered Tern Species

3.5.4.5.1 Roseate Tern

3.5.4.5.2 Spatiotemporal context

The Roseate Tern (*Sterna dougallii*) is a small seabird that breeds colonially on coastal islands. The northwest Atlantic population has been Federally listed as *Endangered* under the ESA since 1987 and is listed as *Endangered* in Virginia. This population breeds in the northeastern U.S. and Atlantic Canada, and winters in South America, primarily eastern Brazil (U.S. Fish and Wildlife Service 2010, Nisbet et al.

2014). Roseate Terns formerly bred in Virginia, but have not done so since the 1930s (Gochfeld and Burger 2020). Declines have been largely attributed to low productivity, partially related to predators, habitat loss and degradation, and adult survival rates, which are unusually low for a tern species (U.S. Fish and Wildlife Service 2010). Over 90% of remaining individuals breed at just three colony locations in Massachusetts (Bird Island, Ram Island, and Penikese Island in Buzzards Bay) and one colony in New York (Great Gull Island, near the entrance to Long Island Sound (Gochfeld and Burger 2020; Loring et al. 2017). There are no longer any breeding colonies farther south.

Roseate Terns generally migrate through the mid-Atlantic region and arrive at their northwest Atlantic breeding colonies in late April to late May, with nesting occurring between mid-May and late July. During breeding, Roseate Terns generally stay within about 6 mi (~10 km) of the colony, though they may travel 18–31 mi (30–50 km) from the colony while provisioning chicks (U.S. Fish and Wildlife Service 2010, Burger et al. 2011, Nisbet et al. 2014, Loring et al. 2017). Following the breeding season, adult and hatch year Roseate Terns move to post-breeding coastal staging areas from late July to mid-September (U.S. Fish and Wildlife Service 2010). Foraging activity during the staging period is known to occur up to 16 km from the coast, though most foraging activity occurs much closer to shore (Burger et al. 2011).

Roseate Tern migration routes are poorly understood, but they appear to migrate primarily offshore (Nisbet 1984, U.S. Fish and Wildlife Service 2010, Burger et al. 2011, Mostello et al. 2014, Nisbet et al. 2014). However, the regional MDAT models show that Roseate Terns are generally concentrated closer to shore during spring migration and have limited exposure in Virginia offshore waters during the summer and fall.

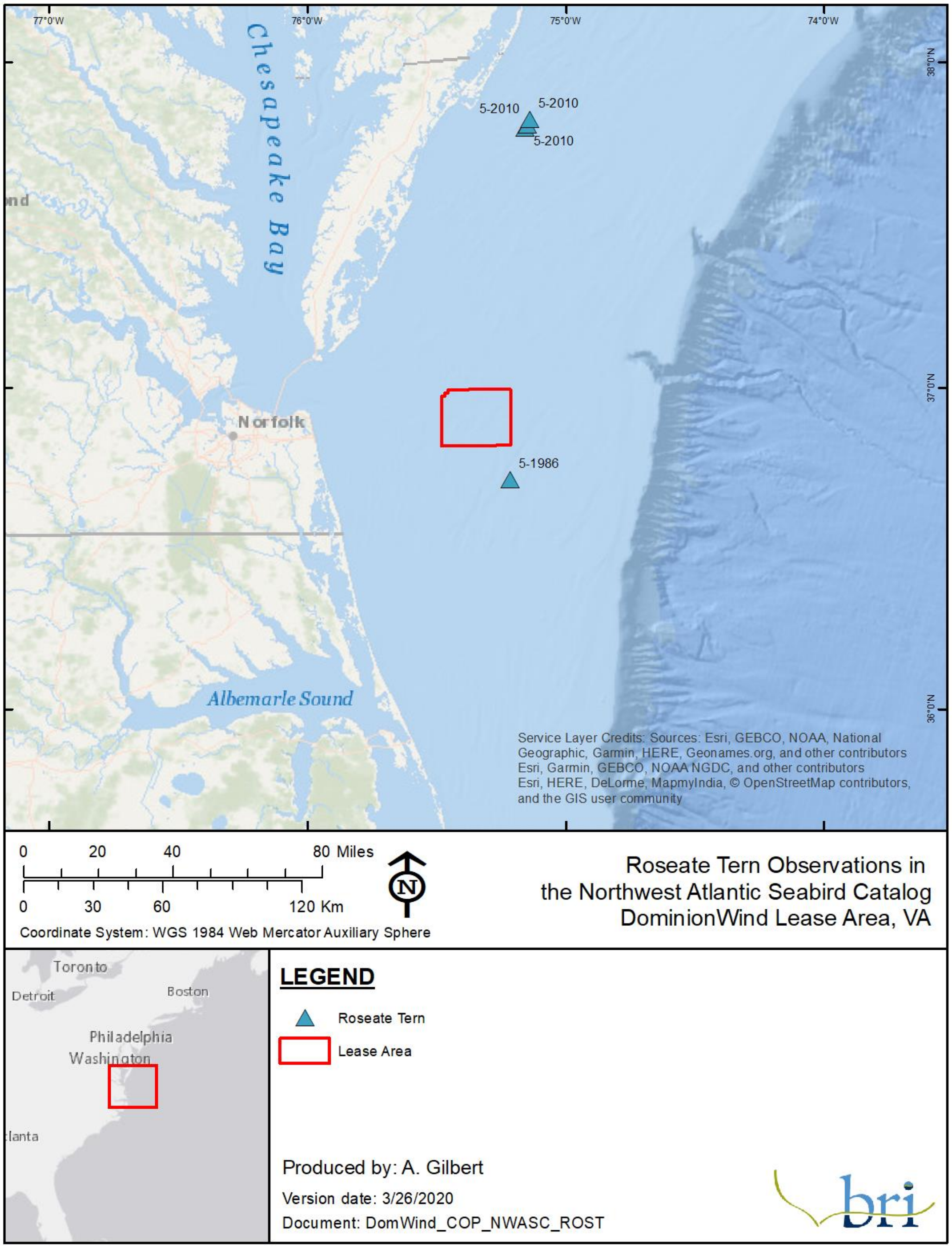


Figure 3-26. Roseate Tern observations in the Northwest Atlantic Seabird Catalog in the vicinity of the Lease Area.

3.5.4.5.3 Exposure

Exposure for Roseate Terns was assessed using species accounts, tracking studies, DOE digital aerial survey data, and MDAT models. While the DOE surveys didn't generally identify terns to the species level, all tern groups received a minimal exposure score, which includes Roseate Tern. The Northwest Atlantic Seabird Catalog had one historical observation of Roseate Terns to the south of the Lease Area (Figure 3-26). A study used nanotags to track Roseate Terns tagged in New York and Massachusetts. While the movement models are not representative of the entire breeding and staging period for many individuals due to incomplete spatial coverage of the receiving stations and tag loss, none of the tracked birds (*n*=145) were estimated to pass through the Lease Area (Loring et al. 2019), although the local receiver stations did not cover the Lease Area. Overall, Roseate Terns display limited spatial and temporal exposure to the Lease Area, and the expected exposure of Roseate Terns is ***minimal*** and is limited to migration.

3.5.4.5.4 Relative Behavioral Vulnerability Assessment

Terns rank in the middle of collision vulnerability assessments (Furness et al. 2013), fly less than 13 % of the time at rotor swept heights of smaller offshore wind turbines (66–492 ft [20–150 m]; Cook et al. 2012), and avoid rotating blades of small (660 kW) turbines (Vlietstra 2007). Terns have also been documented to lower their flight altitude when approaching a wind development to avoid the RSZ (Krijgsveld et al. 2011). A two-year study of an small onshore turbine in Buzzard's Bay, Massachusetts, found no tern mortalities, though Common Terns regularly flew within 164 ft (50 m) of the turbine (Vlietstra 2007). Terns may detect turbine blades during operation, both visually and acoustically and have been observed to avoid flying between turbine rotors while they are in motion (Vlietstra 2007, Minerals Management Service 2008).

Tern flight height during foraging is typically low, and European studies of related tern species at turbines that are smaller than those being considered by the Project, have suggested that approximately 4–10 % of birds may fly at rotor height (66–492 ft [20–150 m] asl) during local flights (Jongbloed 2016). Estimates of tern flight height from surveys in the Nantucket Sound area suggested that 95% of Common/Roseate Terns flew below the RSZ (Minerals Management Service 2008). A recent nanotag study estimated that terns primarily flew below the RSZ (<82 ft [25 m]) and that Roseate Terns flying offshore only occasionally flew within the lower portion of the RSZ (federal waters, 6.4 %; WEAs, 0%; Figure 3-27; Loring et al. 2019). There were too few Roseate Tern observations in the Northwest Atlantic Seabird Catalog to estimate flight heights, but during the day Common Terns are estimated to fly within the RSZ 0.2-0.56% of time for the turbine options being considered. The altitude at which Roseate Terns migrate far offshore is still being researched, but is thought to be higher than foraging altitudes or nearshore flight altitudes (likely hundreds to thousands of feet/meters; Perkins et al. 2004, Minerals Management Service 2008).

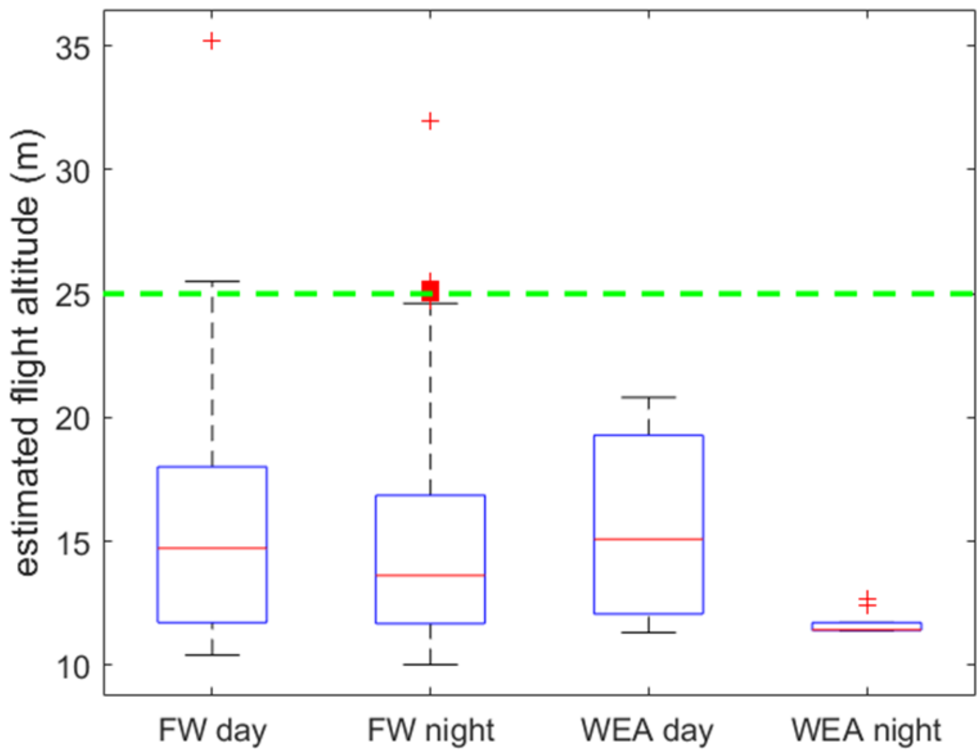


Figure 3-27. Model-estimated flight altitude ranges (m) of Roseate Terns. During exposure to federal waters (FW) and Wind Energy Areas (WEAs) during day and night. The green-dashed line represents the lower limit of the RSZ (25 m). Taken from Loring et al. (2019).

Since there is little data on Roseate Tern flight height and proportion of time flying, data for the Common Tern was used as a surrogate. Common Terns and Roseate Terns are often observed flying and foraging in mixed species flocks (Safina 1990) and as such Common Terns provide a good surrogate for Roseate Terns. The Common Tern received a collision vulnerability score of ***low*** for all turbine options; and a displacement score was ***high*** (Table 3-22; see tern discussion above for further details). A lower range was added to the displacement scores because the estimates of tern avoidance are primary based upon two studies of wind farms with small turbines (2 MW; see section 3.5.4). In addition, Wade et al. (2016) determined high and very high uncertainty for flight heights and displacement for Roseate Terns.

3.5.4.5.5 Risk

This analysis suggests that the potential impacts to individual Roseate Terns from collision and displacement is minimal, because these birds have minimal exposure, both spatially and temporally. However, since Roseate Terns have a high population vulnerability score, the final risk score was adjusted up to ***low***.

3.5.5 Loons

3.5.5.1 Spatiotemporal Context

The Common Loon (*Gavia immer*) and Red-throated Loon (*Gavia stellata*) breed on inland freshwater lakes and ponds during the summer, but both species use the U.S. Atlantic OCS during winter, with migration periods in the spring and fall. Analysis of satellite-tracked Red-throated Loons, captured and tagged in the mid-Atlantic region, found their winter distributions to be coastal or inshore relative to the Lease Area (Gray et al. 2016). In the mid-Atlantic, Common Loons generally show a broader and more dispersed distribution in winter than Red-throated Loons (Williams et al. 2015). As expected, based on the summer breeding habitat of loons, the DOE digital aerial surveys and MDAT models show lower use of the Lease Area by loons in the summer than other seasons.

3.5.5.2 Exposure Assessment

Exposure for loons was assessed using species accounts, tracking data, DOE digital aerial survey data, and MDAT models. Exposure to construction and operation is considered to be ***low*** because although loons may pass through the Lease Area during spring and fall migration, they are estimated to have low relative exposure during the winter (Table 3-23). Relative exposure during the summer and fall is minimal. A persistence analysis conducted on Red-throated Loons tracked with satellite transmitters also showed little use of the Lease Area (Stenhouse et al. 2020). Since Red-throated Loons migrate to far northern inland lakes to breed, density estimates indicate close to no use of the Lease Area during the summer. Similarly, Common Loon density was lower during the summer/spring than the other months because adults migrate to inland lakes to breed.

Table 3-23. Seasonal exposure rankings for the loons group.

Season	Local Rank	Regional Rank	Total Rank	Exposure Score
Winter	1	1	2	low
Spring	2	1	3	medium
Summer	0	0	0	minimal
Fall	0	0	0	minimal

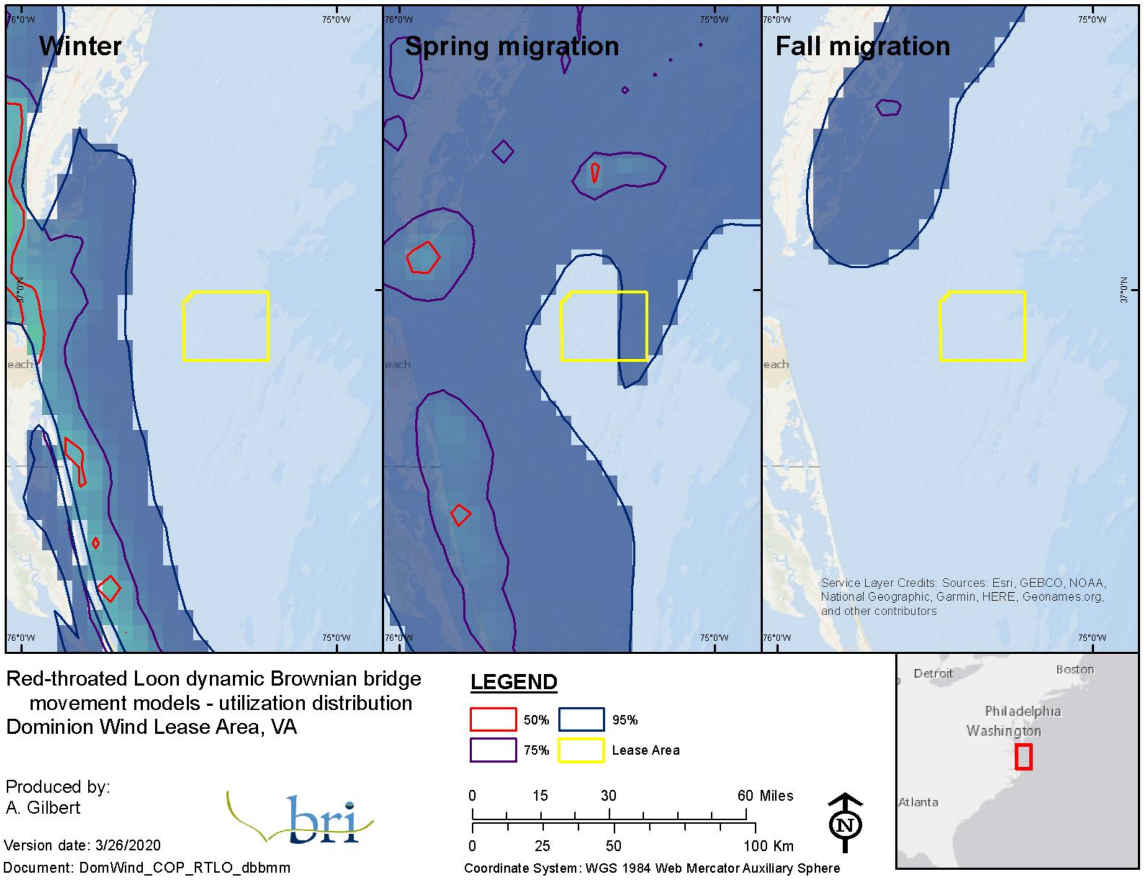


Figure 3-28. Dynamic Brownian bridge movement models for Red-throated Loons (n = 46, 46, 31 [winter, spring, fall]) that were tracked with satellite transmitters. Utilization contour levels (50%, 75%, 95%) were calculated for the mean utilization distribution (UD) surface; a probability density surface showing the relative use of an area by the population of animals in this study over the period of study. The contours represent the percentage of the use area across the UD surface and represent various levels of use from 50% (core use) to 95% (home range).

3.5.5.3 Relative Behavioral Vulnerability Assessment

Loons are consistently identified as being vulnerable to displacement (MMO 2018; Garthe and Hüppop 2004; Furness et al. 2013). Red-throated Loons have been documented to avoid offshore wind developments, which can lead to displacement (Dierschke et al. 2016). In addition to displacement caused by wind turbine arrays, Red-throated Loons have also been shown to be negatively affected by increased boat traffic associated with construction and maintenance (Mendel et al. 2019). This high vulnerability of displacement, coupled with extensive use of the Atlantic coast during migration and wintering increases the potential for cumulative habitat loss for loons (Goodale et al. 2019). However, there is some evidence that Red-throated Loons may return to wind farm areas after construction has been completed (APEM 2016). While data is lacking (because there are few Common Loons present at European wind farms), Common Loons are expected to have a similar avoidance response.

Based upon the above evidence, the risk to loons is primarily displacement from wind developments during construction and operation. From the literature, displacement vulnerability is considered to be high for loons during all stages because they are known to display a strong avoidance to offshore wind developments; the displacement score is ***high*** for both species (Table 3-24). There is little evidence in the literature that loons are vulnerable to collision, although they have the potential to fly through the lower portion of the RSZ (during the day loons fly 7.25–10.88% within the RSZ depending on species and turbine option) if they do not avoid the wind farm; thus, the loons received a ***low*** collision risk score (Figure 3-29). Based upon the literature, a lower range is added to collision vulnerability because loons have such a strong avoidance response.

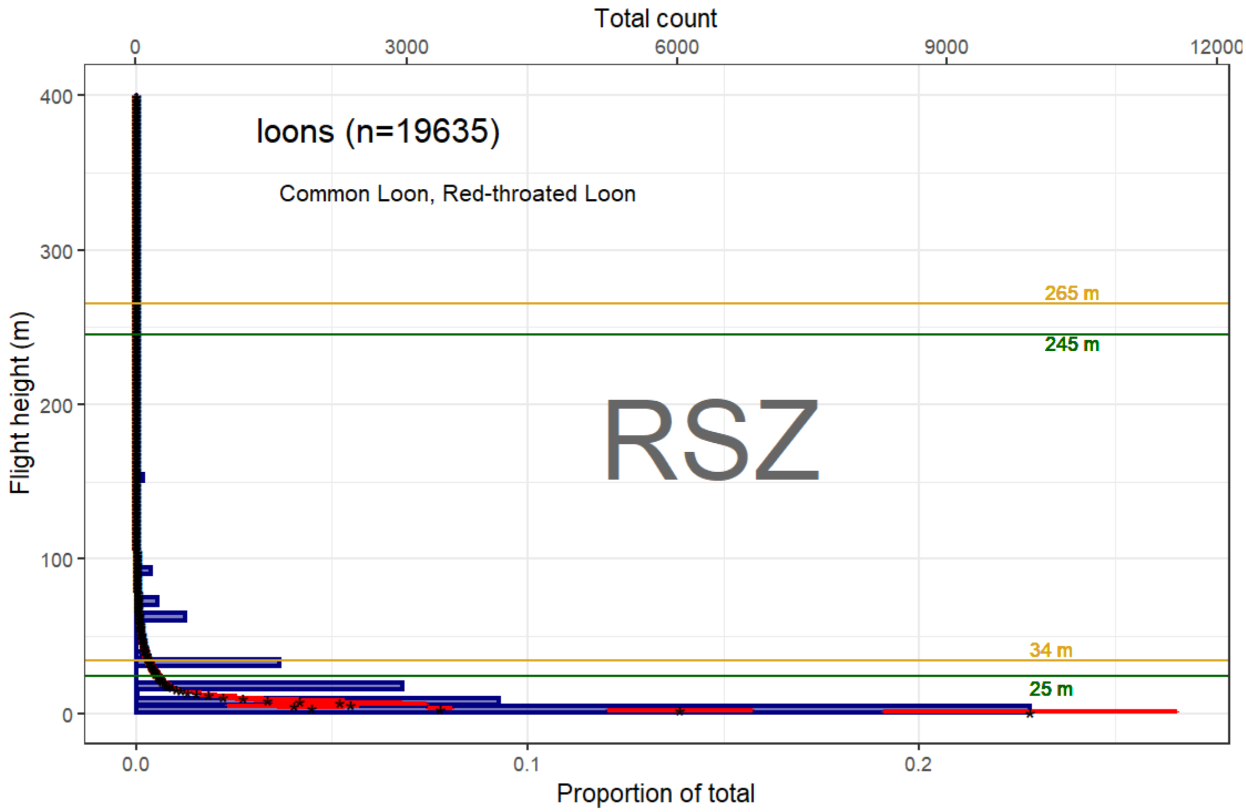


Figure 3-29. Flight heights of loons (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25-245 m) and maximum (gold 34-265 m) turbine options.

Table 3-24. Summary of loon vulnerability. Based upon the literature, collision vulnerability was adjusted to include a lower range limit (green).

Species	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Option 1	Option 2		
Red-throated Loon	minimal–low (0.47)	minimal–low (0.47)	high (0.9)	medium (0.53)
Common Loon	minimal–low (0.33)	minimal–low (0.33)	high (0.8)	medium (0.53)

3.5.5.4 Risk Analysis

This analysis suggests that the risk of potential impacts to loon populations is ***minimal*** to ***low,*** because, overall, these birds are considered to have low exposure, both spatially and temporally, but a high vulnerability to displacement due to strong avoidance. However, there is uncertainty about how displacement will affect individual fitness (e.g. changes in energy expenditure due to avoidance) and effective methodologies for assessing population-level displacement effects are lacking (Mendel et al. 2019). In addition, there is uncertainty about how displacement from the wind farm would reduce foraging opportunities because birds may move to foraging areas adjacent to the wind farm. Overall, habitat loss due to displacement as a result of a single project is unlikely to impact population trends (Fox and Petersen 2019), because of the relatively small size of the Lease Area in relation to available foraging habitat. Loons have the potential to fly through the lower portion of the RSZ, but their strong avoidance behavior most likely significantly reduces their collision vulnerability. Since loons have a medium population vulnerability score, the final risk score was not adjusted.

3.5.6 Petrels, Shearwaters, and Storm-Petrels

3.5.6.1 Spatiotemporal Context

Few species in the petrels, shearwaters, and storm-petrels group breed in the northern hemisphere; these include the Northern Fulmar (*Fulmarus glacialis*), which has a largely Arctic and subarctic breeding range, the Leach's Storm-Petrel (*Oceanodroma leucorhoa*), which breeds largely in Atlantic Canada and as far south as the Gulf of Maine, and a handful of Manx Shearwaters (*Puffinus puffinus*), that breed in Newfoundland, Canada. Of these, only the Northern Fulmar is likely to winter along the U.S. Atlantic OCS. A number of species in this group that breed in the southern hemisphere, however, visit the northern hemisphere during the austral winter (boreal summer) in vast numbers. These species use the U.S. Atlantic OCS region so heavily that, in terms of sheer numbers, they easily outnumber the locally breeding species and year-round residents at this time of year (Nisbet et al. 2013). Several of these species (e.g., Cory's Shearwater [*Calonectris diomedea*], Wilson's Storm-Petrel [*Oceanites oceanicus*]) are found in high densities across the broader region, concentrating beyond the outer continental shelf and in the Gulf of Maine, as indicated in the MDAT avian abundance models (Winship et al. 2018).

3.5.6.2 Exposure Assessment

Exposure was assessed using species accounts, DOE digital aerial survey data, and MDAT models. Overall, exposure is considered to be ***minimal*** to ***medium*** (Table 3-25). While some species in the petrel group are observed throughout the region during the summer months, they are typically found much farther offshore than the Lease Area. (see maps in Part V).

Table 3-25. Seasonal exposure rankings for the petrels and shearwaters, and the storm-petrels.

Season	Local Rank	Regional Rank	Total Rank	Exposure Score
Petrels and Shearwaters				
Winter	0	0	0	minimal
Spring	0	.	0	minimal
Summer	0	0	0	minimal
Fall	0	0	0	minimal
Storm-Petrels				
Winter	0	·	0	minimal
Spring	2	0	2	low
Summer	3	0	3	medium
Fall	3	0	3	medium

3.5.6.3 Relative Behavioral Vulnerability Assessment

Petrels, shearwaters, and storm-petrels rank at the bottom of displacement vulnerability assessments (Furness et al. 2013), and the flight height data indicates the birds have limited exposure to the RSZ (birds flew $\leq$ 0.01% of the time within the RSZ; Figure 3-30). Species within this group forage at night on bioluminescent aquatic prey and are instinctively attracted to artificial light sources (Imber 1975, Montevecchi 2006). This may be particularly true during periods of poor visibility, when collision risk is likely to be highest. There is little data, however, on avian behavior in the marine environment during such periods, as surveys are limited to good weather during daylight hours. Existing studies indicate that light-induced mass mortality events are primarily a land-based issue that involves juvenile birds, specifically fledging birds leaving their colonies at night (Le Corre et al. 2002; Rodríguez et al. 2014; Rodríguez et al. 2015; Rodríguez et al. 2017). Response to intermittent LED lights, which are the type likely to be used at offshore wind farms, is largely unknown. However, population-level effects related to this type of lighting are not expected. The collision vulnerability score is ***low*** for this group (Table 3-26). Displacement has not been well studied for this taxonomic group, but Furness et al. (2013) ranked species in this group as having the lowest displacement rank. A study at Egmond aan Zee, Netherlands, found that 50% (*n*=10) of tube-nosed (or petrel) species passed through the wind farm, which results in the birds receiving a displacement vulnerability score of 5 and thus a ***medium*** vulnerability (Table 3-26). Wade et al. (2016) described uncertainty on displacement vulnerability for these species as "very high". Based on the evidence in the literature, and identified uncertainty, a lower range has been added.

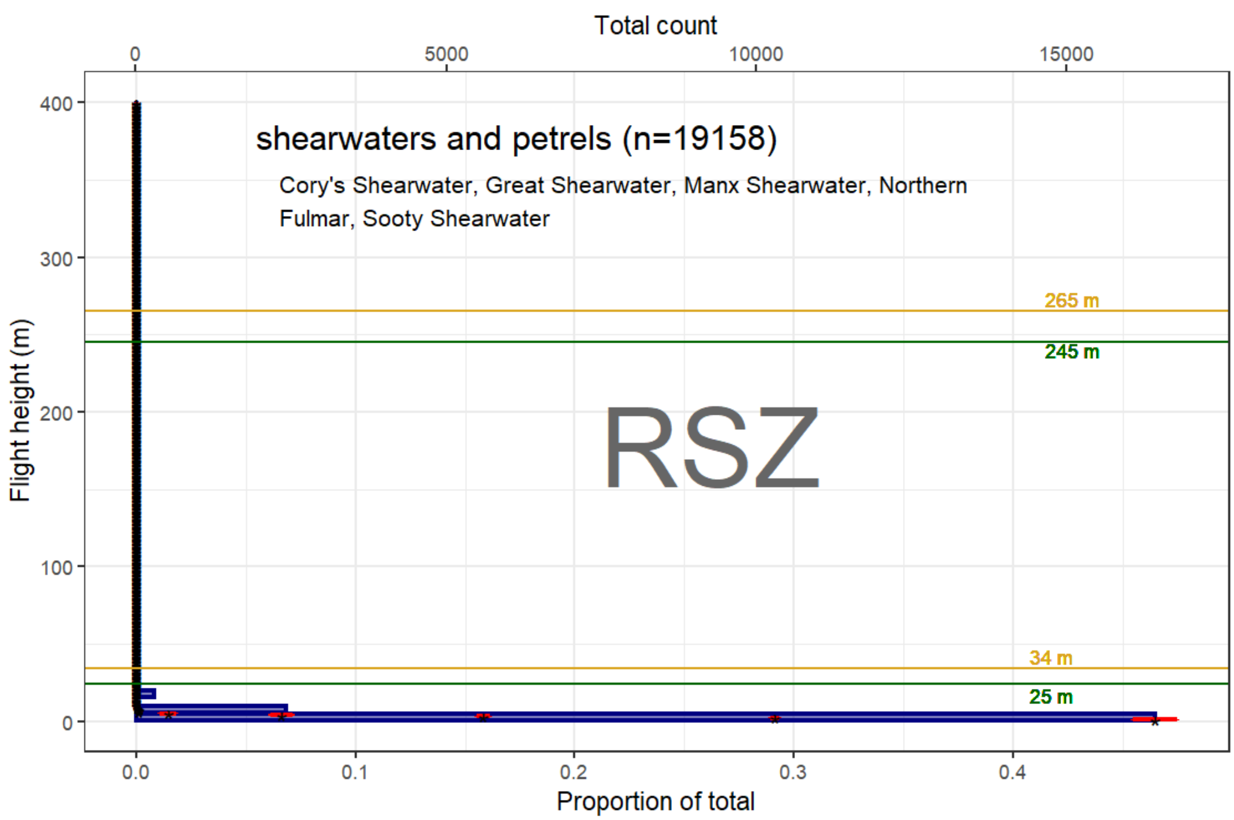


Figure 3-30. Flight heights of shearwaters, petrels, and storm-petrels (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25-245 m) and maximum (gold 34-265 m) turbine options.

Table 3-26. Summary of petrel, shearwater, and storm-petrel vulnerability.

Species	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Option 1	Option 2		
Northern Fulmar	low (0.43)	low (0.43)	low–medium (0.6)	low (0.47)
Cory's Shearwater	low (0.4)	low (0.4)	low–medium (0.6)	medium (0.67)
Sooty Shearwater	low (0.3)	low (0.3)	low–medium (0.6)	medium (0.53)
Great Shearwater	low (0.37)	low (0.37)	low–medium (0.6)	medium (0.67)
Manx Shearwater	low (0.37)	low (0.37)	low–medium (0.6)	medium (0.53)
Wilson's Storm-Petrel	low (0.43)	low (0.43)	low–medium (0.6)	low (0.4)

3.5.6.4 Risk Analysis

This analysis suggests that the potential population level impacts to the petrel group is ***minimal*** to ***medium*** because, overall, these birds have minimal to medium spatial exposure. Since the petrel group had a low to medium population vulnerability score, the final risk score was not adjusted. Due to the listing status of Black-capped Petrel, this species is individually assessed in Section 3.10.4 Candidate Petrel Species.

3.5.6.5 Candidate Petrel Species

3.5.6.5.1 Black-capped Petrel

The Black-capped Petrel (*Pterodroma hasitata*) is a pelagic seabird that breeds in small colonies on remote forested mountainsides of Caribbean islands, although breeding is now thought to be mostly restricted to the islands of Hispaniola (Haiti and the Dominican Republic) and possibly Cuba (Simons et al. 2013). During their breeding season (January–June), Black-capped Petrels travel long distances to forage over the deeper waters (656–6,561 ft; 200–2,000 m) of the southwestern North Atlantic, the Caribbean basin, and the southern Gulf of Mexico (Simons et al. 2013). Outside the breeding season, they regularly spend time in U.S. waters, along the shelf edge of the South Atlantic Bight, commonly as far north as Cape Hatteras and occasionally beyond (Jodice et al. 2015).

The small, declining global population is likely less than 2,000 breeding pairs, and has been listed as *Endangered* on the IUCN Red List since 1994 (BirdLife International 2018). It is currently proposed for Federal listing as *Threatened* in the U.S. (U.S. Fish and Wildlife Service 2018a), due to its heavy use of the Gulf Stream within U.S. waters (U.S. Fish and Wildlife Service 2018b). The Black-capped Petrel was pushed to the edge of extinction in the late 1800s due to hunting and harvest for food (Simons et al. 2013). Predation of adults and eggs by invasive mammals, and breeding habitat loss and degradation remain major threats to their existence; in addition, the effects of climate change on the biology of the species and its prey are largely unknown (Goetz et al. 2012). An increase in the frequency and intensity of hurricanes is expected to drastically increase mortality in breeding Black-capped Petrels (Hass et al. 2012). Given the small size of the breeding population, the species' resiliency (the ability to withstand normal environmental variation and stochastic disturbances over time) is considered to be low (U.S. Fish and Wildlife Service 2018a).

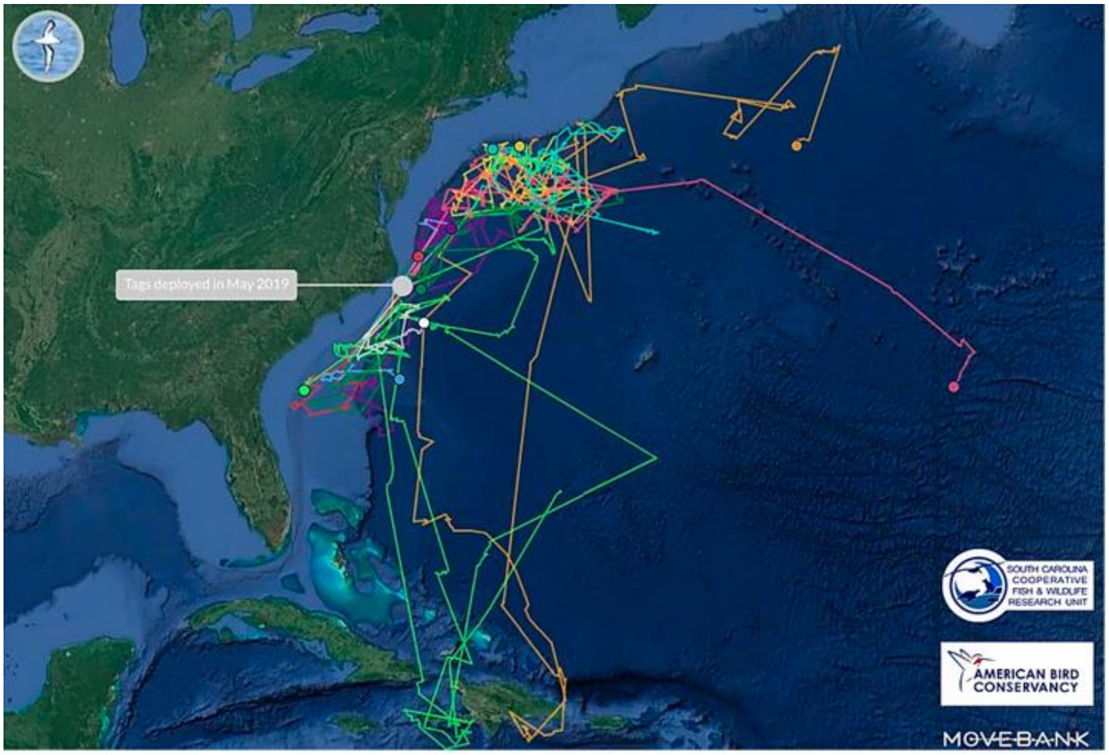


Figure 3-31. Track lines of Black-capped Petrels tagged with satellite transmitters (Atlantic Seabirds 2019).

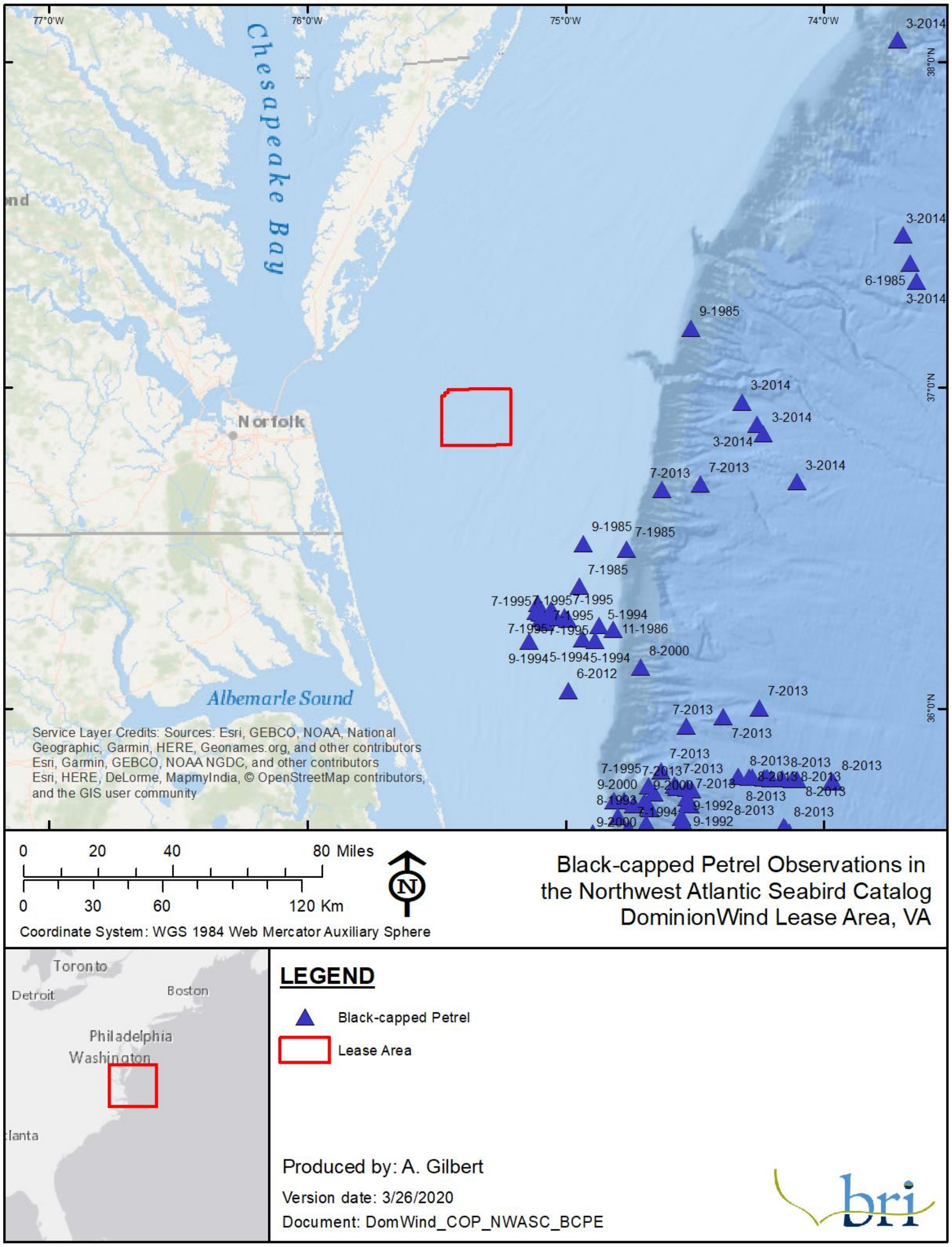


Figure 3-32. Black-capped Petrel observations in the Northwest Atlantic Seabird Catalog in the vicinity of the Dominion Wind Lease Area. The distribution clearly indicates this species' association with the shelf edge and deeper off-shelf waters.

3.5.6.5.2 Exposure Assessment

The Black-capped Petrel is extremely uncommon in areas not directly influenced by the warmer waters of the Gulf Stream (Haney 1987), and thought to be found in coastal waters of the U.S. only as a result of tropical storms (Lee 2000). The Northwest Atlantic Seabird Catalog contains ~5,000 individual observations of Black-capped Petrels at sea (1979–2006; O'Connell et al. 2009, Simons et al. 2013), none of which are found in shelf waters north of Virginia. Recent satellite tracking of a few birds, however, confirms that these birds primarily use areas beyond the shelf break (Figure 3-31), but suggests possibly greater use of shelf waters than previously known, especially in the South Atlantic Bight (Jodice et al. 2015). The closest sightings are far to the southeast (Figure 3-26). While there is a potential for the birds to pass through the Lease Area, although likely in very small numbers, exposure is considered to be ***minimal***.

3.5.6.5.3 Relative Behavioral Vulnerability Assessment

Like most petrels, this species is attracted to lights, and is known to collide with lighted telecommunication towers on breeding islands (Goetz et al. 2012). This behavior could make Black-capped Petrels vulnerable to collision with lighted offshore vessels and structures. Despite some concern about the potential effects of wind farms on Black-capped Petrels at sea, the highly pelagic nature of this species and its near absence from continental shelf waters of the southeastern U.S., led Simons et al. (2013) to conclude it unlikely that wind farms will be detrimental to this species. Because of a lack of data, a vulnerability score was not developed for this species, and the vulnerability range for the other petrel species is used as a proxy.

3.5.6.5.4 Risk Analysis

This analysis suggests that the potential impacts to the Black-capped Petrel is ***minimal*** because, overall, these birds have minimal spatial and temporal exposure. A population vulnerability assessment was not conducted because the species were not documented in or in the vicinity of the Lease Area.

3.5.7 Gannets, Cormorants, and Pelicans

Like the shorebirds, wading birds, and coastal waterbirds, pelicans are coastal breeders and foragers and generally confine their movements to shallow coastal waters. Although a few Brown Pelicans (*Pelecanus occidentalis*) were recorded in the DOE digital aerial surveys, none were recorded in the Lease Area, thus, exposure to construction and operation is considered to be ***minimal*** and a vulnerability and risk assessment was not conducted.

Northern Gannets and cormorants are addressed separately below, due to their specific behaviors and potential vulnerabilities highlighted in European studies.

3.5.7.1 Gannets

3.5.7.1.1 Spatiotemporal Context

The Northern Gannet (*Morus bassanus*) uses the U.S. Atlantic OCS during winter and migration. They breed in southeastern Canada and winter along coasts of the mid-Atlantic region and the Gulf of Mexico. Based on analysis of satellite-tracked Northern Gannets captured and tagged in the mid-Atlantic region, these birds show a preference for shallow, productive waters and are mostly found inshore of the mid-Atlantic WEAs in winter (Stenhouse et al. 2017). Northern Gannets are opportunistic foragers, capable of long-distance oceanic movements, and generally migrate on a broad front, all of which may increase their exposure to offshore wind facilities in some seasons, compared with species that are truly restricted to inshore habitats (Stenhouse et al. 2017).

3.5.7.1.2 Exposure Assessment

Exposure was assessed using species accounts, tracking data, DOE digital aerial survey data, and MDAT models. Overall, exposure is considered to be ***low*** for Northern Gannets. Although the mean density within the Lease Area was higher than the entire DOE digital aerial survey area (Table 3-12) and individual tracking data indicates that the Lease Area overlaps with Northern Gannet use of the U.S. Atlantic OCS in winter, as well as in the fall and spring migrations (Figure 3-33), the annual exposure score is low (Table 3-27). Relative exposure during the summer and fall is minimal. A persistence analysis conducted on Northern Gannet tracked with satellite transmitters also showed use of the Lease Area during the fall and winter (Stenhouse et al. 2020).

Table 3-27. Seasonal exposure rankings for Northern Gannets.

Season	Local Rank	Regional Rank	Total Rank	Exposure Score
Winter	1	0	1	low
Spring	2	2	4	medium
Summer	0	0	0	minimal
Fall	0	0	0	minimal

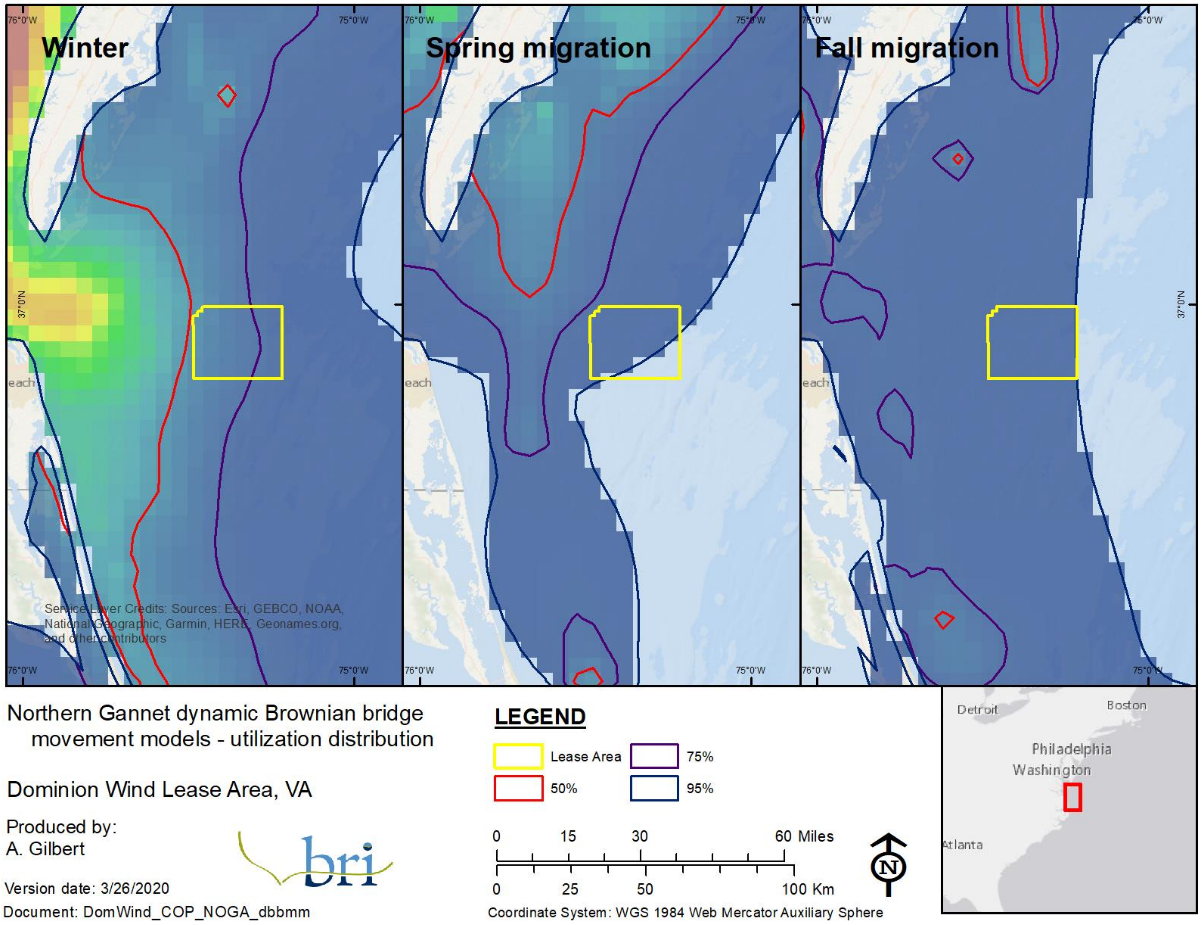


Figure 3-33. Dynamic Brownian bridge movement models for Northern Gannets (n = 34, 35, 36 [winter, spring, fall]) that were tracked with satellite transmitters. Utilization contour levels (50%, 75%, 95%) were calculated for the mean utilization distribution (UD) surface; a probability density surface showing the relative use of an area by the population of animals in this study over the period of study. The contours represent the percentage of the use area across the UD surface and represent various levels of use from 50% (core use) to 95% (home range).

3.5.7.1.3 Relative Behavioral Vulnerability Assessment

The Northern Gannet is identified as being vulnerable to both displacement and collision. They are considered to be vulnerable to displacement from habitat because studies indicate Northern Gannets avoid offshore wind developments (Krijgsveld et al. 2011, Cook et al. 2012, Hartman et al. 2012, Vanermen et al. 2015, Dierschke et al. 2016, Garthe et al. 2017). Satellite tracking studies indicate near complete avoidance of active wind developments (Garthe et al. 2017) and avoidance rates are estimated to be 64–84% (macro) and a 99.1% (total) rate (Krijgsveld et al. 2011; Vanermen et al. 2015; Skov et al. 2018; Cook et al. 2012). However, there is little information suggesting avoidance behavior leads to permanent displacement. Since Northern Gannets feed on highly mobile surface-fish and follow their prey throughout the OCS (Mowbray 2002), avoidance of the Lease Area is unlikely to lead to habitat loss. Within a wind development, however, Northern Gannets may be vulnerable to collision because they have the potential to fly within the RSZ (Garthe et al. 2014; Cleasby et al. 2015; Furness et al. 2013). When they enter an offshore wind development, Northern Gannets fly in the RSZ 9.6% of the time (Cook et al. 2012) and models indicate that the proportion of birds at risk height is 0.07 (Johnston et al. 2014b).

Flight height data from the Northwest Atlantic Seabird Catalog shows that during the day these birds fly within the RSZ 1.61–2.51% of the time depending upon the turbine option (Figure 3-34).

Based upon the above evidence, the risk of offshore developments to Northern Gannets is collision and displacement. The vulnerability of Northern Gannet to collision is considered to be ***low*** during construction and operation. Recent studies indicate strong avoidance behavior (Garthe et al. 2017), which will likely reduce collision risk. Vulnerability to displacement is considered ***medium*** because Northern Gannets are known to avoid offshore wind developments (Table 3-28).

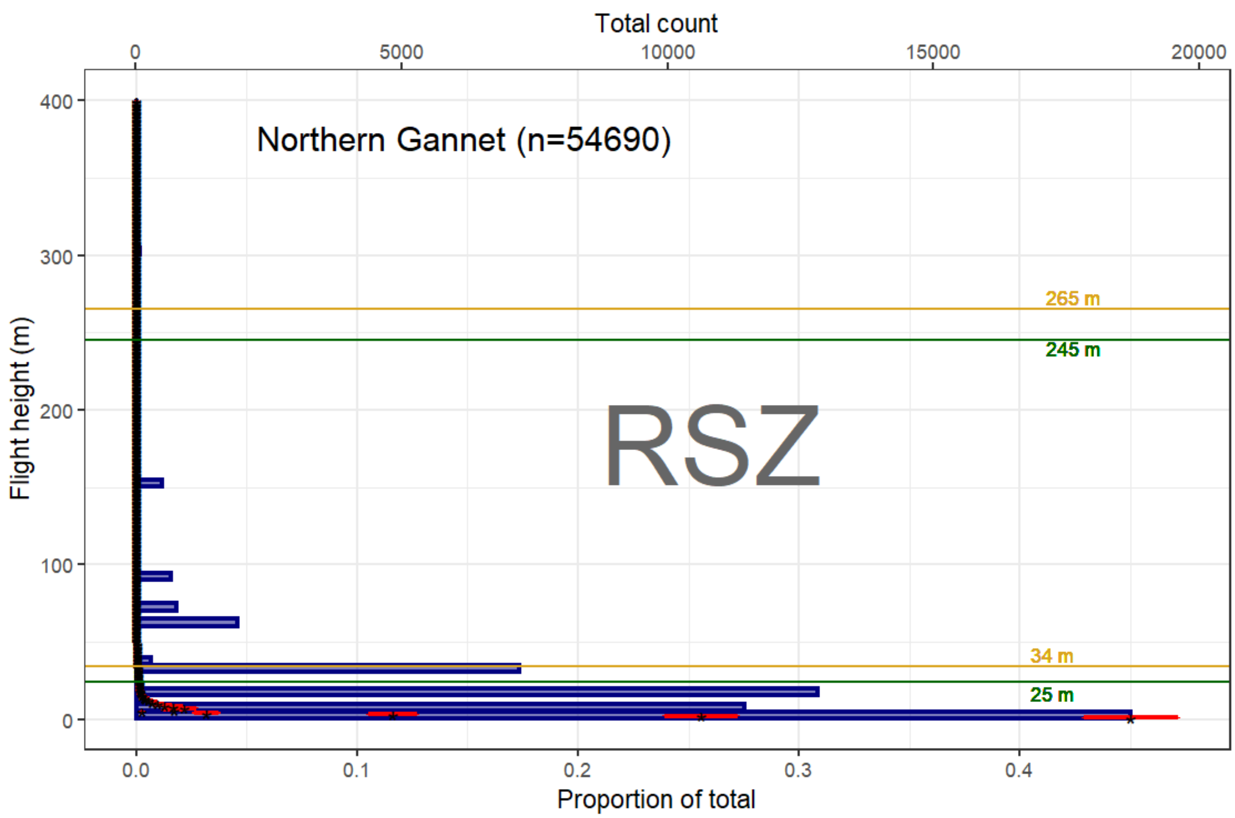


Figure 3-34. Flight heights of Northern Gannet (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25-245 m) and maximum (gold 34-265 m) turbine options.

Table 3-28. Summary of gannet vulnerability.

Species	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Option 1	Option 2		
Northern Gannet	low (0.3)	low (0.3)	medium (0.6)	medium (0.6)

3.5.7.1.4 Risk Analysis

This analysis suggests that the potential impacts to the Northern Gannet population is ***low*** because, overall, these birds have low to medium exposure, both spatially and temporally, and low to medium vulnerability. However, there is uncertainty about how displacement will affect individual fitness (e.g., will it increase energy expenditure due to avoidance). In addition, while there is uncertainty about how displacement from the wind farm could reduce foraging opportunities, birds may move to foraging areas adjacent to the wind farm and displacement from individual wind farms is unlikely to affect populations (Fox and Petersen 2019). Since the Northern Gannet has a medium population vulnerability score, the final risk score was not adjusted.

3.5.7.2 Cormorants

3.5.7.2.1 Spatiotemporal Context

The Double-crested Cormorant (*Phalacrocorax auritus*) is the most likely species of cormorant to be exposed to the Lease Area. While Great Cormorants (*P. carbo*) could possibly pass through the Lease Area during the non-breeding season, they are likely to remain in coastal waters (Hatch et al. 2020); no Great Cormorants were identified during the DOE digital aerial surveys. Double-crested Cormorants tend to forage and roost close to shore. The regional MDAT abundance models show that cormorants are concentrated close to shore and are not commonly encountered offshore. This aligns with the literature, which indicates these birds rarely use the offshore environment (Dorr et al. 2020).

3.5.7.2.2 Exposure Assessment

Exposure was assessed using species accounts, DOE digital aerial survey data, and MDAT models. Exposure is considered to be ***minimal*** for cormorants because the exposure score is minimal to low, and no cormorants were observed within the Lease Area during the DOE digital aerial surveys (Table 3-12).

Table 3-29. Seasonal exposure rankings for the cormorant group.

Season	Local Rank	Regional Rank	Total Rank	Exposure Score
Winter	0	1	1	low
Spring	0	0	0	minimal
Summer	0	·	0	minimal
Fall	0	0	0	minimal

3.5.7.2.3 Relative Behavioral Vulnerability Assessment

Cormorants have been documented to be attracted to wind turbines (Krijgsveld et al. 2011, Lindeboom et al. 2011), may fly through the RSZ (Figure 3-35), rank in the middle of collision vulnerability assessments (Furness et al. 2013), and received a ***medium*** collision vulnerability score (Table 3-30). Based on the evidence, the risk to cormorants is from collision; there is no evidence to suggest they will be displaced by offshore wind farms and cormorants received a ***low*** displacement vulnerability score (Table 3-28).

Table 3-30. Summary of cormorant vulnerability

Species	Collision Vulnerability		Displacement Vulnerability	Population Vulnerability
	Option 1	Option 2		
Double-crested Cormorant	medium (0.73)	medium (0.73)	low (0.4)	minimal (0.13)

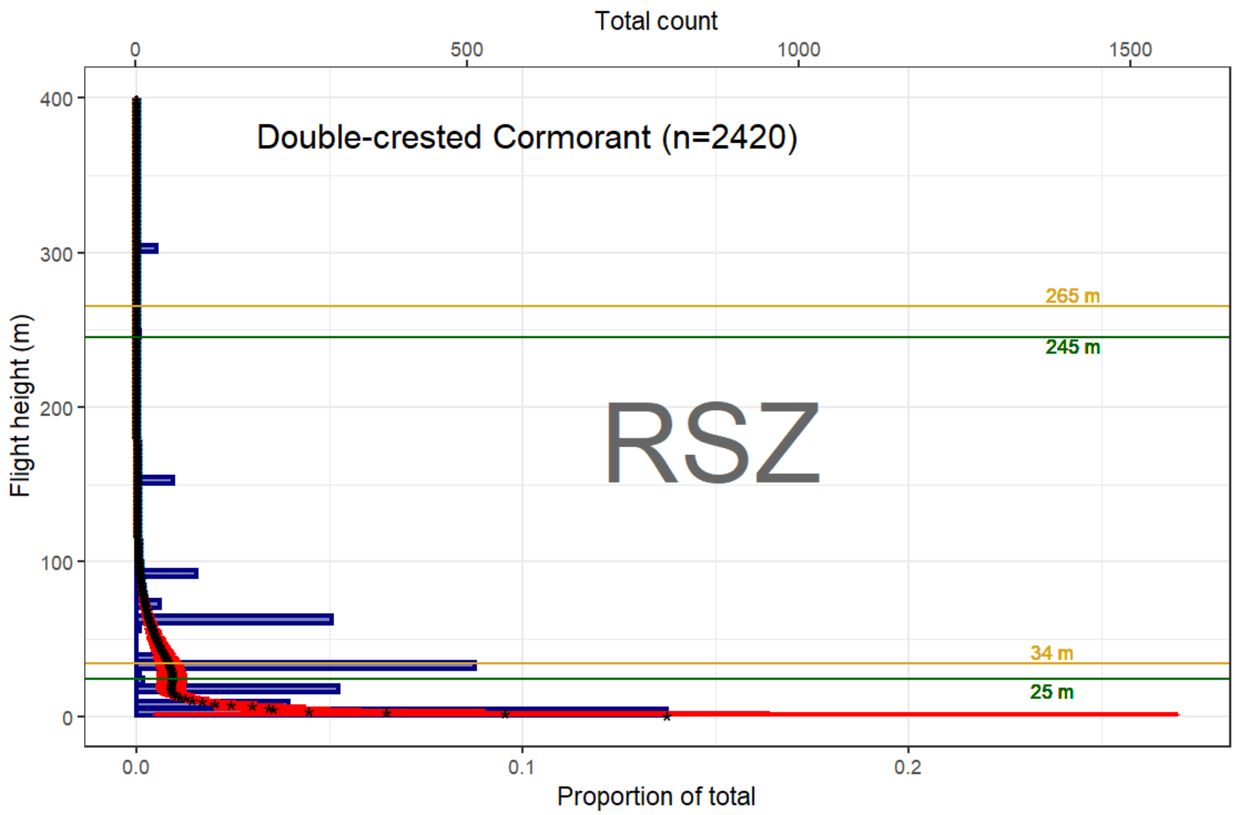


Figure 3-35. Flight heights of Double-crested Cormorant (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for minimum (green: 25-245 m) and maximum (gold 34-265 m) turbine options.

3.5.7.2.4 Risk Analysis

This analysis suggests that the potential impacts to cormorant is ***minimal*** because these birds have minimal exposure, both spatially and temporally. Double-crested Cormorant also had a minimal population vulnerability score, but the final risk score could not be adjusted down because the birds already were in the lowest risk category.

3.6 Mitigation and Monitoring

Exposure of bird populations to wind turbine generators has been avoided by siting the Project's wind turbines offshore, in a wind energy area designated by BOEM following environmental analysis. The Project will take the following mitigation and monitoring measures:

- Comply with Federal Aviation Administration (FAA) and United States Coast Guard (USCG) requirements for lighting while, to the extent practicable, use lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian species.
- Reduce perching opportunities on offshore structures to the extent practicable.

- Develop a robust post-construction monitoring plan with clear goals, monitoring questions, and methods designed to have the statistical power to answer the monitoring questions including research that focuses on areas of uncertainty such as bird flight height and avoidance rates.
- Install automated radio telemetry receiver station (e.g., Motus towers) on select offshore structures.
- Document any dead or injured birds found on Project vessels or structures during construction, operation, or decommissioning via the USFWS online Injury and Mortality Reporting (IMRs) database (any birds found with federal bands will be reported to the USGS Bird Band Laboratory).

3.7 Summary and Conclusions

This offshore avian assessment considered the potential impacts on birds during construction and operation within the Lease Area. Overall, construction, operation, and decommissioning activities occurring in the Lease Area are unlikely to affect the populations of coastal or marine birds because, with the exception of storm-petrels, exposure for most species is minimal to low (Table 3-31). The Lease Area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species and avoids marine bird concentration areas. Federally listed species (Golden Eagle, Bald Eagle, Red Knot, Piping Plover, and Roseate Tern, as well as the Black-capped Petrel, a candidate species) are expected to have minimal to low exposure, and thus risks to individuals are unlikely.

Table 3-31. Overall summary of the assessment of potential effects on birds. Categories that are adjusted up due to high population vulnerability (general measure of how sensitive the population is to mortality or habitat loss, methods detailed on p. 52) are highlighted in orange.

Group	Exposure	Relative Vulnerability to					Collision Risk	Displacement Risk
		Collision to Option		Displacement		Population		
		1 (min)	2 (max)	Temporary	Permanent			
Coastal Waterbirds	min	.	.	.	.	.	.	.
Shorebirds	min	.	.	.	.	.	.	.
Piping Plover	low	min–low	min–low	min	min	med	min–low	min
Red Knot	min–low	low	low	min	min	med	min–low	min
Wading Birds	min–low	low	low	min	min	.	min–low	min
Raptors (falcons)[1]	low	low–med	low–med	min–low	min–low	.	low	min–low
Eagles	min	min	min	min	min	.	min	min
Songbirds	min–low	low–med	low–med	min	min	.	min–low	min
Marine Birds								
Sea Ducks[2]	min	low	low	high	med	low–med	min	min
Auks	min	min–low	min–low	med–high	med–high	low–med	min	min
Gulls, Jaegers & Skuas	min–low	low–med	low–med	low–med	low–med	min–med	min–low	min–low
Terns (excluding Roseate Tern)	min	low–med	low–med	low–high	low–high	med	min	min
Roseate Tern	min	low	low	med–high	med–high	high	low	low
Loons	low	min–low	min–low	high	high	med	min–low	low
Shearwaters, Petrels & Storm-Petrels	min–med	low	low	low–med	low–med	med	min–low	min–med
Black-capped Petrel	min	low	low	low–med	low–med	.	min	min
Gannets, Cormorants, Pelicans								
Northern Gannet	low	low	low	med	med	med	low	low
Double-crested Cormorant	min	med	med	low	low	min	min	min

[1]Almost exclusively Peregrine Falcon and Merlin. Non-falcon raptors have limited use of the offshore environment.
[2]Excluding Red-breasted Merganser

Table 3-32. Detailed seasonal species densities (counts/km2 of survey transect) within the Dominion Lease Area and the DOE Mid-Atlantic digital aerial survey area within the Atlantic OCS. These data are only for marine birds and are supplemental to Table 3-15 (Part III: Birds - Offshore).

Species	Mean density (total count/sq. km)										Total count
	Lease Area					DOE Mid-Atlantic aerial survey area					
	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	
Dabblers, Geese, and Swans											
Brant	0	0	0	0	0	<0.001	0.002	0	0	0	3
Unidentified Duck	0	0	0	0	0	0.021	0.003	0	0	0	76
Unidentified Goose	0	0	0	0	0	<0.001	<0.001	0	0	0	1
Sea ducks											
Surf Scoter	0	0	0	0	0	0.119	0.157	0.303	0	0	795
White-winged Scoter	0	0	0	0	0	0.001	0.007	<0.001	0	0	16
Black Scoter	0	0	0	0	0	1.411	0.426	4.690	0	0.010	9156
Unidentified Scoter	0	0	0	0	0	0.986	3.157	1.394	0	<0.001	8876
Grebes											
Horned Grebe	0	0	0	0	0	<0.001	0	<0.001	0	0	1
Unidentified Grebe	<0.001	0.003	0	0	0	<0.001	<0.001	0	0	0	3
Shorebirds											
Unidentified Dowitcher spp.	0	0	0	0	0	<0.001	0	0	0.002	0	7
Phalaropes											
Unidentified Phalarope	0	0	0	0	0	0.002	0	0	0	0	6
Skuas and Jaegers											
Pomarine Jaeger	<0.001	0	0	0.003	0	0	0	0	<0.001	0	1
Parasitic Jaeger	0	0	0	0	0	<0.001	0	<0.001	0	0	2
Unidentified Jaeger	0	0	0	0	0	<0.001	0	<0.001	<0.001	0	3
Auks											
Dovekie	<0.001	0.003	0	0	0	<0.001	0.001	0	0	0	2
Razorbill	0	0	0	0	0	0.001	0.005	0	0	0	6
Atlantic Puffin	0.003	0.010	0	0	0	<0.001	0.001	0	0	0	7
Unidentified Alcid	0.015	0.054	0	0	0	0.032	0.120	0.002	0	0	240
Unidentified large alcid (Razorbill or Murre)	0.002	0.009	0	0	0	0.003	0.013	0	0	0	34
Unidentified small alcid (Puffin/Dovekie)	0.015	0.053	0	0	0	0.010	0.038	0.005	0	0	115
Small Gulls											
Sabine's Gull	0	0	0	0	0	<0.001	0	0	0	<0.001	1

Species	Mean density (total count/sq. km)										Total count
	Lease Area					DOE Mid-Atlantic aerial survey area					
	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	
Bonaparte's Gull	0.101	0.309	0.046	0	0	0.128	0.510	0.028	0	0	995
Unidentified Small Gull/Tern	0.074	0.228	0.027	0.009	0	0.117	0.299	0.113	0.006	0.010	931
Unidentified small gull	0.011	0.031	0.006	0	0	0.009	0.025	0.007	0.005	<0.001	83
Medium Gulls											
Laughing Gull	<0.001	0.002	0	0	0	0.007	<0.001	0.002	0.022	0.010	65
Ring-billed Gull	0	0	0	0	0	<0.001	0	<0.001	0	0	2
Unidentified medium gull	0.002	0	0.006	0	0	0.005	0.010	0.006	0.001	0.003	42
Large Gulls											
Herring Gull	0.001	0.004	0	0	0	0.008	0.008	0.009	0.002	0.016	77
Lesser Black-backed Gull	<0.001	0.003	0	0	0	<0.001	<0.001	<0.001	0.002	0.002	7
Great Black-backed Gull	0.012	0.038	0.005	0	0	0.018	0.028	0.009	0.002	0.041	191
Unidentified Large Gull	0.012	0.040	0.002	0	0	0.015	0.020	0.010	0.006	0.029	154
All Gulls											
Unidentified Gull	0.062	0.140	0.069	0	0.013	0.065	0.092	0.080	0.032	0.053	658
Small Terns											
Black Tern	0	0	0	0	0	0.002	0	0	0.009	0.003	21
Unidentified small Tern	0	0	0	0	0	0.002	0	<0.001	0.004	0.003	23
Medium Terns											
Common Tern	0	0	0	0	0	0	0	0	<0.001	0	1
Royal Tern	0	0	0	0	0	<0.001	0	<0.001	0	0	1
Unidentified medium tern	<0.001	0	0	0.003	0	0.007	0	0.019	0.004	0.005	99
Large Terns											
Caspian Tern	0	0	0	0	0	<0.001	0	0	<0.001	0.002	6
Unidentified large Tern	0.002	0	0.006	0	0	0.007	<0.001	0.018	0.002	0.006	63
All Terns											
Unidentified Tern	0.004	0.003	0	0.009	0.003	0.035	0.003	0.022	0.049	0.067	307
Loons											
Red-throated Loon	0.008	0.006	0.022	0	0	0.013	0.034	0.013	<0.001	0	97
Common Loon	0.086	0.098	0.203	0	0	0.046	0.102	0.071	0.002	<0.001	522

Species	Mean density (total count/sq. km)										Total count
	Lease Area					DOE Mid-Atlantic aerial survey area					
	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	
Unidentified Loon	0.406	1.025	0.407	0	0	0.456	1.317	0.459	0.003	0.001	4104
Storm-Petrels											
Wilson's Storm-Petrel	0.035	0	0.004	0.048	0.107	0.004	0	<0.001	0.020	0.011	78
Unidentified Storm-petrel	0.008	0.005	0	0.028	0	0.004	0.007	0	0.008	0.001	36
Shearwaters and Petrels											
Northern Fulmar	0	0	0	0	0	<0.001	0.001	0	<0.001	0	3
Cory's Shearwater	0	0	0	0	0	<0.001	0	0	0.002	0.002	11
Sooty Shearwater	0	0	0	0	0	<0.001	0	0	0.002	0	2
Great Shearwater	0.002	0	0	0.011	0	0.003	0.001	0	0.015	0	53
Manx Shearwater	<0.001	0.002	0	0	0	<0.001	0.001	0	0	0	2
Unidentified Shearwater	0	0	0	0	0	0.002	0.003	<0.001	0.005	0	16
Unidentified Petrel	0	0	0	0	0	<0.001	0.002	0	0	0	7
Unidentified Large Shearwater	0	0	0	0	0	<0.001	0	0	<0.001	0.003	5
Gannet											
Northern Gannet	1.126	3.131	0.825	0	0	0.667	2.251	0.395	<0.001	0.076	6756
Cormorants											
Double-crested Cormorant	0	0	0	0	0	0.001	0.001	0.002	0	0.002	9
Pelicans											
Brown Pelican	0	0	0	0	0	0.004	0	<0.001	0.018	0.001	23
Heron and Egrets											
American Bittern	0	0	0	0	0	<0.001	0	0	0	0.001	3
Great Blue Heron	0.003	0	0	0	0.015	<0.001	0	0	<0.001	0.004	12
Snowy Egret	0	0	0	0	0	<0.001	0	<0.001	0	0	2
Raptors											
Osprey	0	0	0	0	0	<0.001	<0.001	0	0.002	0.003	7
Passerines											
Common Nighthawk	0	0	0	0	0	<0.001	0	0	<0.001	0	1
Belted Kingfisher	0	0	0	0	0	<0.001	0	0	0	0	1
Barn Swallow	0	0	0	0	0	<0.001	0	0	0.001	0	1
Cedar Waxwing	0	0	0	0	0	0.001	0	0.004	0	0	6
Baltimore Oriole	0	0	0	0	0	0	0	0	0	<0.001	1

Species	Mean density (total count/sq. km)										Total count
	Lease Area					DOE Mid-Atlantic aerial survey area					
	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	
Unidentified Passerine (perching birds, songbirds)	0	0	0	0	0	<0.001	0	0	0	<0.001	3
Unidentified Swallow	0	0	0	0	0	<0.001	0	0	0	0.001	3
All Birds											
Unidentified Bird	0.463	1.240	0.318	0.045	0.054	0.854	2.521	0.613	0.102	0.145	7038

4 Part IV: Birds – Onshore

4.1 Birds likely to occupy existing habitat

Due to the mobility of birds, a variety of species have the potential to use the habitats within or adjacent to the Cable Landing Location, Onshore Export Cable Route, Switching Station Alternatives, Interconnection Cable Routes, and Onshore Substation throughout the year. At the Cable Landing Location, dunes and dune grass, scrub-shrub, artificial wetlands, and residential areas may support avian species, including the Double-crested Cormorant, Ring-billed Gull, Great-blue Heron, and Brown Pelican. Along the Onshore Export Cable and Interconnection Cable Routes, mixed forest, wetlands, agricultural areas, and residential areas may support avian species, including the American Crow, American Robin, European Starling, Northern Mockingbird, Northern Cardinal, Mourning Dove, and Blue Jay. The woods adjacent to Rifle Range Road would support a variety of species throughout the year, including the Northern Cardinal, Carolina Chickadee, Mourning Dove, and Blue Jay (Table 4-1).

The areas adjacent to or encompassing the Switching Station Alternatives may provide breeding, wintering, and migratory stopover habitat due to the mix of forest, field, and wetland habitat. The Onshore Substation parcel is largely characterized by a pre-existing substation and provides only a small amount of forested area. This site is unlikely to provide significant habitat for avian species. Below, Table 4-1 lists common birds identified in the eBird database within 20 km of the Onshore Project Components; and Table 4-2 lists the Species of Greatest Conservation Need and their habitat associations. At the end of the Onshore Bird section, Table 4-7 lists all birds identified in the eBird database within 20 km of the onshore stages.

Table 4-1. List of birds common in eBird database (75 quartile) within 20 km of the Project corridors with associated breeding habitat.

Common Name	Scientific Name	eBird Count (# days)	Primary Habitat	Detailed Breeding Habitat
Northern Cardinal	*Cardinalis cardinalis*	2,586	Terrestrial	Shrubland, Artificial/Terrestrial, Forest, Shrubland, Wetlands (inland)
Carolina Chickadee	*Poecile carolinensis*	2,485	Terrestrial	Forest, Artificial/Terrestrial, Forest, Shrubland, Wetlands (inland)
Carolina Wren	*Thryothorus ludovicianus*	2,451	Terrestrial	Artificial/Terrestrial, Forest
Great Blue Heron	*Ardea herodias*	2,418	Marine, Freshwater	Wetlands (inland), Forest, Marine Intertidal, Wetlands (inland)
American Crow	*Corvus brachyrhynchos*	2,415	Terrestrial	Artificial/Terrestrial, Forest, Grassland, Shrubland
Mourning Dove	*Zenaida macroura*	2,389	Terrestrial	Artificial/Terrestrial, Artificial/Terrestrial, Forest, Shrubland, Wetlands (inland)
Double-crested Cormorant	*Phalacrocorax auritus*	2,362	Terrestrial	Marine Neritic, Wetlands (inland)
American Robin	*Turdus migratorius*	2,349	Terrestrial	Forest, Artificial/Terrestrial, Forest, Shrubland
Northern Mockingbird	*Mimus polyglottos*	2,338	Terrestrial	Shrubland
European Starling	*Sturnus vulgaris*	2,260	Terrestrial	Artificial/Terrestrial, Forest, Grassland, Marine Intertidal, Shrubland
Canada Goose	*Branta canadensis*	2,220	Marine, Freshwater	Grassland, Wetlands (inland), Artificial/Aquatic & Marine, Artificial/Terrestrial, Grassland, Wetlands (inland)
Blue Jay	*Cyanocitta cristata*	2,219	Terrestrial	Forest, Artificial/Terrestrial, Forest

Common Name	Scientific Name	eBird Count (# days)	Primary Habitat	Detailed Breeding Habitat
Mallard	*Anas platyrhynchos*	2,196	Marine, Freshwater	Artificial/Aquatic & Marine, Wetlands (inland)
Ring-billed Gull	*Larus delawarensis*	2,157	Marine, Freshwater	Grassland, Wetlands (inland)
Red-winged Blackbird	*Agelaius phoeniceus*	2,092	Terrestrial, Freshwater	Wetlands (inland)
Great Egret	*Ardea alba*	2,061	Marine, Terrestrial, Freshwater	Grassland, Wetlands (inland), Artificial/Aquatic & Marine, Marine Intertidal
Tufted Titmouse	*Baeolophus bicolor*	2,041	Terrestrial	Forest, Artificial/Terrestrial, Shrubland
Turkey Vulture	*Cathartes aura*	2,017	Terrestrial	Artificial/Terrestrial, Desert, Forest, Grassland, Shrubland
House Finch	*Haemorhous mexicanus*	1,997	Terrestrial	Shrubland, Artificial/Terrestrial, Grassland
Song Sparrow	*Melospiza melodia*	1,980	Terrestrial	Marine Intertidal, Artificial/Terrestrial, Grassland, Shrubland, Wetlands (inland)
Red-bellied Woodpecker	*Melanerpes carolinus*	1,963	Terrestrial	Forest, Artificial/Terrestrial, Forest, Savanna, Wetlands (inland)
Common Grackle	*Quiscalus quiscula*	1,962	Terrestrial	Artificial/Terrestrial, Forest, Shrubland, Wetlands (inland)
Brown Pelican	*Pelecanus occidentalis*	1,918	Marine	Marine Intertidal, Marine Neritic, Marine Coastal/Supratidal, Marine Intertidal, Marine Oceanic
Fish Crow	*Corvus ossifragus*	1,917	Marine, Freshwater, Terrestrial	Grassland, Wetlands (inland), Marine Intertidal
Great Black-backed Gull	*Larus marinus*	1,879	Marine	Marine Coastal/Supratidal, Marine Coastal/Supratidal, Marine Intertidal, Marine Neritic
American Goldfinch	*Spinus tristis*	1,852	Terrestrial	Artificial/Terrestrial, Forest, Grassland, Shrubland
Downy Woodpecker	*Dryobates pubescens*	1,825	Terrestrial	Artificial/Terrestrial, Forest
Eastern Bluebird	*Sialia sialis*	1,810	Terrestrial	Forest, Artificial/Terrestrial, Forest, Shrubland, Wetlands (inland)
Osprey	*Pandion haliaetus*	1,796	Marine	Artificial/Aquatic & Marine, Forest, Marine Coastal/Supratidal, Marine Neritic, Wetlands (inland)
Herring Gull	*Larus argentatus*	1,785	Marine	Artificial/Aquatic & Marine, Artificial/Terrestrial, Marine Coastal/Supratidal, Marine Intertidal, Marine Neritic, Wetlands (inland)
Eastern Towhee	*Pipilo erythrophthalmus*	1,767	Terrestrial	Forest, Artificial/Terrestrial, Forest, Shrubland
Laughing Gull	*Leucophaeus atricilla*	1,759	Marine	Marine Coastal/Supratidal, Marine Intertidal, Marine Neritic
Brown Thrasher	*Toxostoma rufum*	1,711	Terrestrial	Shrubland, Forest
Bald Eagle	*Haliaeetus leucocephalus*	1,656	Marine, Freshwater, Terrestrial	Wetlands (inland), Artificial/Aquatic & Marine, Forest, Marine Intertidal, Marine Neritic, Wetlands (inland)
Pine Warbler	*Setophaga pinus*	1,608	Terrestrial	Forest
Yellow-rumped Warbler	*Setophaga coronata*	1,595	Terrestrial	Forest
Rock Pigeon	*Columba livia*	1,579	Terrestrial	Artificial/Terrestrial, Artificial/Terrestrial, Caves and Subterranean Habitats (non-aquatic), Rocky areas (eg. inland cliffs, mountain peaks)

Common Name	Scientific Name	eBird Count (# days)	Primary Habitat	Detailed Breeding Habitat
Boat-tailed Grackle	*Quiscalus major*	1,492	Terrestrial	Marine Coastal/Supratidal, Wetlands (inland)
Gray Catbird	*Dumetella carolinensis*	1,491	Terrestrial	Shrubland, Artificial/Terrestrial, Forest
Northern Flicker	*Colaptes auratus*	1,433	Terrestrial	Forest, Artificial/Terrestrial, Forest
Chipping Sparrow	*Spizella passerina*	1,360	Terrestrial	Artificial/Terrestrial, Forest, Grassland, Shrubland
Belted Kingfisher	*Megaceryle alcyon*	1,340	Marine, Freshwater	Wetlands (inland), Artificial/Terrestrial, Wetlands (inland)
Pileated Woodpecker	*Dryocopus pileatus*	1,315	Terrestrial	Forest, Artificial/Terrestrial, Wetlands (inland)
Tree Swallow	*Tachycineta bicolor*	1,314	Terrestrial, Freshwater	Wetlands (inland), Artificial/Terrestrial
Brown-headed Cowbird	*Molothrus ater*	1,307	Terrestrial	Forest, Grassland
Red-tailed Hawk	*Buteo jamaicensis*	1,269	Terrestrial	Artificial/Terrestrial, Desert, Forest, Grassland, Shrubland
White-breasted Nuthatch	*Sitta carolinensis*	1,266	Terrestrial	Forest, Artificial/Terrestrial, Forest
Brown-headed Nuthatch	*Sitta pusilla*	1,261	Terrestrial	Forest
Sanderling	*Calidris alba*	1,257	Marine	Grassland
Killdeer	*Charadrius vociferus*	1,239	Terrestrial	Wetlands (inland), Artificial/Terrestrial, Wetlands (inland)
White-throated Sparrow	*Zonotrichia albicollis*	1,238	Terrestrial	Forest, Shrubland
Royal Tern	*Thalasseus maximus*	1,229	Marine	Marine Intertidal, Marine Neritic
Pied-billed Grebe	*Podilymbus podiceps*	1,225	Freshwater	Wetlands (inland)
Lesser Black-backed Gull	*Larus fuscus*	1,222	Marine	Marine Coastal/Supratidal, Marine Intertidal, Artificial/Terrestrial, Grassland, Marine Neritic, Marine Oceanic, Wetlands (inland)
Black Vulture	*Coragyps atratus*	1,159	Terrestrial	Artificial/Terrestrial, Artificial/Terrestrial, Forest, Grassland, Shrubland
Cooper's Hawk	*Accipiter cooperii*	1,118	Terrestrial	Forest
Field Sparrow	*Spizella pusilla*	1,106	Terrestrial	Artificial/Terrestrial, Forest, Grassland, Shrubland
Wood Duck	*Aix sponsa*	1,085	Freshwater	Forest, Wetlands (inland), Wetlands (inland)
Forster's Tern	*Sterna forsteri*	1,044	Marine	Marine Neritic, Wetlands (inland)
Common Yellowthroat	*Geothlypis trichas*	1,040	Freshwater, Terrestrial	Wetlands (inland), Marine Intertidal, Shrubland
Common Loon	*Gavia immer*	985	Marine, Freshwater	Wetlands (inland)

Table 4-2. Bird Species of Greatest Conservation Need associated with each habitat type found in the Project Area. The Offshore Export Cable Landing Location is in the beaches, dunes, and mudflats habitat type; the Onshore Export Cable Route passes through all the habitats; and the substations are predominantly in urban/suburban built.

Common Name	Scientific Name	Agricultural Plantation Forest	Beaches, Dunes, and Mudflats	Cliff and Talus	Mixed Hardwood and Conifer	Non-tidal Wetlands	Open Habitat	Spruce-Fir Forest	Tidal Wetlands	Urban Suburban Built	Water
American Black Duck	*Anas rubripes*		x			x			x		x
American Oystercatcher	*Haematopus palliates*		x						x		
American Woodcock	*Scolopax minor*				x			x			
Bank Swallow	*Riparia riparia*		x	x		x	x		x		x
Barn Owl	*Tyto alba*	x			x		x				
Belted Kingfisher	*Megaceryle alcyon*					x			x		x
Bicknell's Thrush	*Catharus bicknelli*										
Black Skimmer	*Rhynchops niger*		x								
Black-and-white Warbler	*Mniotilta varia*										
Black-bellied Plover	*Pluvialis squatarola*		x						x		
Black-billed Cuckoo	*Coccyzus erythropthalmus*										
Black-crowned Night-heron	*Nycticorax nycticorax*					x			x		x
Brant	*Branta bernicla*		x						x		
Brown Thrasher	*Toxostoma rufum*				x		x				
Canada Warbler	*Cardellina Canadensis*										
Cerulean Warbler	*Setophaga cerulean*										
Chimney Swift	*Chaetura pelagica*									x	
Clapper Rail	*Rallus crepitans*								x		
Common Tern	*Sterna hirundo*		x								
Dunlin	*Calidris alpine*		x								
Eastern Kingbird	*Tyrannus tyrannus*	x			x		x				
Eastern Meadowlark	*Sturnella magna*	x					x		x		
Eastern Towhee	*Pipilo erythropthalmus*				x		x				
Eastern Whip-poor-will	*Anstrostomus vociferous*				x		x	x			
Eastern Wood-pewee	*Contopus virens*				x						
Field Sparrow	*Spizella pusilla*	x			x		x				
Forster's Tern	*Sterna forsteri*		x						x		
Glossy Ibis	*Plegadis falcinellus*					x			x		
Golden Eagle	*Aquila chrysaetos*			x			x				
Golden-winged Warbler	*Vermivora chrysoptera*	x					x				
Grasshopper Sparrow	*Ammodramus savannarum*						x				
Gray Catbird	*Dumetella carolinensis*				x		x				
Greater Scaup	*Aythya marila*										x

Common Name	Scientific Name	Agricultural Plantation Forest	Beaches, Dunes, and Mudflats	Cliff and Talus	Mixed Hardwood and Conifer	Non-tidal Wetlands	Open Habitat	Spruce-Fir Forest	Tidal Wetlands	Urban Suburban Built	Water
Green Heron	*Butorides virescens*					x					
Gull-billed Tern	*Gelochelidon nilotica*		x						x		
Kentucky Warbler	*Geothlypis Formosa*				x	x					
King Rail	*Rallus elegans*					x			x		
Laughing Gull	*Leucophaeus atricilla*		x								
Least Bittern	*Ixobrychus exilis*					x					
Least Tern	*Sternula antillarum*		x								
Little Blue Heron	*Egretta caerulea*					x			x		
Loggerhead Shrike	*Lanius ludovicianus*	x					x				
Marbled Godwit	*Limosa fedoa*		x						x		
Marsh Wren	*Cistothorus palustris*					x					
Nelson's Sparrow	*Ammospiza nelsoni*								x		
Northern Bobwhite	*Colinus virginianus*	x			x		x				
Northern Flicker	*Colaptes auratus*				x		x				
Northern Gannet	*Morus bassanus*										x
Northern Pintail	*Anas acuta*	x				x	x				x
Northern-Rough Winged Swallow	*Stelgidopteryx serripennis*			x		x	x		x		
Northern Saw-whet Owl	*Aegolius acadicus*				x			x			
Peregrine Falcon	*Falco peregrinus*			x						x	
Piping Plover	*Charadrius melodus*		x								
Purple Sandpiper	*Calidris maritima*		x								
Red Crossbill	*Loxia curvirostra*				x			x			
Red Knot	*Calidris canutus*		x								
Red-cockaded Woodpecker	*Dryobates borealis*				x						
Red-throated Loon	*Gavia stellate*										x
Royal Tern	*Thalassesus maximus*		x								
Ruffed Grouse	*Bonasa umbellus*				x			x			
Rusty Blackbird	*Euphagus carolinus*				x	x					
Saltmarsh Sparrow	*Ammospiza caudacuta*		x						x		
Sanderling	*Calidris alba*		x								
Seaside Sparrow	*Ammospiza maritima*								x		
Short-billed Dowitcher	*Limnodromus griseus*		x						x		
Snowy Egret	*Egretta thula*					x			x		
Swainson's Warbler	*Limnothlypis swainsonii*				x						
Virginia Rail	*Rallus limicola*					x			x		

Common Name	Scientific Name	Agricultural Plantation Forest	Beaches, Dunes, and Mudflats	Cliff and Talus	Mixed Hardwood and Conifer	Non-tidal Wetlands	Open Habitat	Spruce-Fir Forest	Tidal Wetlands	Urban Suburban Built	Water
Wayne's Black-throated Green Warbler	*Setophaga virens*				x						
Whimbrel	*Numenius phaeopus*								x		
Willet	*Tringa semipalmata*		x						x		
Wilson's Plover	*Charadrius wilsonia*		x								
Wood Thrush	*Hylocichla mustelina*				x						
Yellow-billed Cuckoo	*Coccyzus americanus*				x		x				
Yellow-breasted Chat	*Icteria virens*	x			x		x				

4.2 Endangered and Threatened Species

There were three species detected in the eBird database within 20 km of the Onshore Project Area that are listed under the Federal Endangered Species Act: Piping Plover, Red Knot (*rufa* subspecies), and Red-cockaded Woodpecker. In addition, the USFWS IPaC database (USFWS 2020) was queried using a polygon encompassing Virginia Beach County. However, because Red-cockaded Woodpecker distribution within Virginia is restricted to two breeding locations and eBird does not report any sightings from the immediate Onshore Project Area, they will not be included in analysis. Below is a table of bird species detected within 20 km of the Onshore Project Area, listed by the state of Virginia as Threatened or Endangered.

Table 4-3. Virginia State listed Threatened and Endangered species detected within 15 km of the Project Area: E = endangered, T = threatened

Species	Scientific Name	VA Listed
Wilson's Plover	*Charadrius wilsonia*	E
Piping Plover	*Charadrius melodus*	T
Gull-billed Tern	*Gelochelidon nilotica*	T
Red-cockaded Woodpecker	*Picoides borealis*	E
Peregrine Falcon	*Falco peregrinus*	T
Loggerhead Shrike	*Lanius ludovicianus*	T
Henslow's Sparrow	*Ammodramus henslowii*	T
Red Knot	*Calidris canutus rufa*	T
Black Rail	*Laterallus jamaicensis*	E
Bachman's Sparrow	*Peucaea aestivalis*	T

4.2.1 Red Knot

The Red Knot subspecies (*Calidris canutus rufa*) was listed as *Threatened* under the Endangered Species Act of 1973, as amended in the Federal Register on December 11, 2014 (U.S. Fish and Wildlife Service 2015), and is listed as *Threatened* by the state of Virginia. The *rufa* subspecies breeds in the Arctic and winters at sites as far south as Tierra del Fuego, Argentina. During both migrations, Red Knots use key staging and stopover areas to rest and feed, primarily on clams, crustaceans, and invertebrates. Major spring stopover areas are located along the mid-Atlantic coast of the U.S. The Virginia coastline provides essential staging and foraging habitat for *rufa* Red Knots particularly during the spring migration (late April through mid-June), when they rely on its peat banks and sandy beaches for foraging for bivalves and resting before continuing northward to breeding grounds in the Arctic (Watts and Truitt 2015). The highest densities of birds are found along Virginia's eastern shore among the barrier islands (~20 miles [32 km] from the proposed landing sites), which support a significant population of the *rufa* subspecies each spring (Smith et al. 2008).

4.2.2 Piping Plover

The Atlantic Coast population of the Piping Plover was federally listed as *Threatened* in 1986 and is listed as *Threatened* by the state of Virginia. Piping Plovers nest on coastal beaches, sandflats at the ends of sand spits and barrier islands, gently sloped foredunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Breeding plovers feed on exposed wet sand in wash zones; intertidal ocean beach; wrack lines; washover passes; mud, sand, and algal flats; and shorelines of streams, ephemeral ponds, lagoons, and salt marshes by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening. Small sand dunes, debris, and sparse vegetation within adjacent beaches provides shelter from wind and extreme temperatures. Piping Plovers arrive in Virginia in mid-March and lay eggs from mid-April to early July. Unfledged young may be seen through August (VDGIF 2020f). Since the Late 1990's, 100% of Piping Plover breeding activity in Virginia has occurred along the eastern shore among the barrier islands (an estimate of 208 pairs in 2008) (VDGIF 2020g). However, eBird records indicate that Piping Plovers use the southern shore of Virginia, where the Onshore Project Area is located, during pre- and post-breeding periods, particularly during spring migration. Piping Plovers are absent from the study area from November through January (Figure 4-1).

Piping Plovers are sensitive to disturbance during breeding. The presence of people is stressful for adults and chicks, forcing them to spend significantly less time foraging, which may result in decreased overall reproductive success (Burger 1990). Excessive disturbance may cause Piping Plovers to desert the nest, exposing eggs or chicks to the summer sun and predators. Interrupted feedings may stress juvenile birds during critical periods in their development, and foot and vehicle traffic may crush eggs or chicks (USFWS 2001). Examples of actions that may affect this species include construction of any new permanent or temporary structure, grading, vegetation removal, equipment storage, any new or expanded human activity during the nesting season of March 15 to August 31, including activities involving motorized vehicles, permanent or temporary increases in noise or disturbance during the nesting season, including, but not limited to, construction work. Best management practices for protecting Piping Plovers include avoiding permanent or temporary modification of nest habitat and avoiding noise and disturbance during the nesting season, particularly work involving use of motorized vehicles (U.S. Fish and Wildlife Service 2018a).

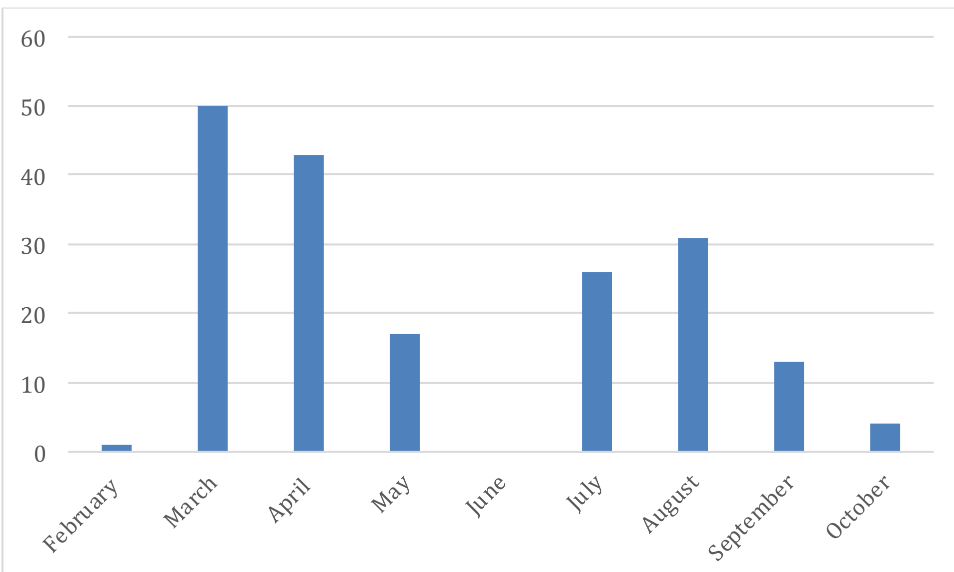


Figure 4-1. eBird records of Piping Plover from Virginia Beach to the South Carolina border

4.3 Methods

Temporary and permanent impacts to avian species from activities related to the proposed Project were assessed. The terrestrial areas potentially impacted by the Project occur at the Cable Landing Location, along the Onshore Export Cable Route, at the Switching Station Alternatives, along Interconnection Cable Routes, and at the Onshore Substation. The impact assessment was conducted by evaluating the habitat that would be modified by Onshore Project Components and the birds likely to occur in the habitat. This approach is different from the bat section and the offshore bird section, which assess exposure and behavioral vulnerability. A different approach was taken because onshore hazards generally only cause indirect effects (i.e., habitat modification and disturbance) and vulnerability to habitat modification is generally similar across the species. Habitat was identified for each Onshore Project Component and the species likely to occur in each habitat type were identified. The categorical final risk assessment was conducted using a weight-of-evidence approach by considering the severity of habitat modification and duration of hazard (Table 4-4).

4.3.1 Onshore Export Cable and Onshore Interconnection Cable Route habitat assessment

The habitat potentially to be disturbed by Onshore Project Components was assessed by calculating the overlap of the cable routes with sensitive ecological areas and habitat types; and then by calculating the percentage each route was co-located with existing development. The routes were first analyzed by determining the average ecological value ranking using the Coastal Virginia Ecological Value Assessment (VCZMP 2020) dataset, [12] which ranks terrestrial and aquatic areas on a scale from 1 to 5 of ecological value (5 being the highest conservation value). The 1-5 scale corresponded to qualitative categories of "general, moderate, high, very high, and outstanding". These values were determined by combining data for important environmental features (e.g., endangered species habitat, wetlands, rare plant habitat, etc.) and informed by the Virginia Department of Environmental Quality - Coastal Zone Management Program and its project partner's expert opinions. The cable routes were buffered by the construction right of way (ROW) widths: 175 ft (53 m) for the Onshore Export Cable Route and underground portions of the Interconnection Cable Route, and 200 ft (61 m) for Overhead Interconnection Cable Routes. The weighted mean ecological value rank was calculated for each route using the area of each ranking within the route as the weights. The rank area was calculated by multiplying the weighted mean rank by the total construction ROW area in square km (km^2).

The habitat types were determined for each construction ROW using the National Land Cover Database (NLCD 2016). The area of each landscape type within a construction ROW was estimated by determining the number of raster cells for each landscape type from the NLCD16 within the construction ROW for each route multiplied by the area of a raster cell (30 m x 30 m), converted to area in km^2. Some land cover classifications were generalized to reduce the number of landscape types (e.g., deciduous forest, evergreen forest, and mixed forest were combined into a "Forested" category). These analyses were conducted in R version 4.0.2 (R Core Team 2020) using packages sf version 0.9-5 (Pebesma 2018) and raster version 3.3-13 (Hijmans 2020).

Co-occurrence of the Onshore Export Cable and Interconnection Cable Route Alternatives with existing linear infrastructure was assessed in ArcGIS (ESRI v10.8.1). A 200 ft. buffer was applied to either side of

[12] Coastal Virginia Ecological Value Assessment: The Virginia Ecological Value Assessment (VEVA) integrates elements of the Priority Conservation Areas dataset, Healthy Waters data and VIMS Center for Coastal Resource Management Cumulative Resource Inventory. VEVA delineates priority conservation areas ranked by level of importance based on VA Dept. of Game and Inland Fisheries' Priority Wildlife Diversity Conservation Areas, VA Dept of Conservation and Recreation Division of Natural Assessment. The Virginia Ecological Value Assessment builds on the definition of the Priority Conservation Areas and are defined as lands, aquatic resources and surface waters identified as important for conservation of Virginia's wildlife, plants, and aquatic and natural communities. The identified lands, aquatic resources and waters can be used to prioritize areas for preservation, protection or specific management action. Heritage Conservation Sites Layer (CSL) and Natural Lands Network (NLN), VCU Center for Environmental Studies aquatic resource integrity layer and VIMS College of William and Mary Center for Coastal Resource Management Cumulative Resource. (https://www.arcgis.com/apps/Cascade/index.html?appid=9dfac707ddb344b1906d1effad9537f1)

each proposed cable route. Road centerlines for the state of Virginia were downloaded from the Virginia Geographic Information Network (VGIN) and clipped to the buffered cable route layers. All road features that ran parallel to the cable route were manually selected and summed for total road length and percentage of total route length. These same methods were used to assess total, and percentage co-occurrence with existing transmission line corridors using an Electrical Power Transmission Lines layer developed for the Homeland Infrastructure Foundation-Level Data (HIFLD; https://gii.dhs.gov/HIFLD).

Table 4-4. Risk categories

Risk level	Definition
Minimal	Development primarily co-located in disturbed areas with little to no permanent habitat modification; hazard(s) temporary.
Low	Development primarily co-located in disturbed areas with some permanent habitat modification; hazard(s) temporary.
Medium	Development in non-disturbed areas with some permanent habitat modification; hazard(s) temporary and/or permanent.
High	Development in non-disturbed areas with permanent habitat modification; multiple temporary and permanent hazards.

4.3.2 Data sources

The primary datasets used to describe the habitats associated with the Project Area were collected from the Virginia 2015 State Wildlife Action Plan (VASWAP). The VASWAP identifies priority species of conservation need and the habitats they rely on at a statewide and local level, threats impacting those species and habitats, conservation actions to address those threats, and methods for documenting and evaluating the success of conservation actions (Virginia Department of Game and Inland Fisheries 2015). The Project Area is located within the Hampton Roads Planning Region. The VASWAP was used to describe habitats critical to Species of Greatest Conservation Need (SGCN) located within or near the potential cable corridors. In addition, a national land cover dataset, as well as the Coastal Virginia Ecological Value Assessment (VCZMP 2020), were used in assessing habitat quality and potential priority species that may be impacted by the Project within the onshore construction corridor.

Data on possible bird species present was primarily compiled from eBird citizen science data (Sullivan et al. 2009) from within a 12.4 mi (20 km) buffer of the center of the Onshore Project Area and was temporally constrained to the prior 10 years of data. In addition, the USFWS IPaC database (USFWS 2020) was queried using a polygon encompassing Virginia Beach County.

4.4 Affected Habitat

4.4.1 Overview of Onshore Project Area

The Study Area is located within the Coastal Plain province and Lowland sub province of Virginia, an area characterized by flat, low-relief topography, situated along the coastline, major rivers, and Chesapeake Bay. The Project Area is located within the heavily developed cities of Virginia Beach and Chesapeake, characterized by dense residential and commercial developments, forested wetlands, major watercourses and associated floodplains, the Intracoastal Waterway, agricultural fields, military airport facilities, sports complexes, and golf courses. Onshore Project Components will consist of the Cable Landing Location, Onshore Export Cable Route, Switching Station, Interconnection Cable Routes, and Onshore Substation. These components are discussed below.

4.4.2 Cable Landing Location

The Offshore Export Cable will transition to shore using trenchless installation. Trenchless installation will be initiated in the water within 1,000 m of the beach and will terminate in a Proposed Parking Lot west of the Firing Range at SMR, located east of Regulus Avenue and north of Rifle Range Road (Figure 4-2). There will be no direct disturbance of the beach or dune habitats.

4.4.2.1 Proposed Parking Lot, west of the Firing Range at the State Military Range (SMR)

The Proposed Parking Lot, west of the Firing Range at the State Military Range (SMR) is located within the SMR east of Regulus Avenue and north of Rifle Range Road. The proposed parking lot would be located between the Cable Landing Location and Regulus Avenue, and the Cable Landing Location would be within that proposed parking lot. Trenchless installation would also be considered from the landing site to a point inland to minimize impacts to Rifle Range Road and other features at the SMR. The area is within a highly disturbed area, and likely does not provide important habitat for any species of bird.

Figure 4-2. **Cable Landing Location.**

4.4.3 Onshore Export Cable Route

The Onshore Export Cable Route will pass through mixed commercial and residential areas, before terminating at a Common Location north of Harpers Road (Figure 4-3). The Onshore Export Cable will primarily be buried within previously disturbed areas (Table 4-5), and construction will largely avoid cutting trees or disturbing vegetation. In some areas, individual trees or vegetation immediately adjacent to the road may need to be removed.

The Onshore Export Cable Route passes through several habitat types, including open water, developed, forested, shrub/scrub, agricultural field, and wetland (Table 4-6). Overall, the onshore Project Area includes areas that have been identified as having general to very high ecological value. A broad range of avian species utilize these habitats throughout the year (breeding, wintering, and migration periods).

Road areas co-occurring with the Onshore Export Cable Route are generally bordered by woody wetlands, cultivated crops, mixed forest, evergreen forest dominated by loblolly pine (*Pinus taeda*), small ponds, and dense invasive vegetation, including wisteria (*Wisteria* sp.) and Japanese honeysuckle (*Lonicera japonica*). A variety of common avian species that specialize in edge, disturbed, and urban habitat may use the area.

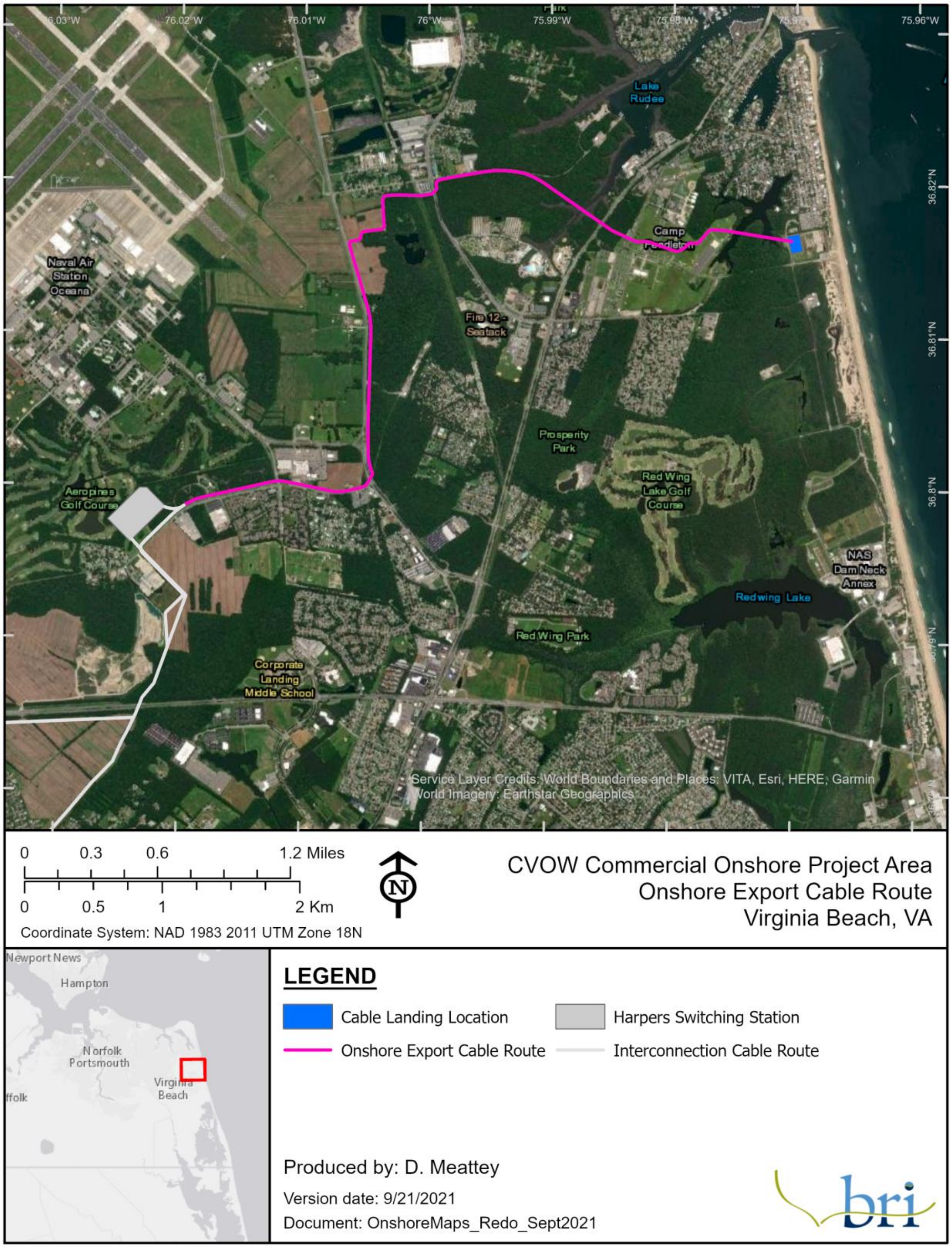


Figure 4-3. Onshore Export Cable Route.

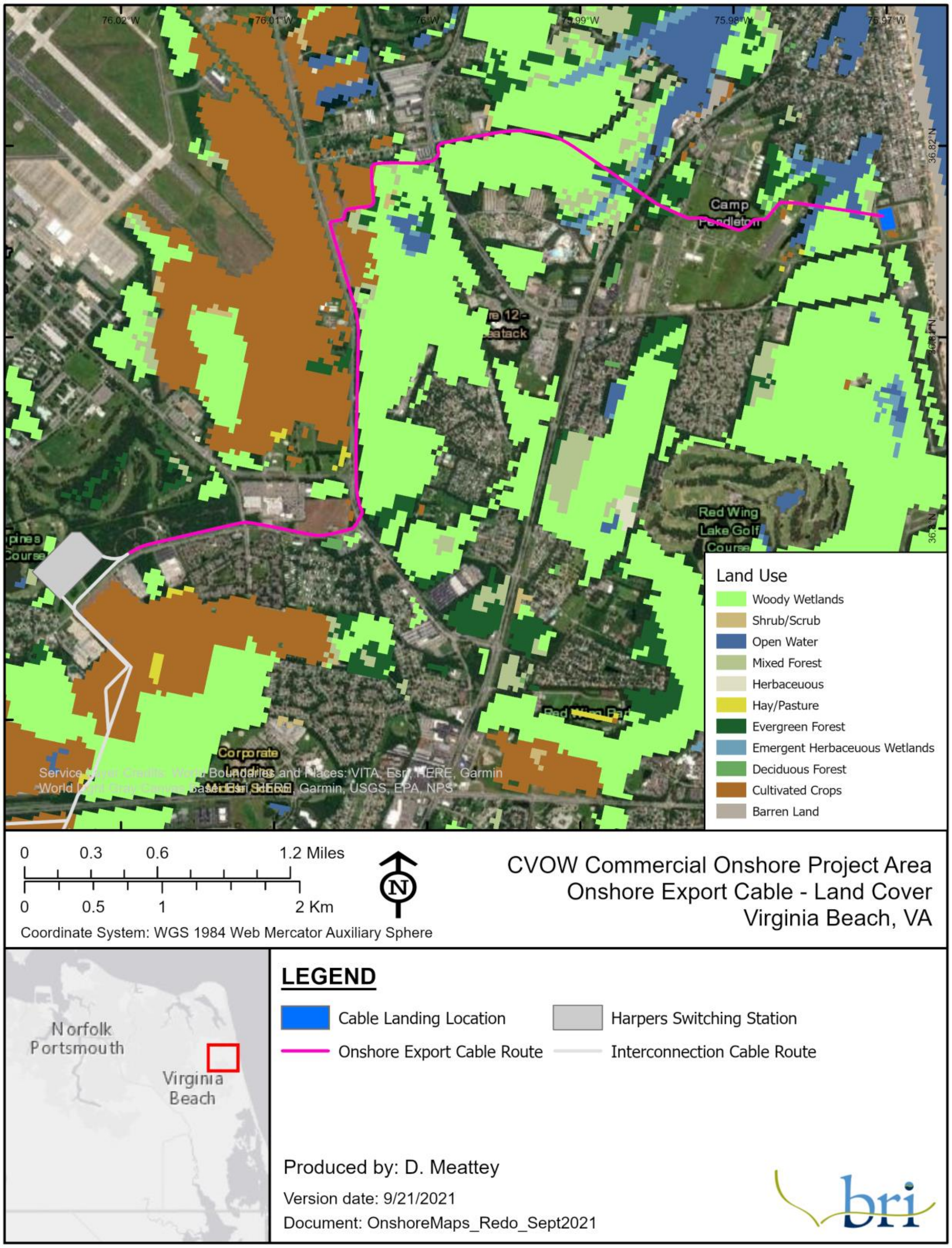


Figure 4-4. Land cover types along the Onshore Export Cable Route and Harpers Switching Station Parcel.

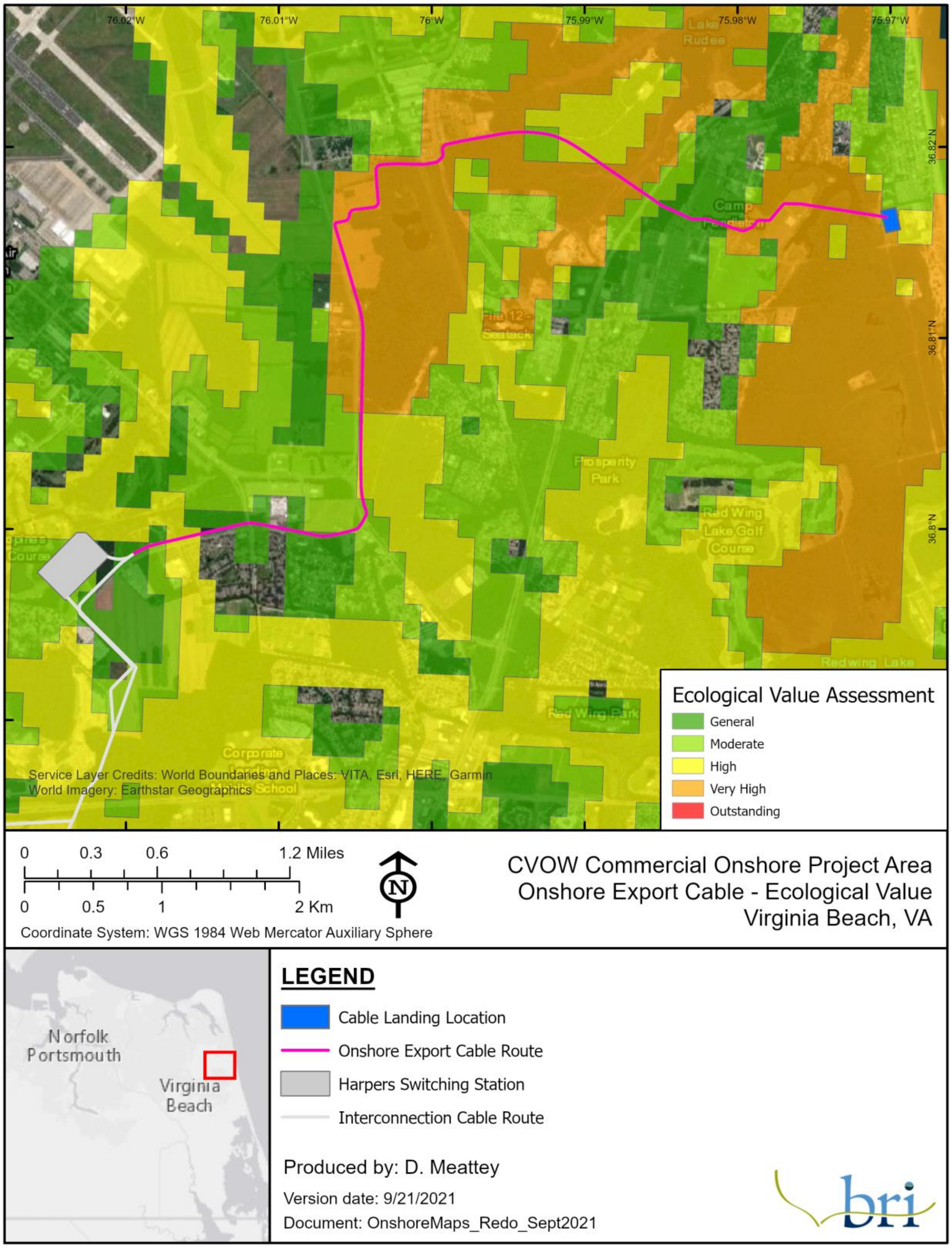


Figure 4-5. Coastal Virginia Ecological Value Assessment along the Onshore Export Cable Route and Harpers Switching Station Parcel (VCZMP 2020).

4.4.4 Interconnection Cable Routes

Interconnection Cable Routes are located from the Common Location north of Harpers Road to the Onshore Substation. There are five Alternatives that use overhead transmission lines from the Harpers Switching Station to the Onshore Substation (Figure 4-6), and one alternative that will be a hybrid of overhead and underground, with the cable continuing underground to the Chicory Switching Station before transitioning to overhead lines to the Onshore Substation. The underground sections of the routes are primarily co-located with existing roadways and overhead transmission lines are primarily co-located with either roadways or pre-existing transmission corridors to varying degrees (Table 4-5). Interconnection Cable Routes pass through several habitat types, including open water, developed, forested, shrub/scrub, agricultural field, and wetland (Table 4-6).

From a bird habitat perspective, there are three broad portions of the Interconnection Cable Route Alternatives. The first portion is from the Harpers Switching Station up to the forested and wetland habitat adjacent to the North Landing River, which primarily passes through a mix of urban developed areas and agricultural land and is generally assessed to have “general” to “high” ecological value. The second portion passes through a relatively undisturbed area of mixed forest, wetlands, and riverine habitat associated with the North Landing River (i.e., Gum Swamp) and is assessed to have “very high” ecological value. Between the developed areas in the cities of Virginia Beach and Chesapeake is a large expanse of the Gum Swamp. The swamp extends on either side of the Intracoastal Waterway. This undeveloped area is characterized by forested wetland and flowing waters. The third portion passes through a mix of agricultural land and wetlands adjacent to a canal and is assessed to have “general” to “high” ecological value. While each of the sections will provide breeding and wintering habitat for birds, the central portion around the North Landing River likely provides habitat for the greatest diversity of birds and birds identified Species of Greatest Conservation Concern. Figure 4-7 displays the ecological value.

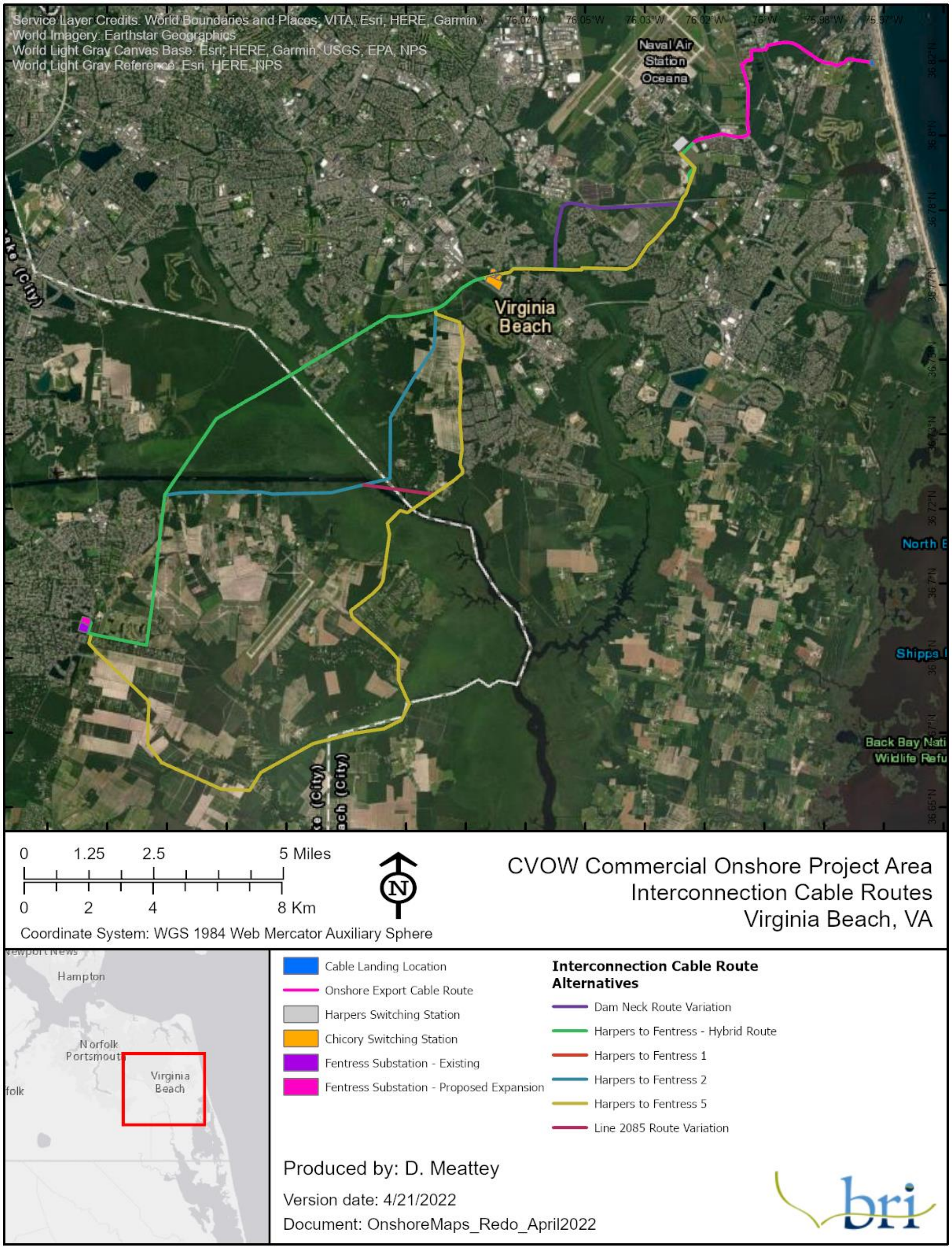


Figure 4-6. Interconnection Cable Route Alternatives.

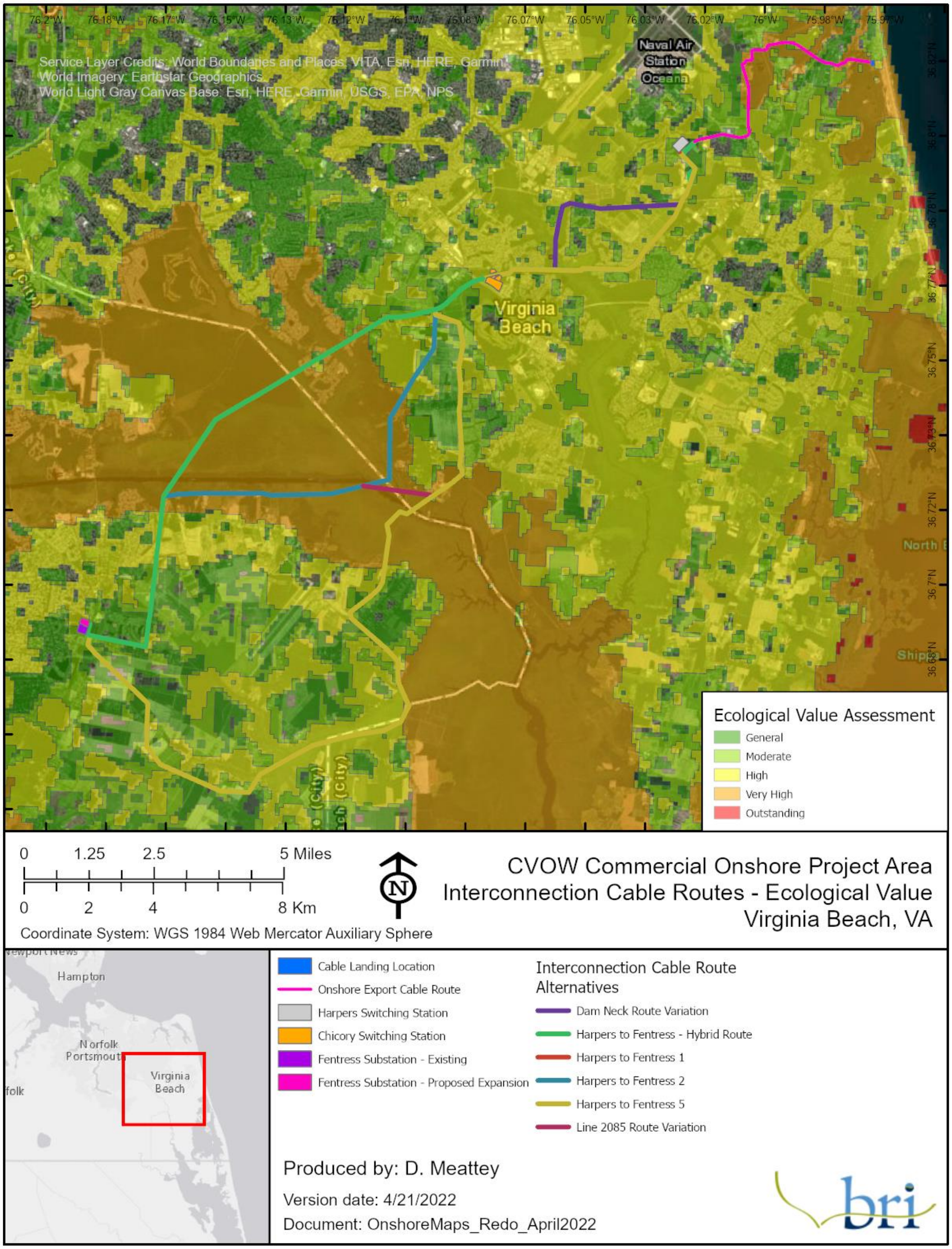


Figure 4-7. Coastal Virginia Ecological Value Assessment for the Interconnection Cable Route Alternatives (VCZMP 2020).

Table 4-5. Road and transmission line co-occurrence of Onshore Export and Interconnection Cable Route Alternatives. Routes with low rank have greater co-occurrence with existing developed areas.

			Co-occurrence with Existing Roads and Transmission Lines				
Route Name	Rank	Total Length (ft)	Roads (ft)	% of Total Length	Transmission Lines (ft)	% of Total Length	Total Co-occurrence
Onshore Export Cable Route	.	22833.7	10113.2	44.3%	0	0%	44.3%
Interconnection Cable Route Alternative 1	1	75221.4	0	0%	56939.2	75.7%	75.7%
Interconnection Cable Route Alternative 2	5	80868.4	0	0%	27374.7	33.9%	33.9%
Interconnection Cable Route Alternative 3	4	82792.8	9058.7	10.9%	21667.4	26.2%	37.1%
Interconnection Cable Route Alternative 4	3	87398.4	0	0%	42462.6	48.6%	48.6%
Interconnection Cable Route Alternative 5	6	107054.2	8448.6	7.9%	25206.7	23.5%	31.4%
Interconnection Cable Route Alternative 6 (Hybrid)	2	75151.4	0	0%	53281.8	70.1%	70.1%

Table 4-6. **Habitat associations of Onshore Export Cable, Interconnection Cable Route Alternatives, and Onshore Substations. The smaller the value in the Rank Area column, the lower the overall habitat value. ROW Type broken into Existing transmission line ROW and Proposed transmission line ROW.**

					Habitat Type (% of Total Area)						
Route Name	ROW Type	Total Area (sq. km)	Ecological Value (weighted)	Rank Area (sq. km)	Open Water	Developed	Barren Land	Forested	Shrub/Scrub	Field/Agro	Wetland
Cable Landing Location	Proposed	0.011	2.43	0.03	0	100	0	0	0	0	0
Onshore Export Cable Route	Proposed	0.108	3.10	0.34	0	50	0	5.7	0.5	16.8	27
Interconnection Cable Route Alternative 1	Existing	0.495	3.15	1.56	1.2	19.2	0	5	0.5	23.8	50.1
	Proposed	0.533	2.71	1.44	1.5	31.1	0	3.8	0.3	17.6	45.5
Interconnection Cable Route Alternative 2	Existing	0.230	2.32	0.53	0.6	47.8	0.2	3.9	0.4	30.1	16.9
	Proposed	0.844	3.10	2.62	3.2	26	0	4.4	0.3	11.7	54.4
Interconnection Cable Route Alternative 3	Existing	0.211	2.27	0.48	0.4	48.7	0.3	4.5	0.4	36.5	9.1
	Proposed	0.888	3.05	2.71	3	25.7	0	4.4	0.3	11.9	54.5
Interconnection Cable Route Alternative 4	Existing	0.297	2.27	0.68	0.7	35.8	0.1	3.4	0.3	39.5	20.2
	Proposed	0.899	3.06	2.75	2.4	32.6	0	4.7	0.2	25.6	34.4
Interconnection Cable Route Alternative 5	Existing	0.108	2.36	0.25	0.9	25.5	0	2.7	0.1	40.7	30
	Proposed	1.279	2.54	3.24	1.2	17.9	0	5.2	0.4	40	35.2
Interconnection Cable Route Alternative 6 (Hybrid)	Existing	0.463	3.16	1.46	1.2	16.8	0.1	5.8	0.4	31.5	44.1
	Proposed	0.378	2.66	1.01	1.9	8.2	0	4.9	0.4	15	69.3
Harpers Switching Station	Proposed	0.084	1.93	0.16	0	89.6	0	2.2	0	0.5	7.7
Chicory Switching Station	Proposed	0.058	3.00	0.17	0	16.9	0	18.7	2.9	7.9	53.6
Fentress Substation	Existing	0.047	2.14	0.10	0	93.8	0	1.6	0	1.6	3.1
	Proposed	0.036	2.95	0.11	0	19.6	0	33.9	0	3.6	42.9

4.4.5 Switching Station Alternatives and Onshore Substation

The Switching Station is located where the Onshore Export Cable and Interconnection Cable meet, and the Onshore Substation is the termination of the Interconnection Cable at the POI.

4.4.5.1 Switching Station Alternatives

The Onshore Export Cable Route will terminate at a Common Location either north of Harpers Road (Interconnection Cable Route Alternatives 1-5) or north of Princess Anne Road (Interconnection Cable Route Alternative 6) (Figure 4-8 and Figure 4-9). The Switching Station would be constructed to collect power and transition from underground transmission line to overhead transmission line. The parcels consist of a mix of forested, woody wetlands, developed areas, and agricultural field. The Switching Station operational footprint is anticipated to be a maximum of approximately 26.3 ac (10.6 ha) north of Harpers Road or 22.3 ac (9.0 ha) north of Princess Anne Road, depending on which alternative is selected, including any associated stormwater facilities, parking areas, etc. The Harpers Switching Station is expected to be constructed within part of an existing golf course, resulting in minimal vegetation clearing. The Chicory Switching Station is located in an area of mixed forest and vegetation clearing will be required.

4.4.5.2 Onshore Substation

The Interconnection Cable Route will terminate at the Onshore Substation. The Onshore Substation Parcel consists of a pre-existing substation and surrounding forest habitat (Figure 4-10). The Onshore Substation will serve as the Point of Interconnection (POI) located at an existing substation with construction activities aimed at expanding the footprint from approximately 12 acres (4.9 ha) to an additional 13 acres (3.3), for a total of approximately 25 acres (10.1 ha). Limited tree cutting may be required in the area adjacent to the substation: the forest surrounding the existing substation is assessed to have “moderate” to “high” ecological value (VCZMP 2020). The forest is in an area that is bordered by agricultural, urban development and roads, and could provide limited habitat for some breeding songbirds.

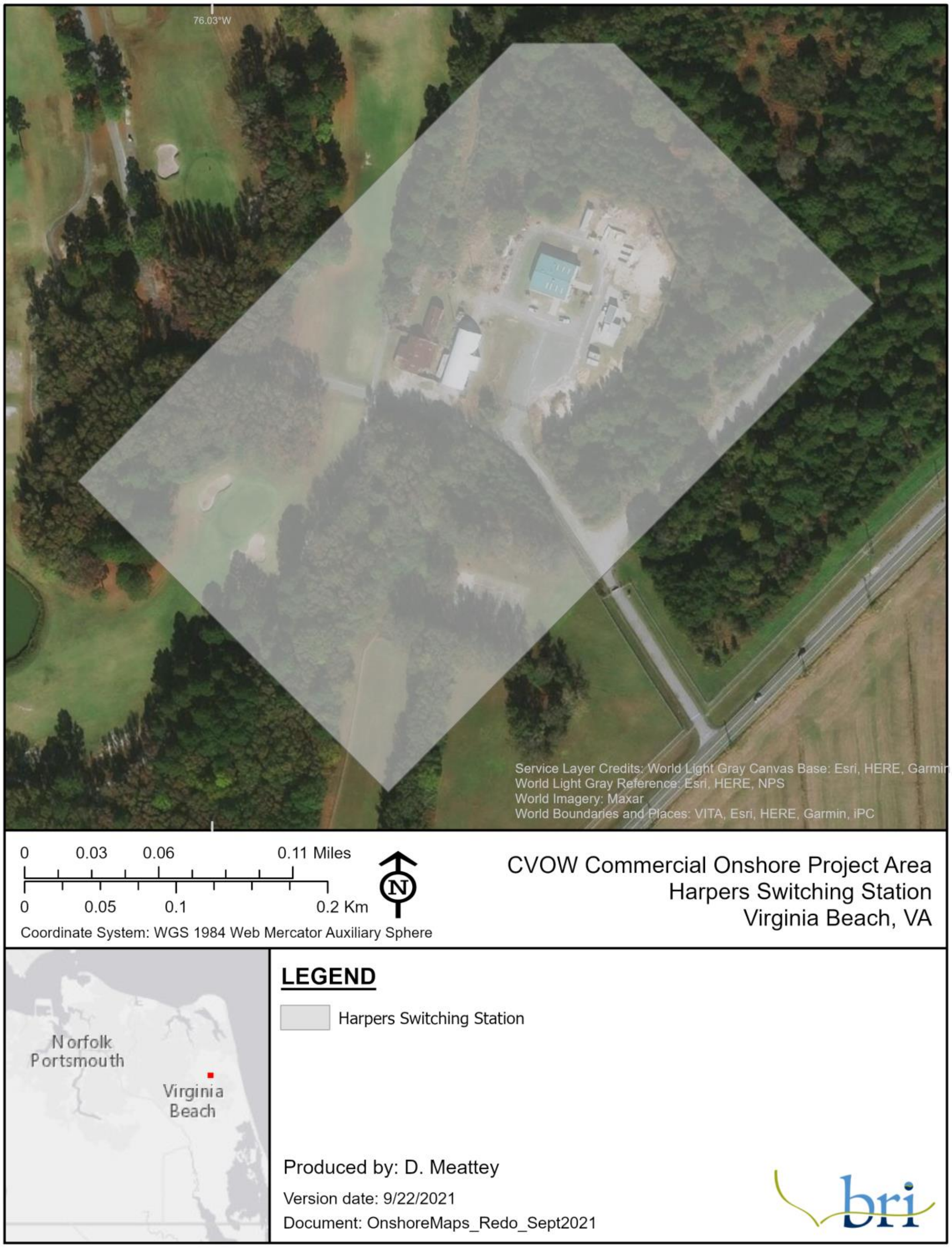


Figure 4-8. Harpers Switching Station Parcel.

Figure 4-9. Chicory Switching Station Parcel

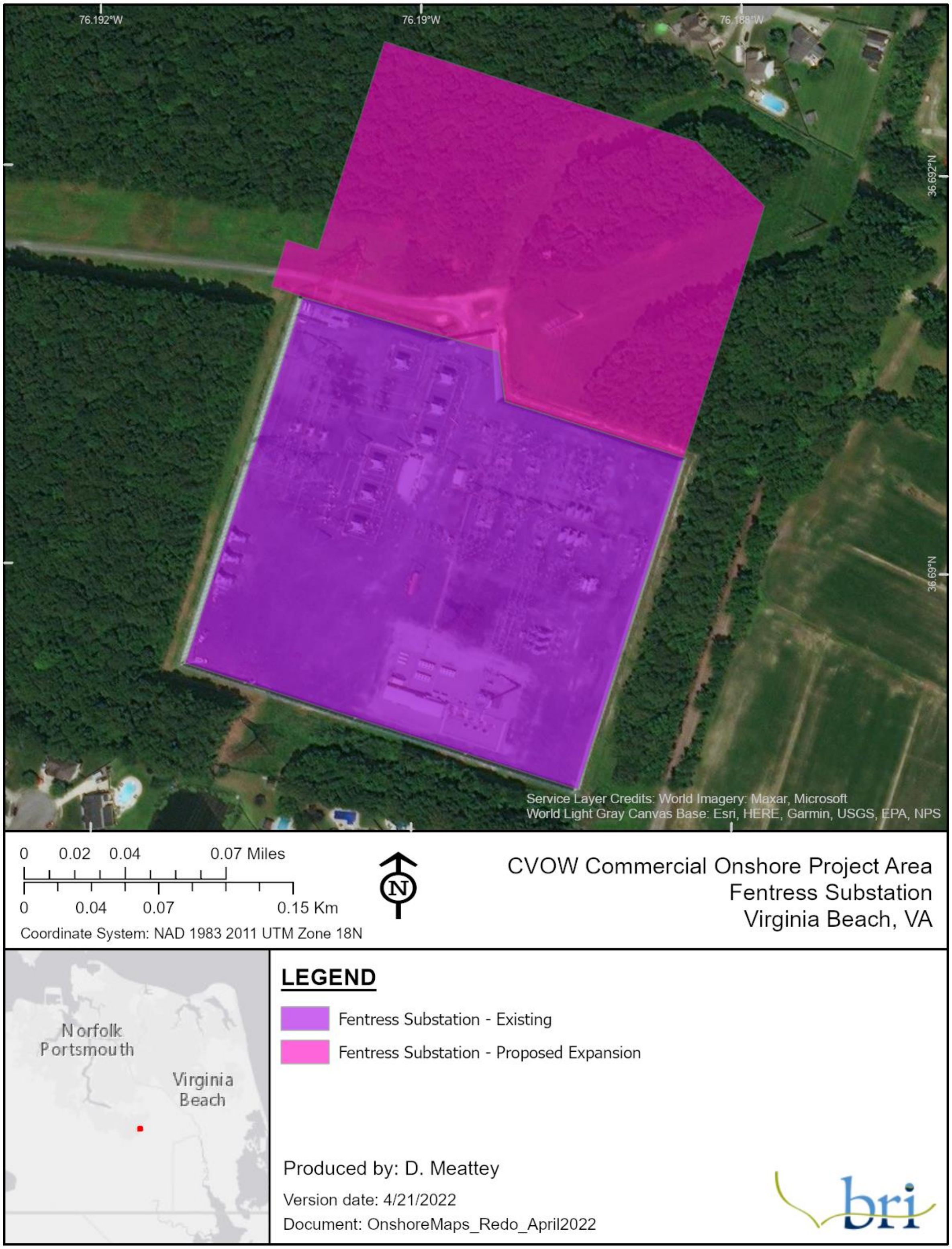


Figure 4-10. Onshore Substation Parcel and surrounding forest area.

4.5 Potential Impacts

4.5.1 Impact-producing factors

The potential impacts of the Onshore Project Components to birds were evaluated by considering the exposure of birds to Project hazards. Hazards (i.e., impact producing factors) are defined as the changes to the environment caused by Project activities during each development stage that have the potential to adversely affect wildlife (BOEM 2012; Goodale and Milman 2016). For the Onshore Project Components, the primary hazard to birds is habitat modification during construction, which may cause an indirect effect of reduced foraging and breeding habitat. Other potential hazards include (1) temporary disturbance from construction and operation activities, causing displacement from breeding and foraging habitat; and (2) the presence of construction equipment, which in rare instances could cause individual mortality. During operation, maintenance activities have the potential to cause temporary habitat modification (e.g., ground disturbance), but the disturbance would generally be similar to or less than the construction of the Onshore Project Components, impact smaller areas, and is expected to be of shorter duration. The overhead transmission lines also have the potential to cause impacts and are discussed blow. Below, potential impacts for each Project component, by development stage, are discussed.

4.5.2 Construction and Installation

4.5.2.1 Habitat Modification

Offshore Export Cable Landing Location: Overall, coastal disturbance during construction will be temporary and is expected to be ***minimal*** to ***low*** because there will be no direct disturbance of the beach or dunes and the Cable Landing Location is in a proposed parking lot. Trenchless installation will avoid disturbing the beach and dune habitat. The cable entry point will be in the water outside the inter-tidal zone used by shorebirds for foraging, and the exit point will be in one of three proposed or existing parking lots, which is not used as primary habitat for any species. While Piping Plover and Red Knot may utilize the beach near the Cable Landing Location during migration (they are unlikely to be present in other Onshore Project Areas), the beach is not expected to be disturbed because trenchless installation will be used. As discussed above, Piping Plovers have not historically used the area for breeding. Impacts from permanent habitat modification are considered to be ***minimal***, because any disturbed areas are expected to return to prior conditions. These findings are consistent with the Vineyard Wind 1 Biological Assessment (similar activities in beach areas), which found the potential effects of the Onshore Project Components to Piping Plovers, Red Knots, and Roseate Terns to be “insignificant and discountable” (BOEM 2019b); and the Vineyard Wind 1 Draft Environmental Impact Statement, which found impacts to birds from construction at Cable Landing Locations would be “negligible” (BOEM 2018b).

Onshore Export Cable: Overall, temporary and permanent impacts to bird populations from Onshore Export Cable Route Corridor activities are expected to be ***minimal*** because the cable will be buried within existing roads to limit disturbance to habitat. Only in rare instances will individual trees need to be removed.

Switching Station Alternatives and Onshore Substation: The Switching Station Alternatives are located adjacent to or within areas identified as having high ecological value. Since the Harpers Switching Station will be located in an existing semi-developed area, including part of a golf course, tree removal will be minimal. However, the Chicory Switching Station is located in a forested area that will require tree cutting and permanent habitat modification. Impacts are expected to be ***low*** to ***medium***. The Onshore Substation is located in an existing developed area and is associated with fragmented habitat; therefore, depending upon the number of trees that need to be removed, impacts are expected to be ***minimal*** to ***low***.

Interconnection Cable Route Alternatives: The Interconnection Cable Route Alternatives pass through a variety of habitat types, with 34–69% of the ROWs passing through freshwater wetlands. The portion of the routes that pass through the forested and wetland areas associated with the North Landing River likely provide habitat for Species of Greatest Conservation Need (Table 4-2) and are most sensitive to development. With the exception of Interconnection Cable Route Alternatives 1 and 6, less than 50% of the routes are co-located with existing linear development such as roads and transmission lines. All Interconnection Cable Route Alternatives are considered to have ***medium*** to ***high*** impacts because more than half of the development will disturb primarily field/agricultural areas and wetlands.

4.5.2.2 Temporary Disturbance: Noise and Vibration

At the Cable Landing Location, noise and vibration generated by construction equipment and trenchless installation may temporarily displace some birds within nearby habitat. These birds are expected to return once construction activity is complete, and, thus, the potential impacts to bird populations from noise are unlikely. Noise is not expected to be an independent hazard during construction for the Onshore Export Cable Route, Switching Station, Interconnection Cable Route, or Onshore Substation.

4.5.2.3 Direct Mortality

Due to their generally high mobility, birds are likely to leave construction areas during construction activities, because of disturbance from noise and equipment. However, since the Switching Station and the Interconnection Cable Routes have the potential to disturb areas in which birds may be present, Dominion Energy will follow minimization measure and conduct the necessary field surveys, if required, to identify the presence of species of conservation concern.

4.5.3 Operation and Maintenance

With the exception of the overhead cables associated with the Interconnection Cable Routes, operation and maintenance activities are expected to create few, if any, hazards that would cause potential effects to birds (BOEM 2018b). There is the potential for birds to be temporarily disturbed by noise during maintenance activities, but these are expected to be ephemeral in nature, and birds that are disturbed would readily return to the area once the activities have ceased. Across the landscape, fixed above ground structures (e.g., substations) can cause mortality due to collision or electrocution, but risk to birds from the Onshore Export Cable Route are likely minimal because transmission lines will be buried. Therefore, the potential impacts to bird populations are unlikely for the operation of coastal and onshore components of the Project.

The Interconnection Cable Routes will include new overhead cables which have the potential to create collision and electrocution hazard for birds (Loss et al. 2014, Bevanger 1994). Birds most prone to collisions with power line infrastructure are those that typically fly at power line height, and examples of those vulnerable to collision are waterfowl, gamebirds, and rails (Jenkins et. al. 2010). Nocturnal species, such as owls and seabirds, as well as night-migrating songbird species, are also susceptible to collisions (Raine et al. 2017). Power lines can reduce breeding performance (Janiszewski et al. 2015), and create a barrier effect (Benítez-López et al. 2010), but can provide hunting or nesting sites (Moreira et al. 2017, D'Amico et al. 2018).

4.5.4 Decommissioning

While the specifics of decommissioning activities are not fully known at this time, impacts from decommissioning are expected to be equal to or less than impacts from construction. The Project will use best practices available at the time to minimize potential effects to birds.

4.6 Mitigation and Monitoring

Dominion Energy proposes to avoid potential effects to birds by using trenchless installation in coastal areas at the Cable Landing Location; co-locating the Onshore Export Cable and Interconnection Routes with existing roads and previously disturbed area as much as possible; and timing construction operations to avoid critical periods when endangered and threatened species may be affected to the extent practicable.

Tree/vegetation clearing would avoid trees favorable for bat maternity roosting locations, and would be conducted outside of the breeding/roosting season to avoid nesting birds and bat maternity roosting locations, to the extent practicable.

Dominion Energy will reduce potential impacts of the overhead lines by complying with Avian Power Line Interaction Committee (APLIC)[13] best practices to reduce collision and electrocution. Impacts from overhead lines can be minimized by avoiding sensitive habitat; application of anti-collision devices; (Barrientos et al. 2011) and minimizing lighting (Gehring et al. 2009). The chance of electrocution can be reduced by ensuring the spacing between wires is further apart than the size of the largest species expected to use the surrounding area, (typically the large eagles in North America, Lehman et al., 2007), and by insulating conductors and separating those with different electric potentials (Dwyer et al. 2017).

Based upon prior recommendations from the Virginia Department of Wildlife Resources (ESSLOG 40754: 16 October 2020), Dominion Energy will conduct the following surveys, if required:

- Offshore Export Cable Landing Location: Shorebird and seabird surveys of the Offshore Export Cable Landing Location should be conducted from March–October to inform species occurrences throughout the potential construction window in case of construction delays. Breeding surveys should be conducted a minimum of every five days (versus every 10 days) to ensure all breeding activity and pairs are detected.

- Onshore Export and Interconnection Cable Routes: If tree cutting is proposed to occur between March–August, a minimum of four raptor/wading bird nest surveys should be conducted along the survey route between March 1 and June 15, and at least one of the surveys should be conducted in early March to ensure detection of early nesting raptors and wading birds (i.e., Great Blue Herons). In addition to surveys, the most recent eagle nest location database will be referenced (https://ccbbirds.org/maps/#eagles).

- Switching Station Alternatives and Onshore Substation: If tree cutting is proposed to occur at the Switching Stations or Onshore Substation between March–July, breeding point counts should be conducted three times during the breeding season: once in March, once in April, and once in May.

4.7 Summary and Conclusions

At the Cable Landing Location, potential impacts will be minimized by using trenchless installation and by locating the cable exit site in a proposed parking lots. Along the Onshore Export Cable Route impacts are minimized by burying the cable within existing roadways and previously disturbed areas. The Switching Station Alternatives are also located adjacent to or within areas of high ecological value and

[13] https://www.aplic.org/

development have the potential to disturb breeding bird habitat depending on the extent of tree clearing required. The Interconnection Cable Routes pass through an area of wetlands identified has have very high ecological value and tree cutting has the potential to impact the habitat of species of conservation concern. The Onshore Substation largely avoids disturbing bird habitat because development will be primarily confined to an existing developed area. Since the Interconnection Cable Routes have the potential to impact bird habitat, Dominion Energy will conduct field surveys, if required, to identify if species of conservation concern are present and will work with the BOEM, VDWR, and USFWS to minimize potential impacts.

Table 4-7. List of species identified in the eBird database within 15 km of potential onshore site(s)

Species	Scientific Name	eBird Count	NAS Oceana	Lake Tecumseh	VA Status	Fed Status	IPaC
Snow Goose	*Anser caerulescens*	346		X			
Ross's Goose	*Anser rossii*	46					
Greater White-fronted Goose	*Anser albifrons*	35					
Brant	*Branta bernicla*	66			SGCN		
Cackling Goose	*Branta hutchinsii*	39					
Canada Goose	*Branta canadensis*	2,220	X	X			
Tundra Swan	*Cygnus columbianus*	599	X	X			
Wood Duck	*Aix sponsa*	1,085	X	X			
Blue-winged Teal	*Spatula discors*	283	X				
Northern Shoveler	*Spatula clypeata*	759	X	X			
Gadwall	*Mareca strepera*	852	X	X			
Eurasian Wigeon	*Mareca penelope*	39					
American Wigeon	*Mareca americana*	680	X	X			
Mallard	*Anas platyrhynchos*	2,196	X	X			
American Black Duck	*Anas rubripes*	703	X	X	SGCN		
Northern Pintail	*Anas acuta*	363	X	X	SGCN		
Green-winged Teal	*Anas crecca*	440	X	X			
Canvasback	*Aythya valisineria*	120	X				
Redhead	*Aythya americana*	195	X	X			
Ring-necked Duck	*Aythya collaris*	614	X	X			
Greater Scaup	*Aythya marila*	144	X	X	SGCN		
Lesser Scaup	*Aythya affinis*	309	X				
King Eider	*Somateria spectabilis*	43					
Common Eider	*Somateria mollissima*	110					MB
Surf Scoter	*Melanitta perspicillata*	538	X				MB
White-winged Scoter	*Melanitta deglandi*	226	X				MB
Black Scoter	*Melanitta americana*	715	X				MB
Long-tailed Duck	*Clangula hyemalis*	128					MB
Bufflehead	*Bucephala albeola*	765	X	X			
Common Goldeneye	*Bucephala clangula*	69					
Hooded Merganser	*Lophodytes cucullatus*	801	X	X			
Common Merganser	*Mergus merganser*	82					
Red-breasted Merganser	*Mergus serrator*	864	X	X			MB
Ruddy Duck	*Oxyura jamaicensis*	630	X	X			
Northern Bobwhite	*Colinus virginianus*	117			SGCN		
Ruffed Grouse	*Bonasa umbellus*				SGCN		
Wild Turkey	*Meleagris gallopavo*	132					
Pied-billed Grebe	*Podilymbus podiceps*	1,225	X	X			
Horned Grebe	*Podiceps auritus*	456	X				
Red-necked Grebe	*Podiceps grisegena*	74	X	X			
Western Grebe	*Aechmophorus occidentalis*		X				
Rock Pigeon	*Columba livia*	1,579	X	X			
Eurasian Collared-Dove	*Streptopelia decaocto*	264					
Mourning Dove	*Zenaida macroura*	2,389	X	X			

Species	Scientific Name	eBird Count	NAS Oceana	Lake Tecumseh	VA Status	Fed Status	IPaC
Yellow-billed Cuckoo	*Coccyzus americanus*	497	X	X	SGCN		
Black-billed Cuckoo	*Coccyzus erythropthalmus*				SGCN		MB
Common Nighthawk	*Chordeiles minor*	31					
Chuck-will's-widow	*Antrostomus carolinensis*	36				BCC	
Eastern Whip-poor-will	*Antrostomus vociferus*				SGCN	BCC	MB
Chimney Swift	*Chaetura pelagica*	786	X	X	SGCN		
Ruby-throated Hummingbird	*Archilochus colubris*	912	X	X			
King Rail	*Rallus elegans*	546			SGCN		MB
Clapper Rail	*Rallus crepitans*	108			SGCN		MB
Virginia Rail	*Rallus limicola*	105			SGCN		
Black Rail	*Laterallus jamaicensis*				E	BCC	
Sora	*Porzana carolina*	134	X				
Common Gallinule	*Gallinula galeata*	36	X	X			
American Coot	*Fulica americana*	752					
Black-necked Stilt	*Himantopus mexicanus*	36					
American Oystercatcher	*Haematopus palliatus*	112			SGCN	BCC	MB
Black-bellied Plover	*Pluvialis squatarola*	498	X		SGCN		
Wilson's Plover	*Charadrius wilsonia*				E	BCC	MB
Semipalmated Plover	*Charadrius semipalmatus*	447	X				
Piping Plover	*Charadrius melodus*	77	X		T	T	T
Killdeer	*Charadrius vociferus*	1,239	X	X			
Whimbrel	*Numenius phaeopus*	109	X		SGCN	BCC	MB
Marbled Godwit	*Limosa fedoa*				SGCN	BCC	MB
Ruddy Turnstone	*Arenaria interpres*	250	X				MB
Red Knot	*Calidris canutus*	74			T	T	T
Stilt Sandpiper	*Calidris himantopus*	40					
Sanderling	*Calidris alba*	1,257	X		SGCN		
Dunlin	*Calidris alpina*	236			SGCN		MB
Purple Sandpiper	*Calidris maritima*	53			SGCN		MB
Least Sandpiper	*Calidris minutilla*	399	X				
White-rumped Sandpiper	*Calidris fuscicollis*	44					
Pectoral Sandpiper	*Calidris melanotos*	126					
Western Sandpiper	*Calidris mauri*	58	X				
Semipalmated Sandpiper	*Calidris pusilla*	368				BCC	MB
Short-billed Dowitcher	*Limnodromus griseus*	199	X		SGCN	BCC	MB
American Woodcock	*Scolopax minor*	39			SGCN		
Wilson's Snipe	*Gallinago delicata*	253					
Spotted Sandpiper	*Actitis macularius*	447	X	X			
Solitary Sandpiper	*Tringa solitaria*	242	X			BCC	
Greater Yellowlegs	*Tringa melanoleuca*	669	X				
Willet	*Tringa semipalmata*	525	X		SGCN		MB
Lesser Yellowlegs	*Tringa flavipes*	320	X				MB
Parasitic Jaeger	*Stercorarius parasiticus*	47	X				MB
Dovekie	*Alle alle*		X				MB
Razorbill	*Alca torda*	160	X				MB
Bonaparte's Gull	*Chroicocephalus philadelphia*	493	X				MB
Laughing Gull	*Leucophaeus atricilla*	1,759	X	X	SGCN		
Ring-billed Gull	*Larus delawarensis*	2,157	X	X			MB
Herring Gull	*Larus argentatus*	1,785	X	X			MB
Lesser Black-backed Gull	*Larus fuscus*	1,222	X				
Great Black-backed Gull	*Larus marinus*	1,879	X	X			MB
Sooty Tern	*Onychoprion fuscatus*		X				
Least Tern	*Sternula antillarum*	332	X		SGCN	BCC	MB
Gull-billed Tern	*Gelochelidon nilotica*	53	X		T	BCC	MB

Species	Scientific Name	eBird Count	NAS Oceana	Lake Tecumseh	VA Status	Fed Status	IPaC
Caspian Tern	*Hydroprogne caspia*	698	X				
Black Tern	*Chlidonias niger*	76	X				
Common Tern	*Sterna hirundo*	417	X		SGCN		MB
Forster's Tern	*Sterna forsteri*	1,044	X	X	SGCN		
Royal Tern	*Thalasseus maximus*	1,229	X	X	SGCN		MB
Sandwich Tern	*Thalasseus sandvicensis*	440	X			BCC	
Black Skimmer	*Rynchops niger*	167	X		SGCN	BCC	MB
Red-throated Loon	*Gavia stellata*	669	X		SGCN	BCC	MB
Pacific Loon	*Gavia pacifica*	37					
Common Loon	*Gavia immer*	985	X				MB
Wilson's Storm-Petrel	*Oceanites oceanicus*		X				MB
Great Shearwater	*Ardenna gravis*		X				
Northern Gannet	*Morus bassanus*	897	X	X	SGCN		MB
Anhinga	*Anhinga anhinga*	183					
Double-crested Cormorant	*Phalacrocorax auritus*	2,362	X	X			MB
American White Pelican	*Pelecanus erythrorhynchos*	30					
Brown Pelican	*Pelecanus occidentalis*	1,918	X	X			MB
American Bittern	*Botaurus lentiginosus*	304				BCC	
Least Bittern	*Ixobrychus exilis*	103			SGCN	BCC	
Great Blue Heron	*Ardea herodias*	2,418	X	X			
Great Egret	*Ardea alba*	2,061	X	X			
Snowy Egret	*Egretta thula*	762	X	X	SGCN		
Little Blue Heron	*Egretta caerulea*	456	X		SGCN		
Tricolored Heron	*Egretta tricolor*	261	X				
Cattle Egret	*Bubulcus ibis*	272					
Green Heron	*Butorides virescens*	723	X	X	SGCN		
Black-crowned Night-Heron	*Nycticorax nycticorax*	172			SGCN		
Yellow-crowned Night-Heron	*Nyctanassa violacea*	335	X		SGCN		
White Ibis	*Eudocimus albus*	715	X	X			
Glossy Ibis	*Plegadis falcinellus*	421	X	X	SGCN		
Black Vulture	*Coragyps atratus*	1,159	X	X			
Turkey Vulture	*Cathartes aura*	2017	X	X			
Osprey	*Pandion haliaetus*	1,796	X	X			
Golden Eagle	*Aquila chrysaetos*				SGCN		MB
Mississippi Kite	*Ictinia mississippiensis*	237					
Northern Harrier	*Circus hudsonius*	837	X				
Sharp-shinned Hawk	*Accipiter striatus*	394	X				
Cooper's Hawk	*Accipiter cooperii*	1,118	X	X			
Bald Eagle	*Haliaeetus leucocephalus*	1,656	X	X		BCC	MB
Red-shouldered Hawk	*Buteo lineatus*	564	X	X			
Broad-winged Hawk	*Buteo platypterus*		X				
Red-tailed Hawk	*Buteo jamaicensis*	1,269	X				
Barn Owl	*Tyto alba*				SGCN		
Eastern Screech-Owl	*Megascops asio*	204					
Great Horned Owl	*Bubo virginianus*	198					
Barred Owl	*Strix varia*	109	X				
Northern Saw-whet Owl	*Aegolius acadicus*				SGCN		
Belted Kingfisher	*Megaceryle alcyon*	1,340	X	X	SGCN		
Yellow-bellied Sapsucker	*Sphyrapicus varius*	605					
Red-headed Woodpecker	*Melanerpes erythrocephalus*	278	X			BCC	MB
Red-bellied Woodpecker	*Melanerpes carolinus*	1,963	X	X			
Downy Woodpecker	*Dryobates pubescens*	1,825	X	X			

Species	Scientific Name	eBird Count	NAS Oceana	Lake Tecumseh	VA Status	Fed Status	IPaC
Red-cockaded Woodpecker	*Dryobates borealis*				E	E	E
Hairy Woodpecker	*Dryobates villosus*	322		X			
Pileated Woodpecker	*Dryocopus pileatus*	1,315	X	X			
Northern Flicker	*Colaptes auratus*	1,433	X	X	SGCN		
American Kestrel	*Falco sparverius*	450	X			BCC	MB
Merlin	*Falco columbarius*	375	X				
Peregrine Falcon	*Falco peregrinus*	281	X		T	BCC	
Eastern Wood-Pewee	*Contopus virens*	388	X	X	SGCN		
Acadian Flycatcher	*Empidonax virescens*	122					
Eastern Phoebe	*Sayornis phoebe*	513	X	X			
Great Crested Flycatcher	*Myiarchus crinitus*	741	X	X			
Eastern Kingbird	*Tyrannus tyrannus*	763	X	X	SGCN		
White-eyed Vireo	*Vireo griseus*	628	X	X			
Yellow-throated Vireo	*Vireo flavifrons*	35	X	X			
Blue-headed Vireo	*Vireo solitarius*	149	X				
Red-eyed Vireo	*Vireo olivaceus*	535	X	X			
Loggerhead Shrike	*Lanius ludovicianus*				T	BCC	
Blue Jay	*Cyanocitta cristata*	2,219	X	X			
American Crow	*Corvus brachyrhynchos*	2,415	X	X			
Fish Crow	*Corvus ossifragus*	1,917	X	X			
Carolina Chickadee	*Poecile carolinensis*	2,485	X	X			
Tufted Titmouse	*Baeolophus bicolor*	2,041	X	X			
Horned Lark	*Eremophila alpestris*	81					
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	184	X		SGCN		
Purple Martin	*Progne subis*	931	X	X			
Tree Swallow	*Tachycineta bicolor*	1,314	X	X			
Bank Swallow	*Riparia riparia*	57			SGCN		
Barn Swallow	*Hirundo rustica*	911	X	X			
Golden-crowned Kinglet	*Regulus satrapa*	457	X				
Ruby-crowned Kinglet	*Regulus calendula*	707	X	X			
Red-breasted Nuthatch	*Sitta canadensis*	344	X	X			
White-breasted Nuthatch	*Sitta carolinensis*	1,266	X				
Brown-headed Nuthatch	*Sitta pusilla*	1,261	X	X		BCC	
Brown Creeper	*Certhia americana*	276	X	X			
Blue-gray Gnatcatcher	*Polioptila caerulea*	788	X	X			
House Wren	*Troglodytes aedon*	810	X				
Winter Wren	*Troglodytes hiemalis*	165	X				
Sedge Wren	*Cistothorus platensis*	102				BCC	
Marsh Wren	*Cistothorus palustris*	422	X		SGCN		
Carolina Wren	*Thryothorus ludovicianus*	2,451	X	X			
Bewick's Wren	*Thryomanes bewickii*				E	BCC	
European Starling	*Sturnus vulgaris*	2,260	X	X			
Gray Catbird	*Dumetella carolinensis*	1,491	X	X	SGCN		
Brown Thrasher	*Toxostoma rufum*	1,711	X	X	SGCN		
Northern Mockingbird	*Mimus polyglottos*	2,338	X	X			
Eastern Bluebird	*Sialia sialis*	1,810	X	X			
Veery	*Catharus fuscescens*	66					
Gray-cheeked Thrush	*Catharus minimus*			X			
Bicknell's Thrush	*Catharus bicknelli*				SGCN		
Swainson's Thrush	*Catharus ustulatus*	67					
Hermit Thrush	*Catharus guttatus*	316	X				
Wood Thrush	*Hylocichla mustelina*	186	X		SGCN	BCC	MB
American Robin	*Turdus migratorius*	2,349	X	X			
Cedar Waxwing	*Bombycilla cedrorum*	721	X	X			
House Sparrow	*Passer domesticus*	742	X	X			

Species	Scientific Name	eBird Count	NAS Oceana	Lake Tecumseh	VA Status	Fed Status	IPaC
American Pipit	*Anthus rubescens*	57					
House Finch	*Haemorhous mexicanus*	1,997	X	X			
Purple Finch	*Haemorhous purpureus*	106					
Red Crossbill	*Loxia curvirostra*				SGCN		
Pine Siskin	*Spinus pinus*	181					
American Goldfinch	*Spinus tristis*	1,852	X	X			
Snow Bunting	*Plectrophenax nivalis*		X				
Bachman's Sparrow	*Peucaea aestivalis*				T	BCC	
Grasshopper Sparrow	*Ammodramus savannarum*				SGCN		
Chipping Sparrow	*Spizella passerina*	1,360	X	X			
Clay-colored Sparrow	*Spizella pallida*	45					
Field Sparrow	*Spizella pusilla*	1,106	X	X	SGCN		
Lark Sparrow	*Chondestes grammacus*	82					
Fox Sparrow	*Passerella iliaca*	206	X	X			
Dark-eyed Junco	*Junco hyemalis*	732	X	X			
White-crowned Sparrow	*Zonotrichia leucophrys*	151	X	X			
White-throated Sparrow	*Zonotrichia albicollis*	1,238	X	X			
Seaside Sparrow	*Ammospiza maritima*	56	X		SGCN	BCC	MB
Savannah Sparrow	*Passerculus sandwichensis*	620					
Song Sparrow	*Melospiza melodia*	1,980					
Swamp Sparrow	*Melospiza georgiana*	765	X				
Eastern Towhee	*Pipilo erythrophthalmus*	1,767			SGCN		
Saltmarsh Sparrow	*Ammospiza caudacuta*		X	X	SGCN	BCC	
Henslow's Sparrow	*Centronyx henslowii*		X	X	T	BCC	
Nelson's Sparrow	*Ammospiza nelsoni*		X	X	SGCN	BCC	MB
Yellow-breasted Chat	*Icteria virens*	444	X		SGCN		
Bobolink	*Dolichonyx oryzivorus*	100					MB
Eastern Meadowlark	*Sturnella magna*	591			SGCN		
Orchard Oriole	*Icterus spurius*	281	X				
Baltimore Oriole	*Icterus galbula*	591					
Red-winged Blackbird	*Agelaius phoeniceus*	2,092	X				
Brown-headed Cowbird	*Molothrus ater*	1,307	X	X			
Rusty Blackbird	*Euphagus carolinus*	38			SGCN	BCC	MB
Brewer's Blackbird	*Euphagus cyanocephalus*	30					
Common Grackle	*Quiscalus quiscula*	1,962	X	X			
Boat-tailed Grackle	*Quiscalus major*	1,492	X				
Ovenbird	*Seiurus aurocapilla*	311	X				
Worm-eating Warbler	*Helmitheros vermivorum*	37					
Northern Waterthrush	*Parkesia noveboracensis*	98					
Golden-winged Warbler	*Vermivora chrysoptera*				SGCN		
Black-and-white Warbler	*Mniotilta varia*	296	X	X	SGCN		
Prothonotary Warbler	*Protonotaria citrea*	440	X	X		BCC	MB
Swainson's Warbler	*Limnothlypis swainsonii*				SGCN	BCC	
Orange-crowned Warbler	*Leiothlypis celata*	478	X	X			
Nashville Warbler	*Leiothlypis ruficapilla*	56	X				
Kentucky Warbler	*Geothlypis formosa*				SGCN	BCC	MB
Common Yellowthroat	*Geothlypis trichas*	1,040	X	X			
Hooded Warbler	*Setophaga citrina*	41					
American Redstart	*Setophaga ruticilla*	322	X	X			
Cape May Warbler	*Setophaga tigrina*	73	X	X			
Cerulean Warbler	*Setophaga cerulea*				SGCN	BCC	MB
Northern Parula	*Setophaga americana*	367	X	X			
Magnolia Warbler	*Setophaga magnolia*	130	X				
Yellow Warbler	*Setophaga petechia*	238	X	X			
Blackpoll Warbler	*Setophaga striata*	218	X	X			

Species	Scientific Name	eBird Count	NAS Oceana	Lake Tecumseh	VA Status	Fed Status	IPaC
Black-throated Blue Warbler	*Setophaga caerulescens*	158		X			
Palm Warbler	*Setophaga palmarum*	419	X				
Pine Warbler	*Setophaga pinus*	1,608	X	X			
Yellow-rumped Warbler	*Setophaga coronata*	1,595	X	X			
Yellow-throated Warbler	*Setophaga dominica*	171	X				
Prairie Warbler	*Setophaga discolor*	527	X	X		BCC	MB
Black-throated Green Warbler	*Setophaga virens*	69	X	X		BCC	
Canada Warbler	*Cardellina canadensis*				SGCN		
Wilson's Warbler	*Cardellina pusilla*	35					
Summer Tanager	*Piranga rubra*	262	X				
Scarlet Tanager	*Piranga olivacea*	70		X			
Western Tanager	*Piranga ludoviciana*	35					
Northern Cardinal	*Cardinalis cardinalis*	2,586	X	X			
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	76					
Blue Grosbeak	*Passerina caerulea*	808	X	X			
Indigo Bunting	*Passerina cyanea*	783	X	X			
Painted Bunting	*Passerina ciris*	141				BCC	

SGCN = Species of Greatest Conservation Need, BCC = Bird of Conservation Concern, MB = Migratory Bird, T = Threatened, E = Endangered

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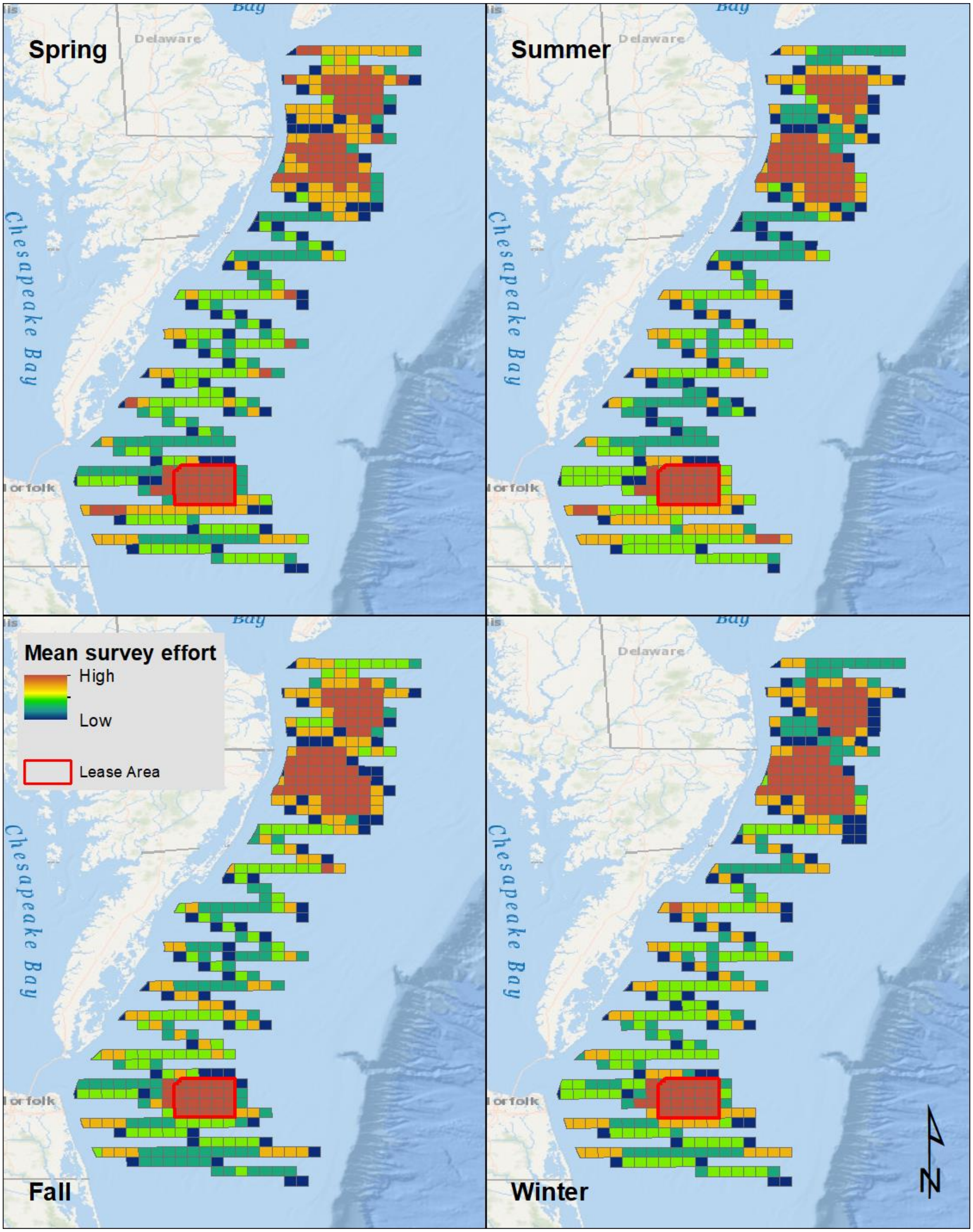
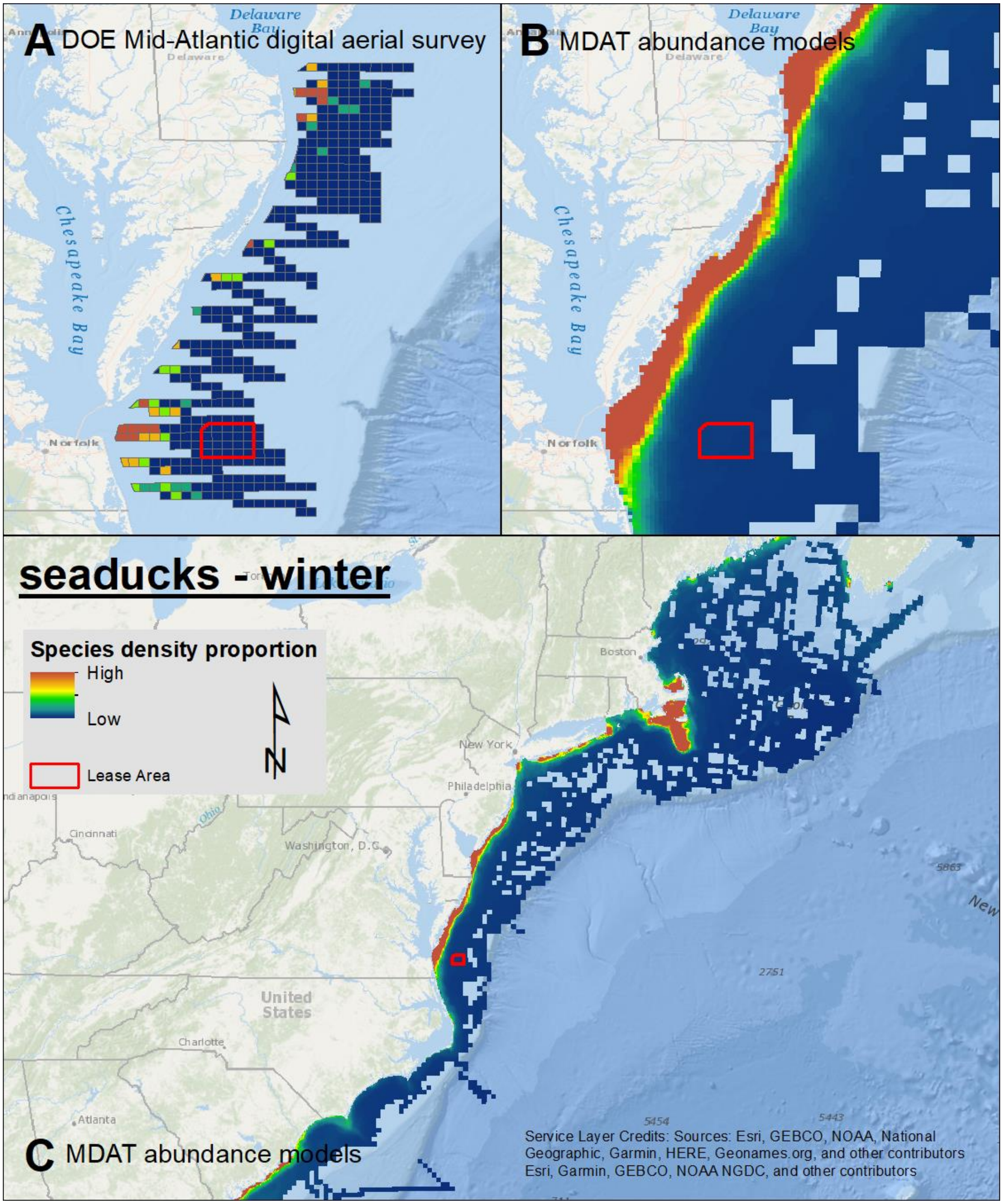
Part V: Maps - Assessment of Exposure for Marine Birds for the Lease Area

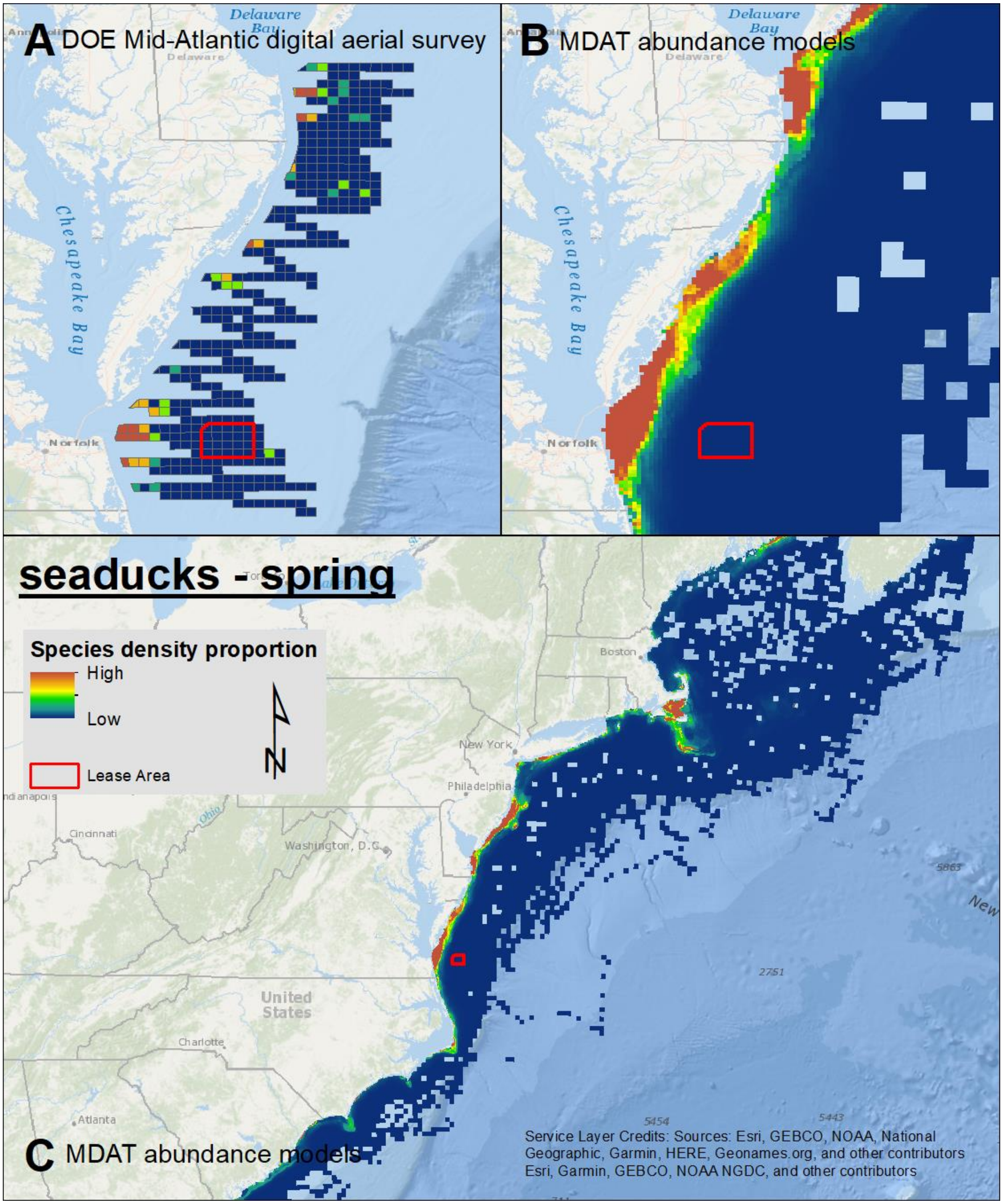
5.1 Table of Maps



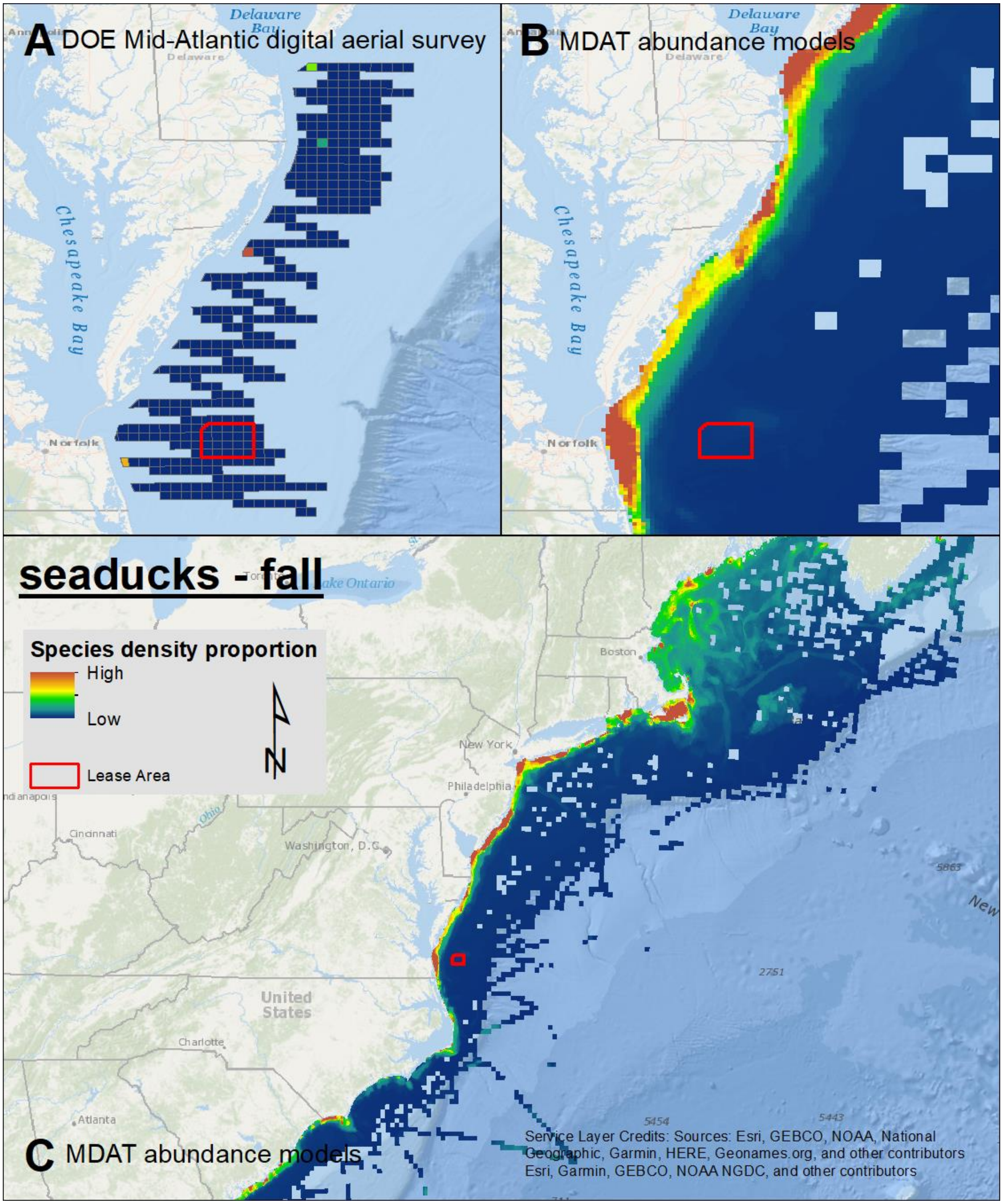
Map 1. DOE Mid-Atlantic high-resolution digital aerial baseline seasonal survey effort. Mean survey effort in sq. km by full or partial lease block inside and outside the Lease Area.



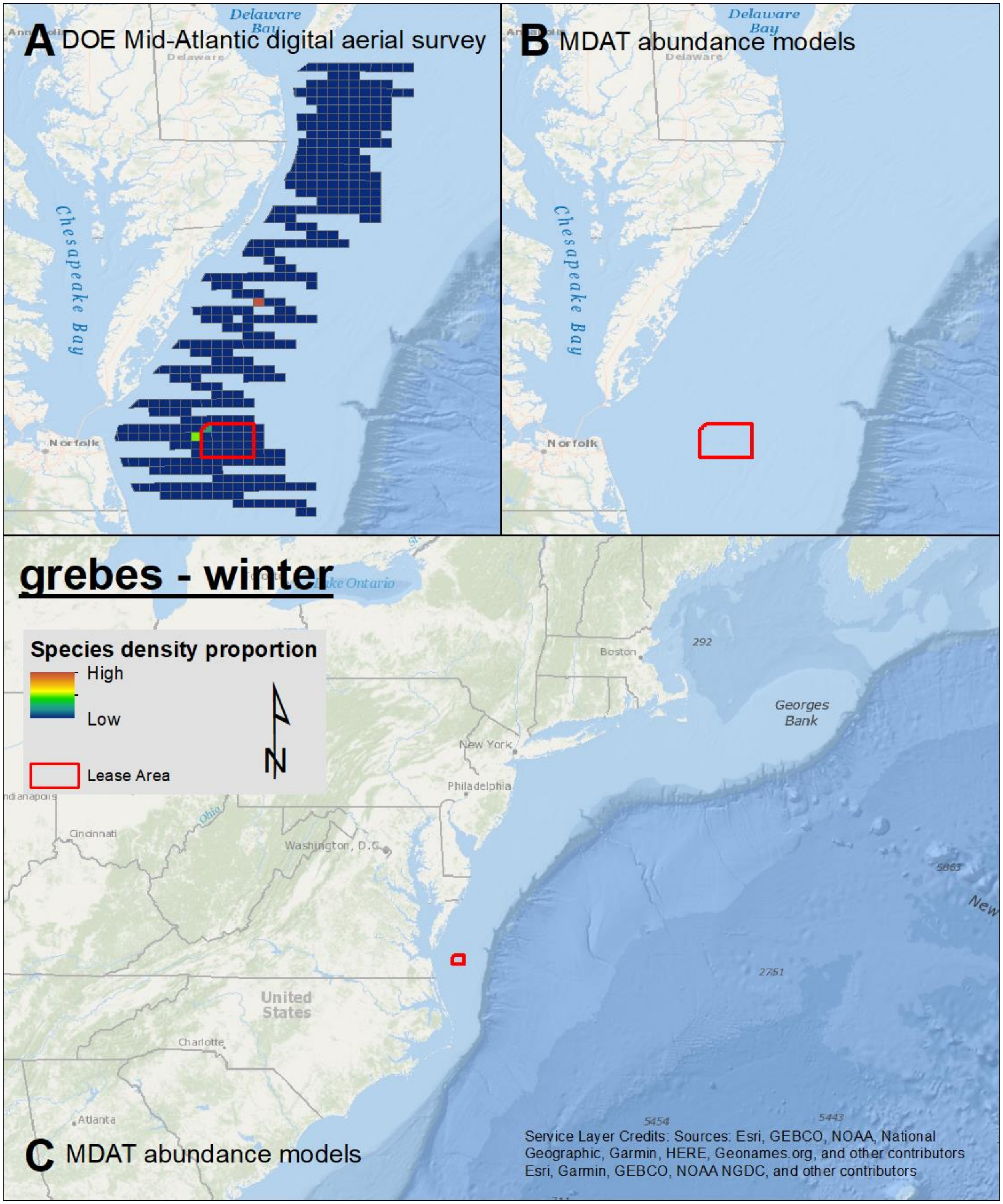
Map 2. Winter sea ducks density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Surf Scoter, White-winged Scoter, Black Scoter, Unidentified Scoter and MDAT maps: Black Scoter, Surf Scoter, White-winged Scoter.



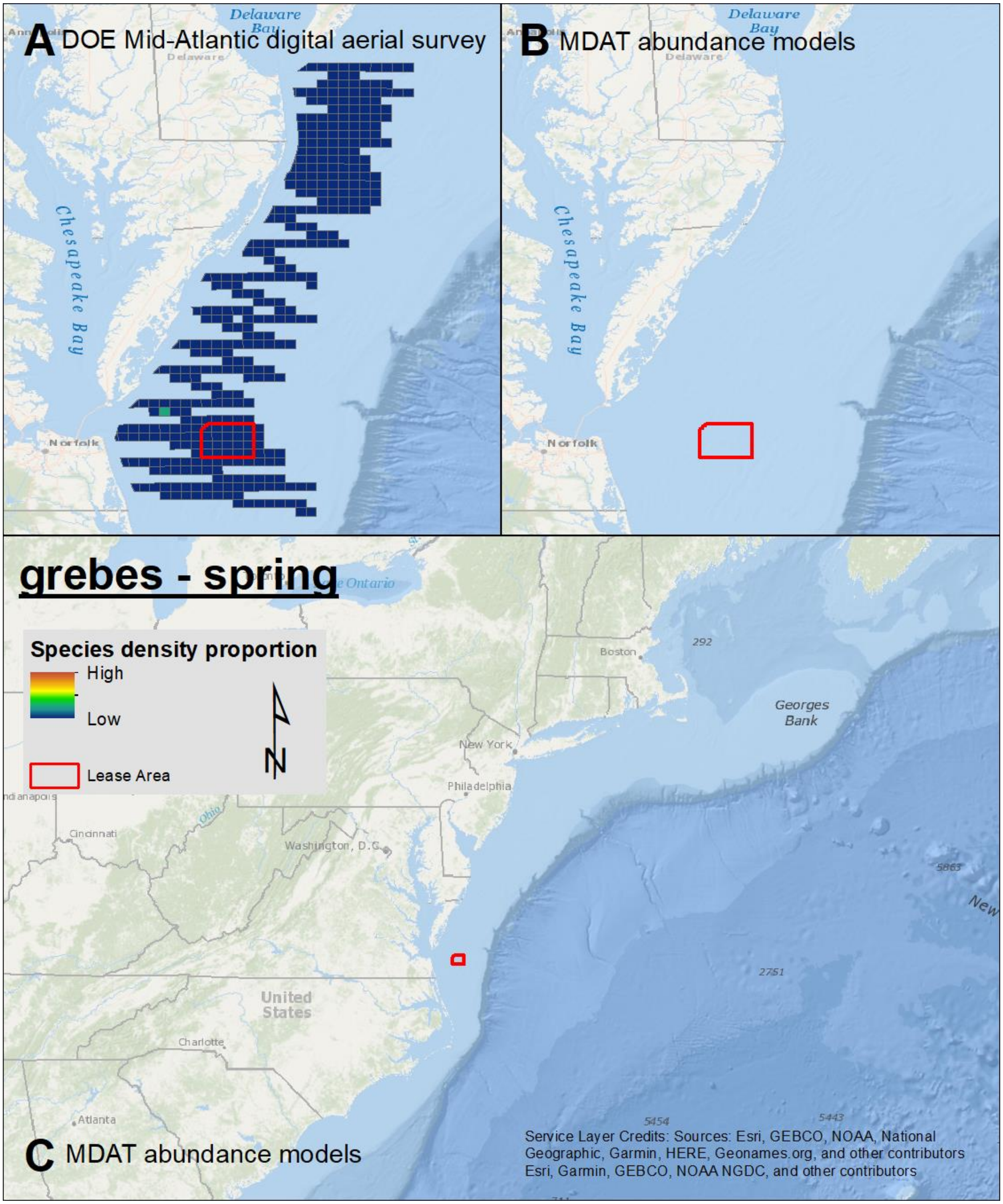
Map 3. Spring sea ducks density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Surf Scoter, White-winged Scoter, Black Scoter, Unidentified Scoter and MDAT maps: Black Scoter, Surf Scoter, White-winged Scoter.



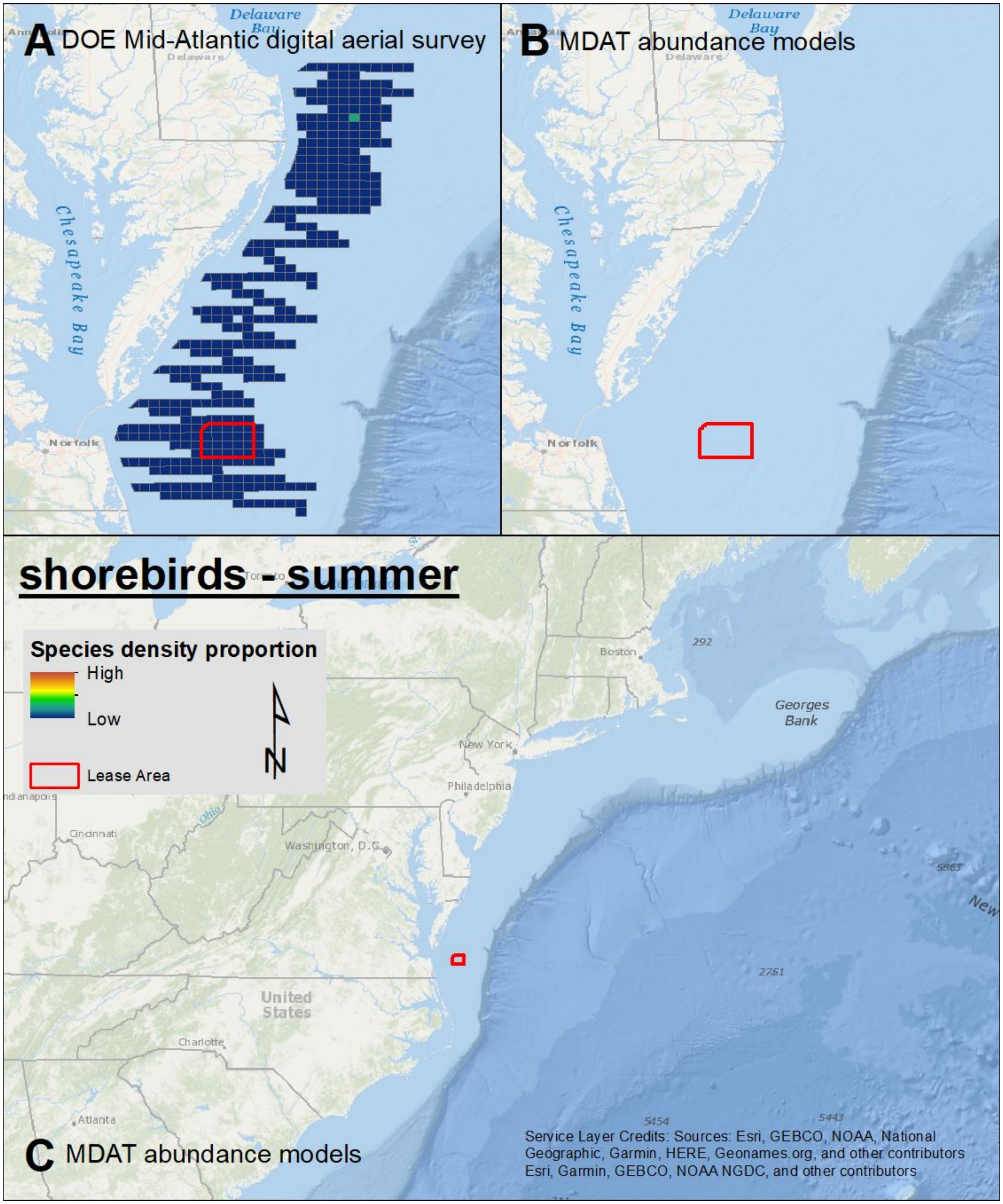
Map 4. Fall sea ducks density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Black Scoter, Unidentified Scoter and MDAT maps: Black Scoter.



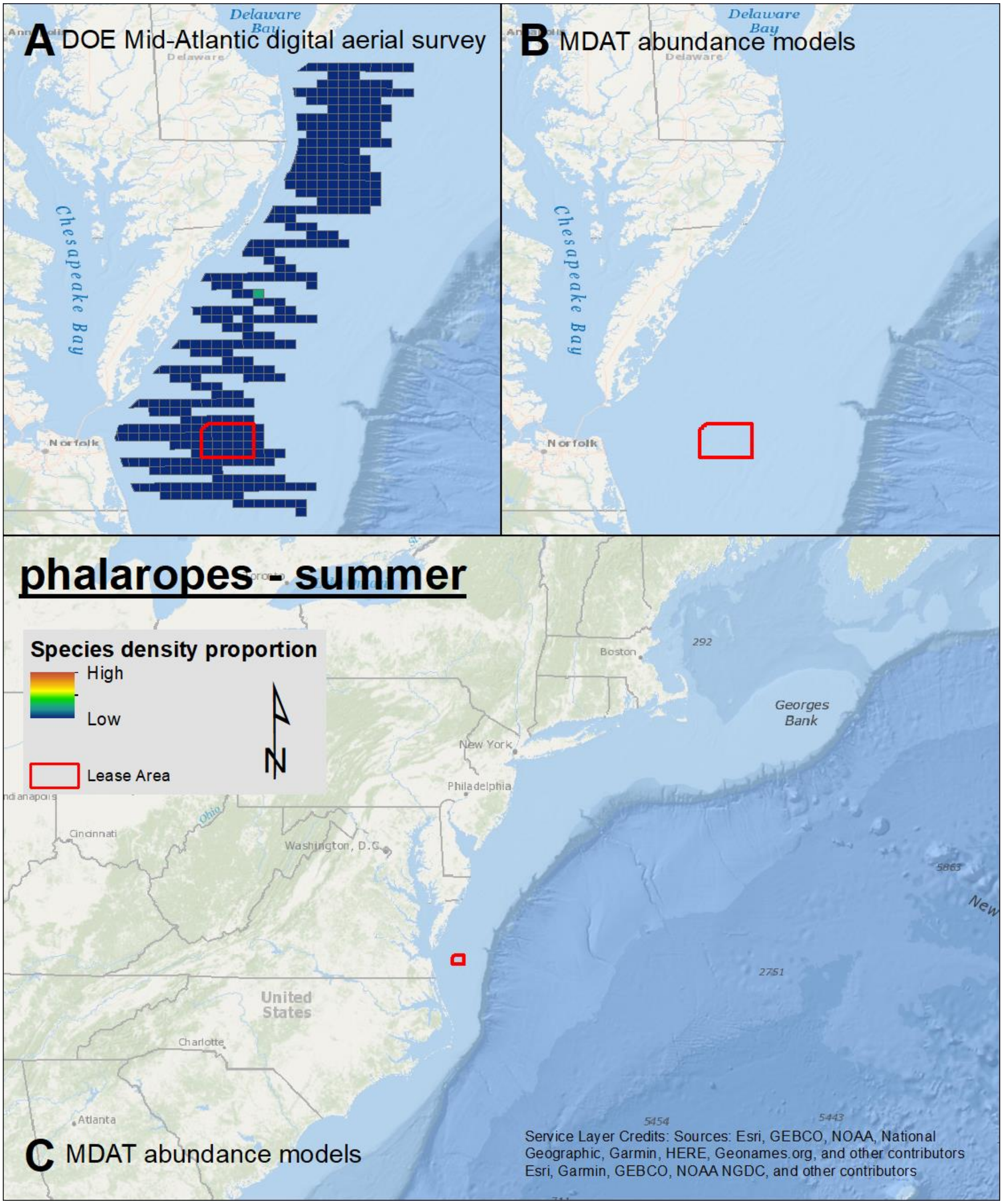
Map 5. Winter grebes density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Grebe and MDAT maps: NA.



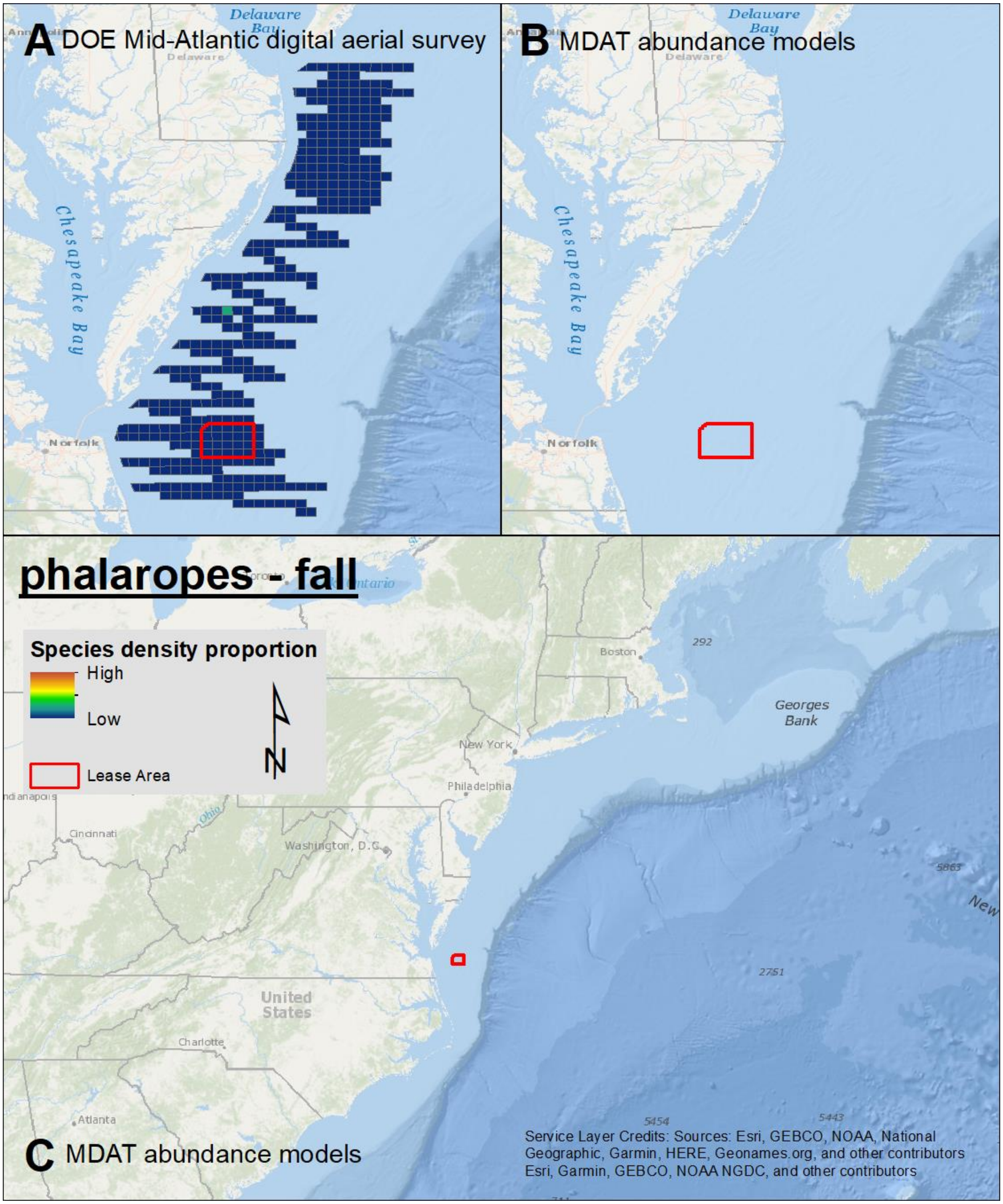
Map 6. Spring grebes density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Horned Grebe and MDAT maps: NA.



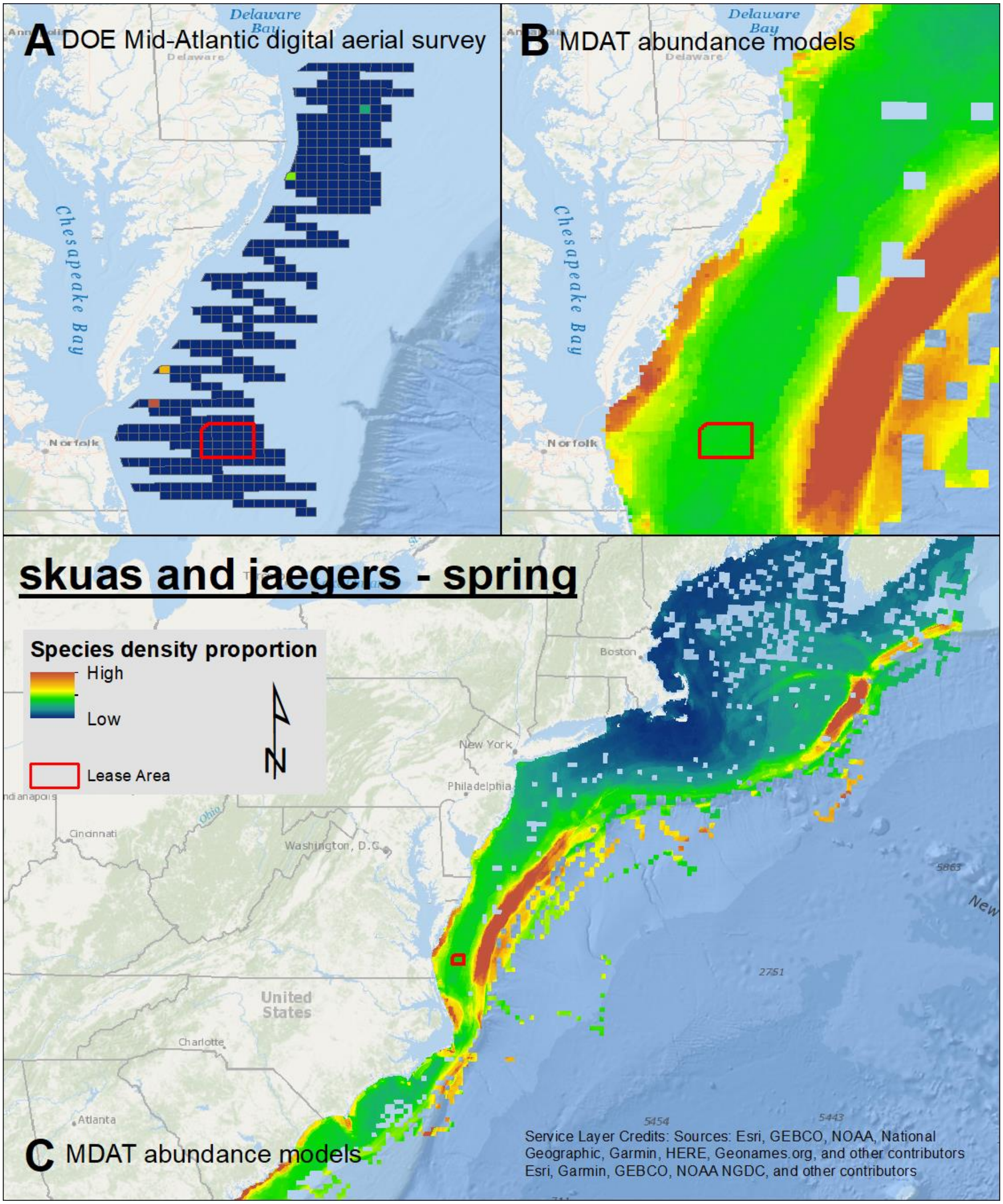
Map 7. Summer shorebirds density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Dowitcher spp. and MDAT maps: NA.



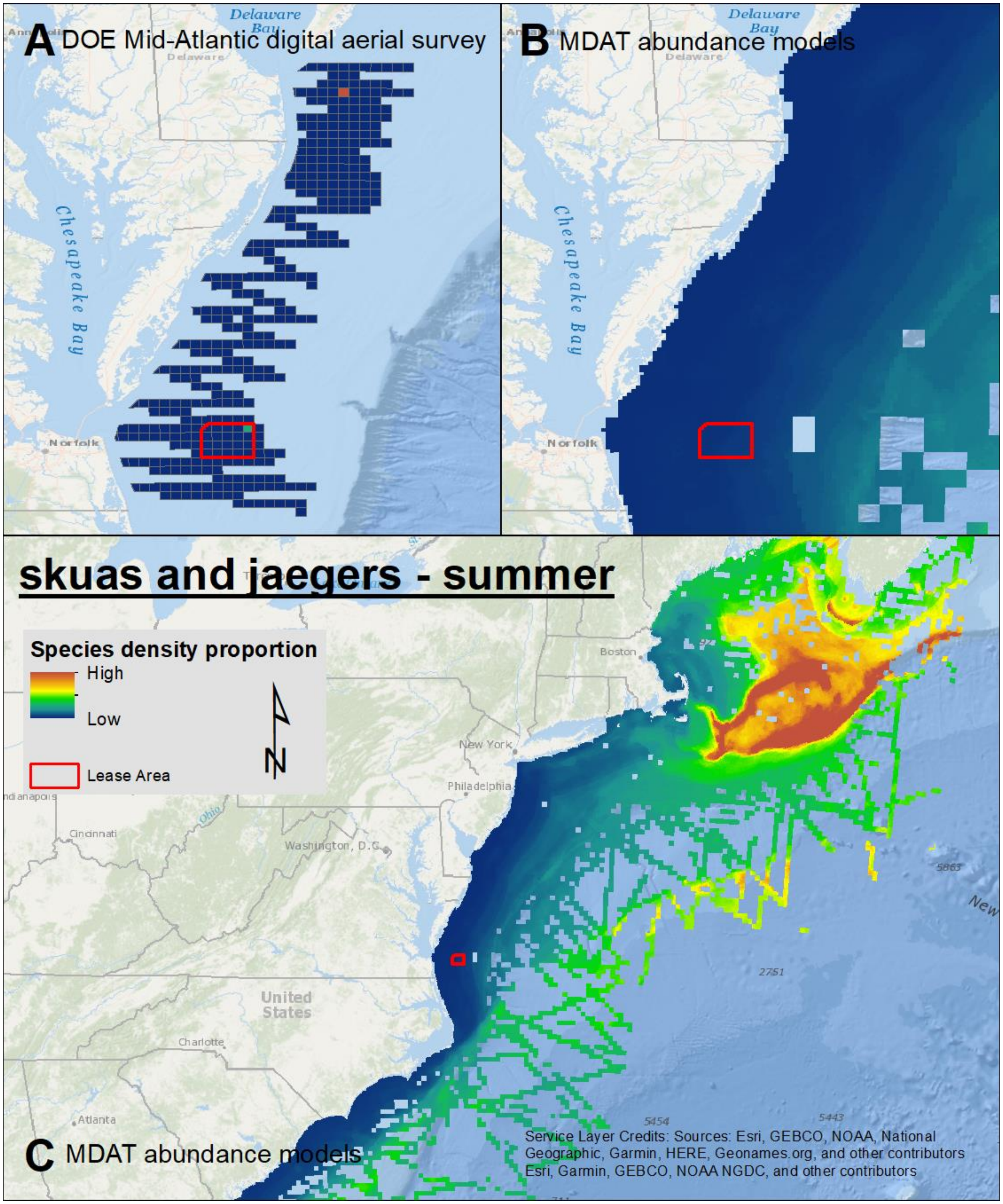
Map 8. Summer phalaropes density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Phalarope and MDAT maps: NA.



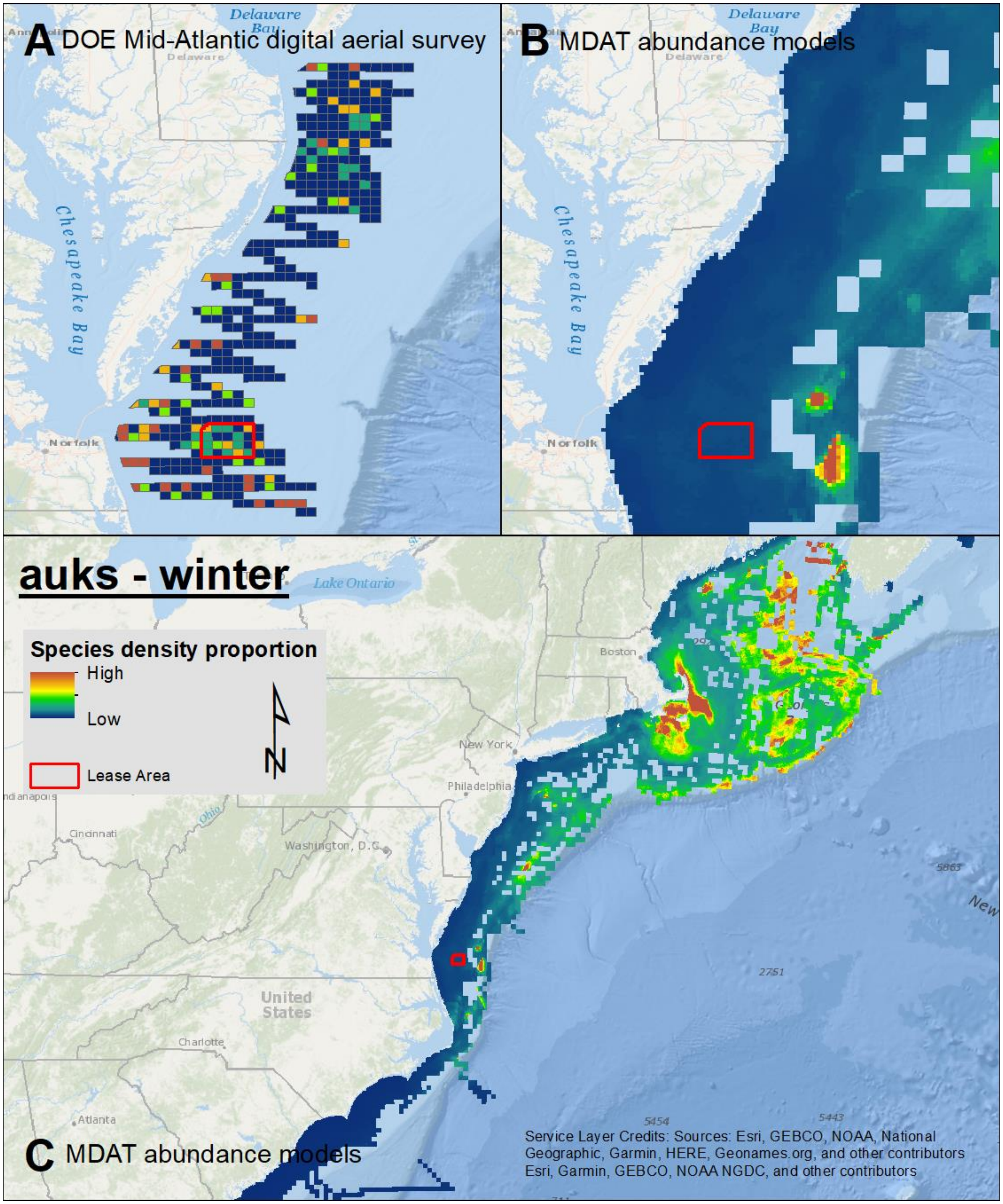
Map 9. Fall phalaropes density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Phalarope and MDAT maps: NA.



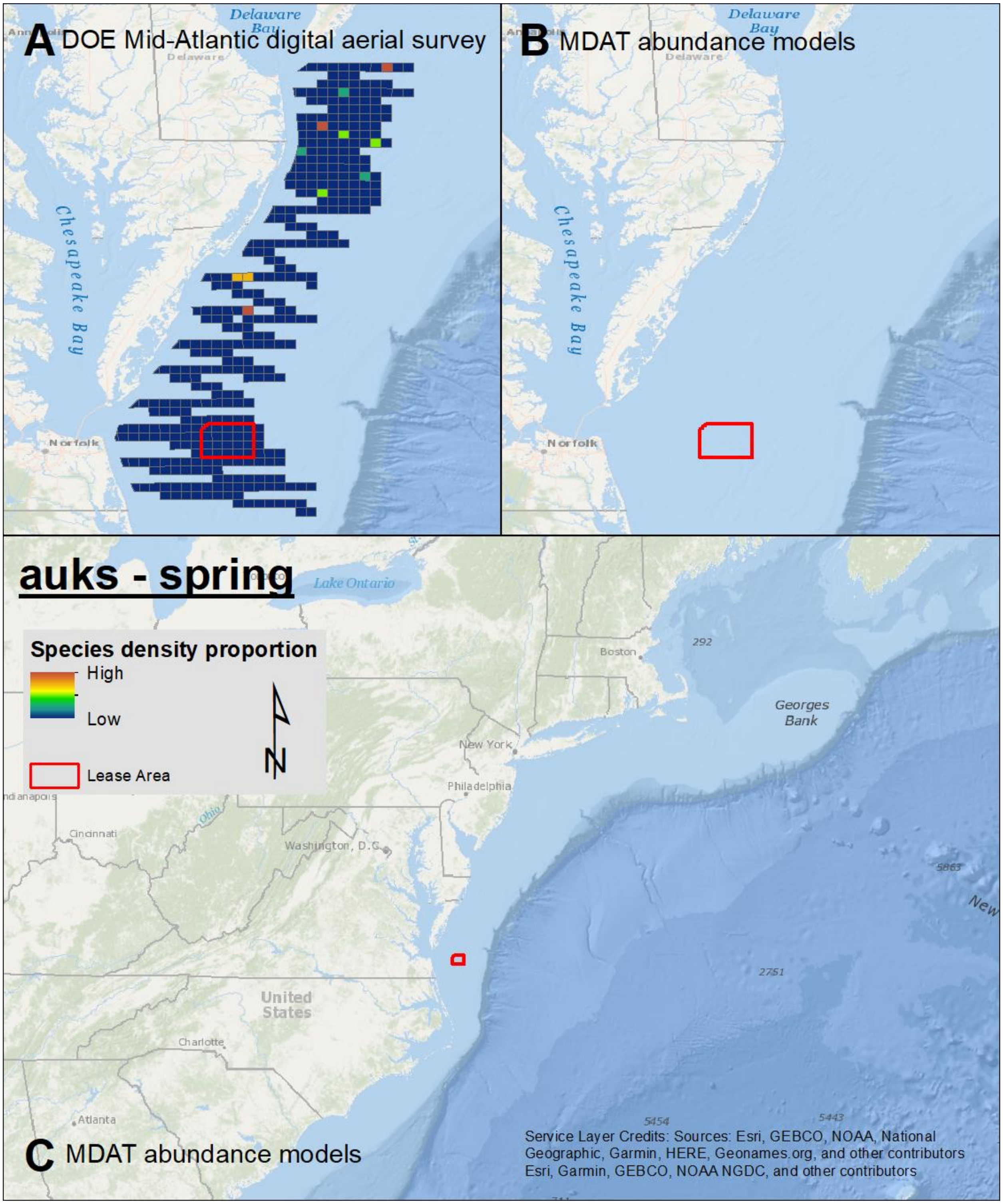
Map 10. Spring skuas and jaegers density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Parasitic Jaeger, Unidentified Jaeger and MDAT maps: Parasitic Jaeger.



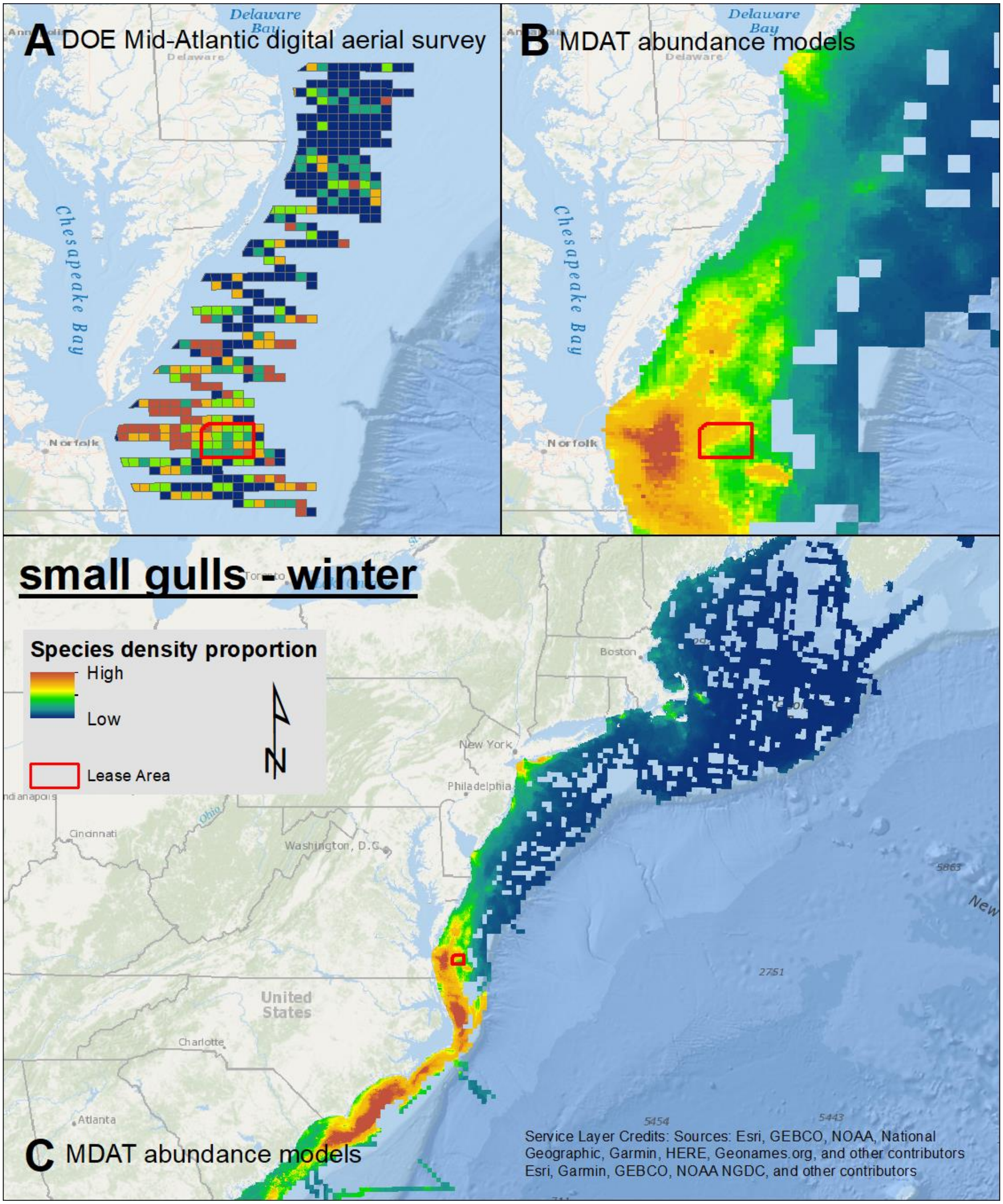
Map 11. Summer skuas and jaegers density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Pomarine Jaeger, Unidentified Jaeger and MDAT maps: Pomarine Jaeger.



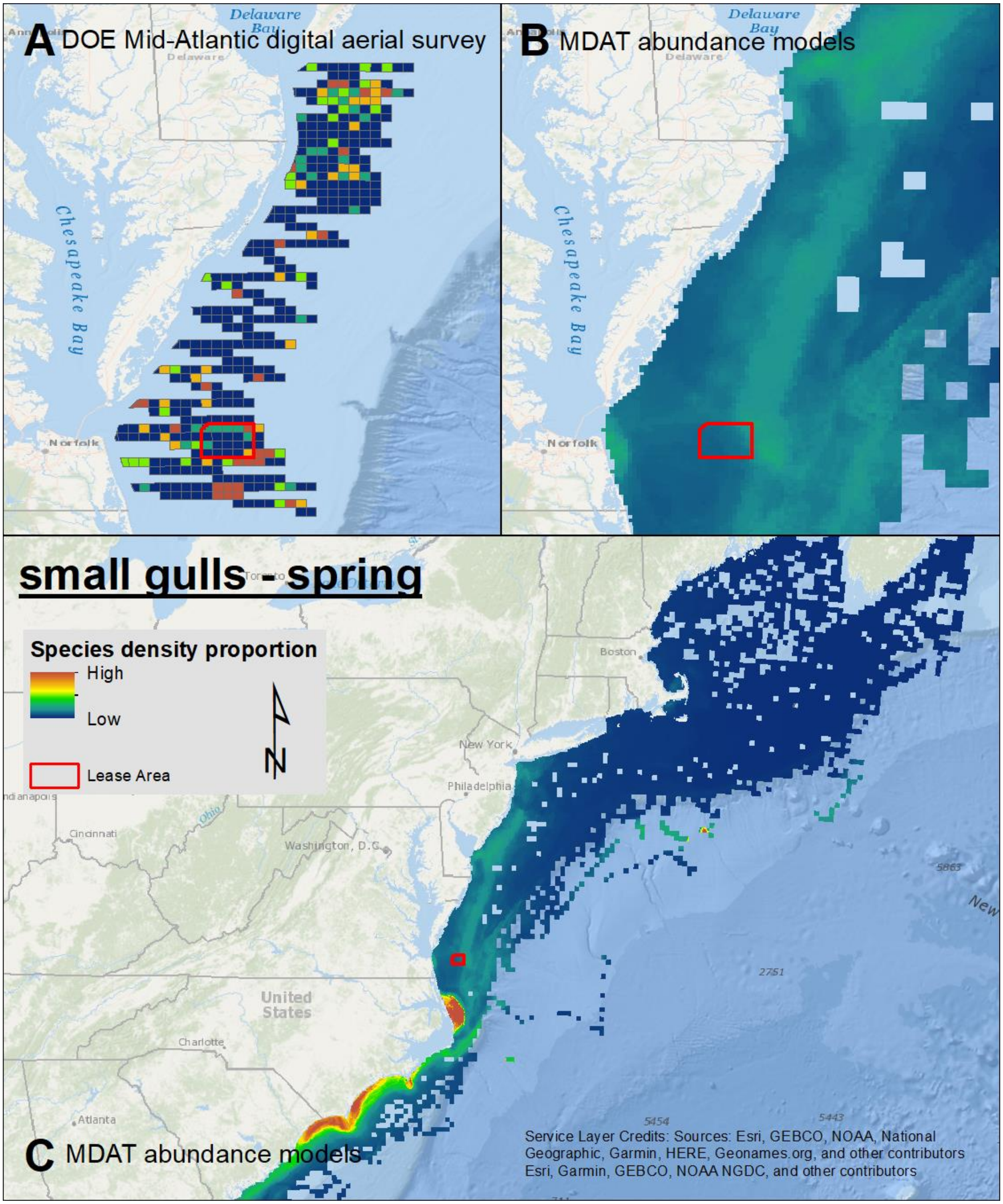
Map 12. Winter auks density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Dovekie, Razorbill, Atlantic Puffin, Unidentified Alcid, Unidentified large alcid (Razorbill or Murre), Unidentified small alcid (Puffin/Dovekie) and MDAT maps: Atlantic Puffin, Dovekie, Razorbill.



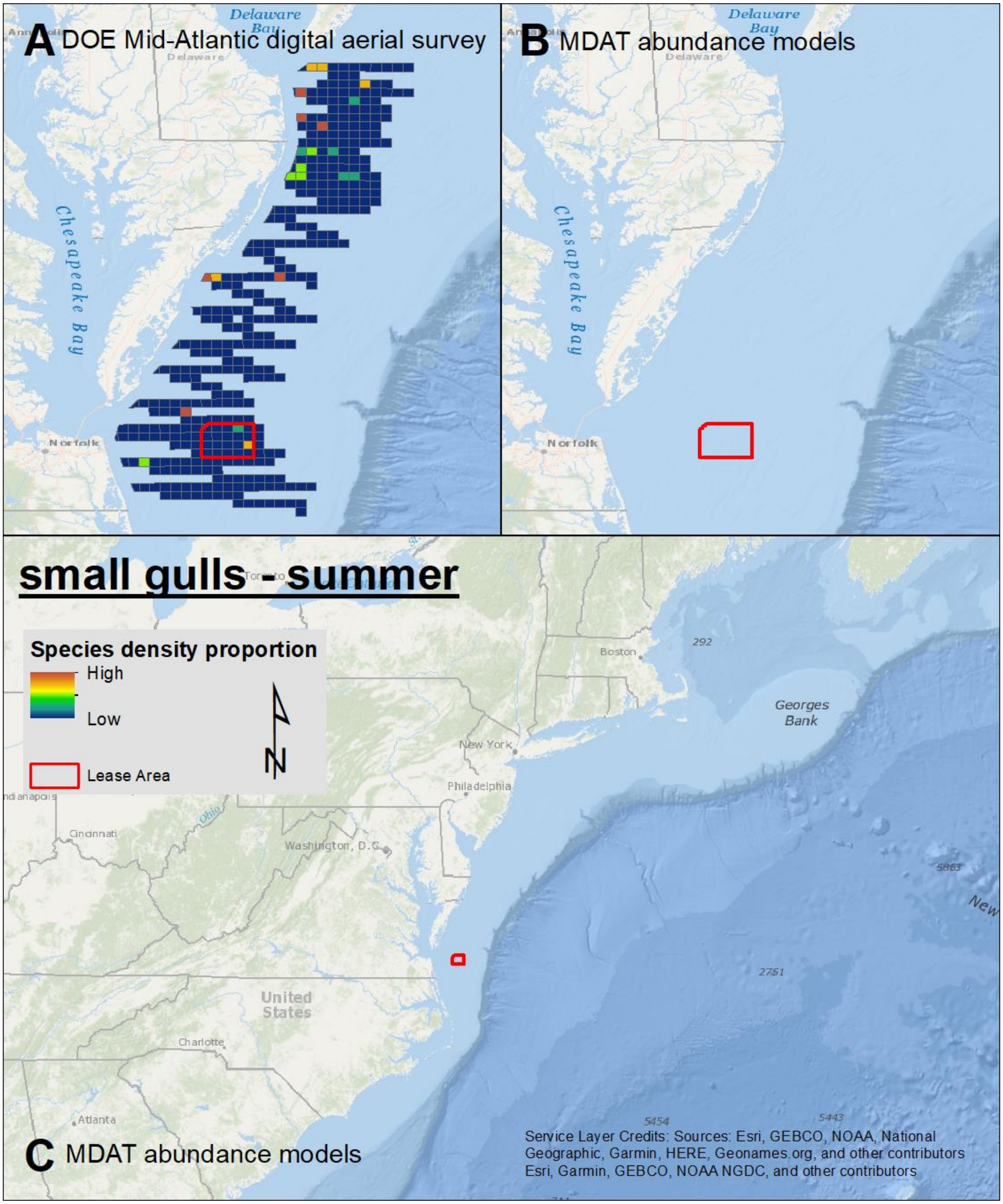
Map 13. Spring auks density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Alcid, Unidentified small alcid (Puffin/Dovekie) and MDAT maps: NA.



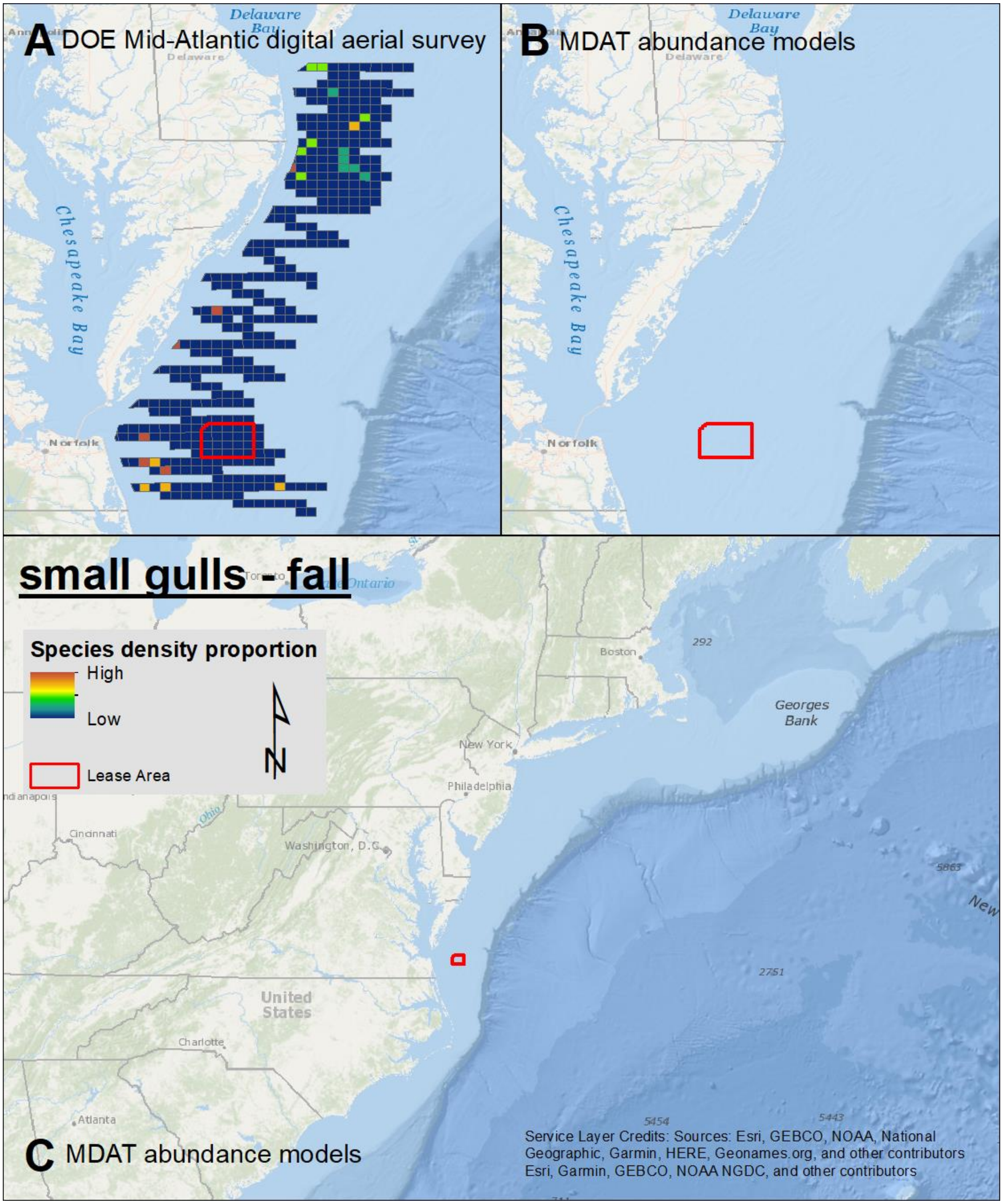
Map 14. Winter small gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Bonaparte's Gull, Unidentified Small Gull/Tern, Unidentified small gull and MDAT maps: Bonaparte's Gull.



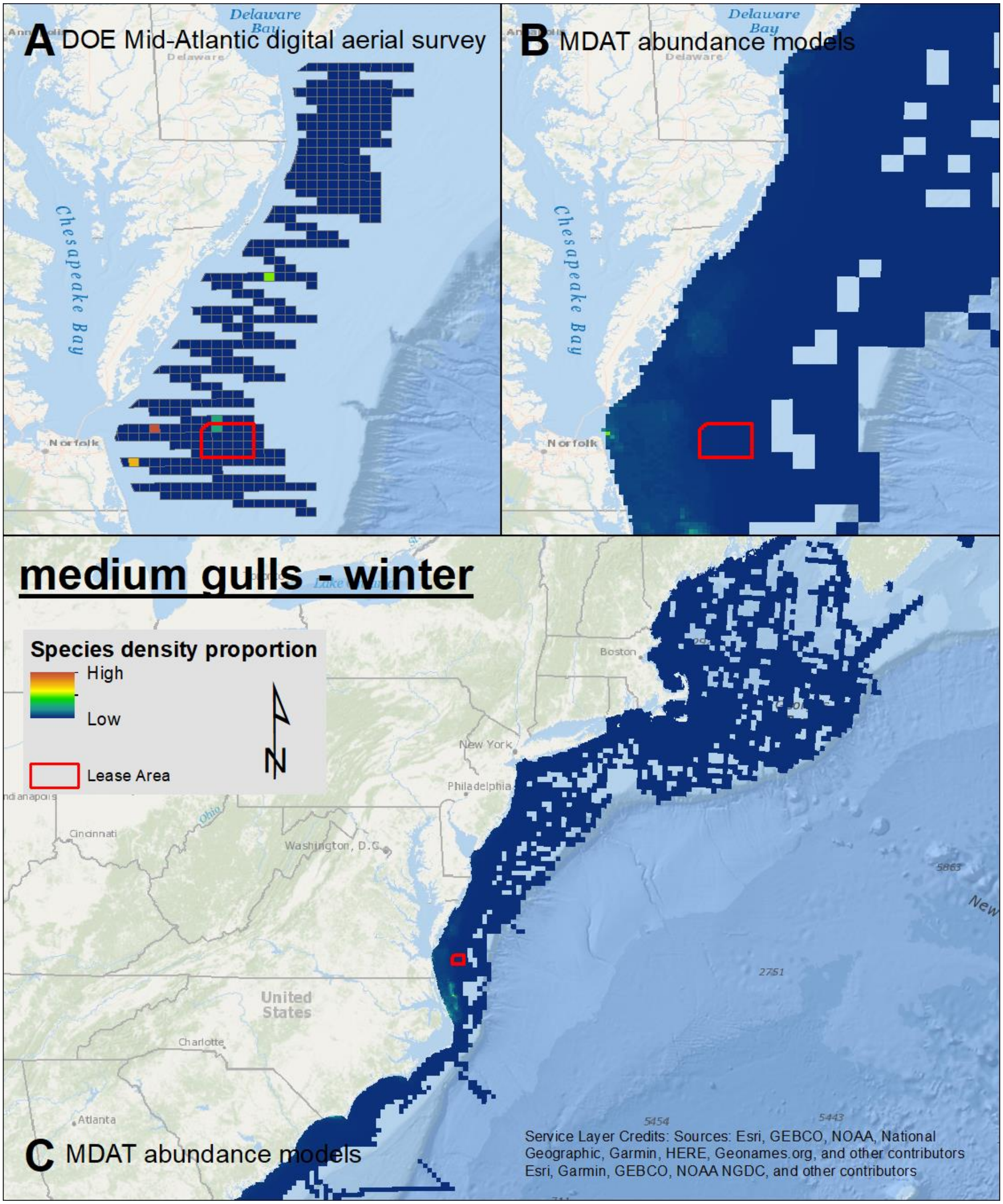
Map 15. Spring small gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Bonaparte's Gull, Unidentified Small Gull/Tern, Unidentified small gull and MDAT maps: Bonaparte's Gull.



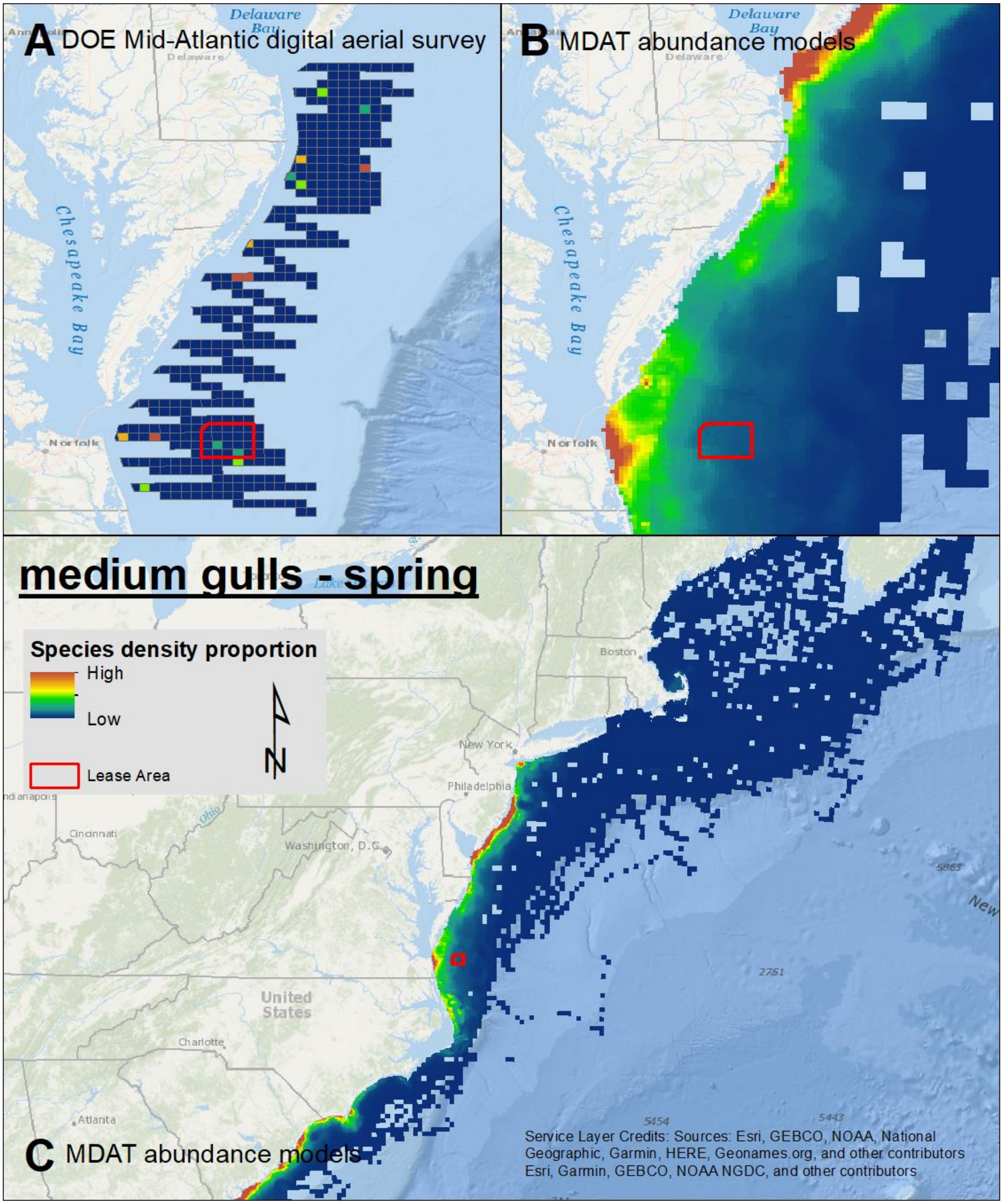
Map 16. Summer small gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Small Gull/Tern, Unidentified small gull and MDAT maps: NA.



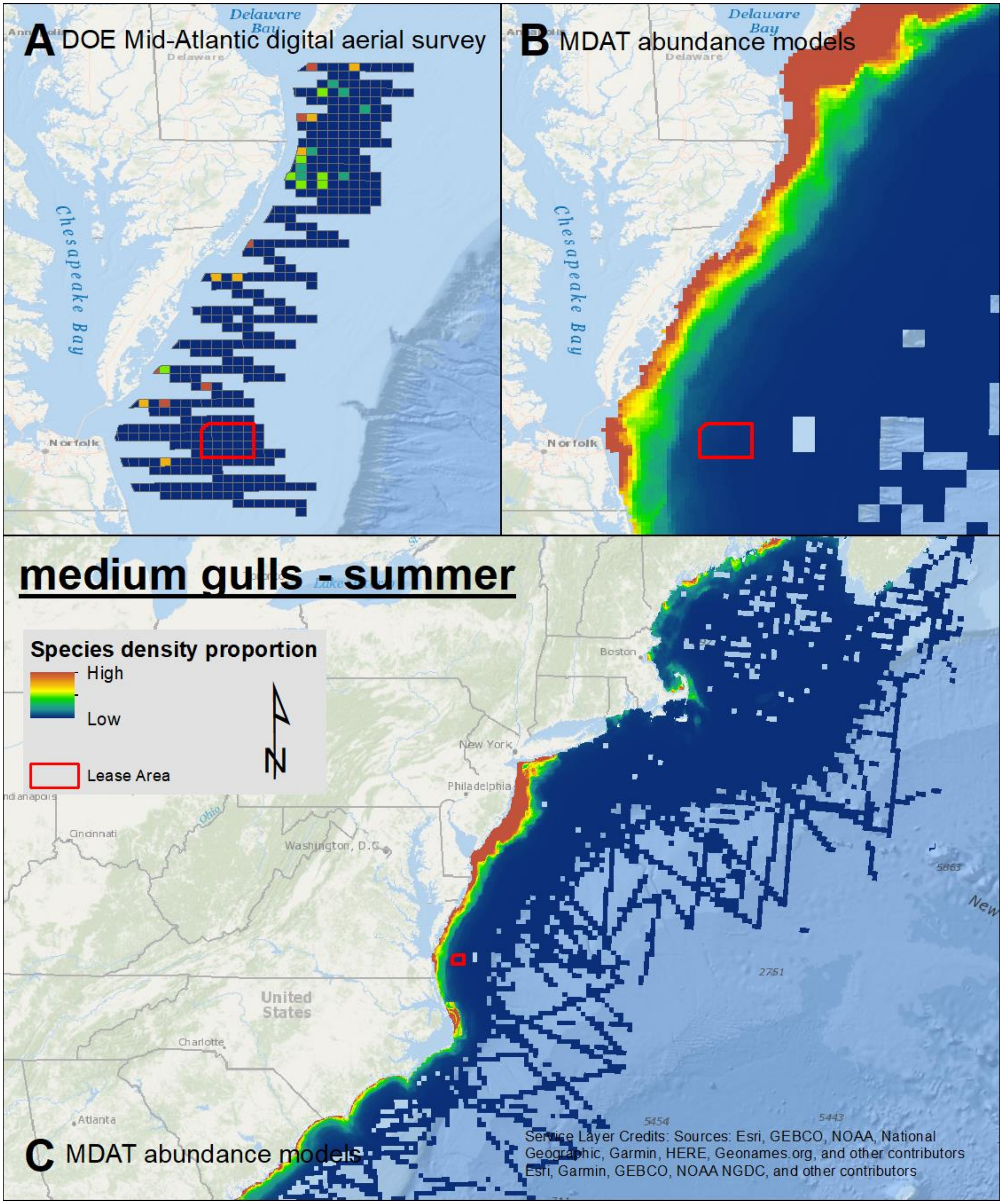
Map 17. Fall small gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Sabine's Gull, Unidentified Small Gull/Tern, Unidentified small gull and MDAT maps: NA.



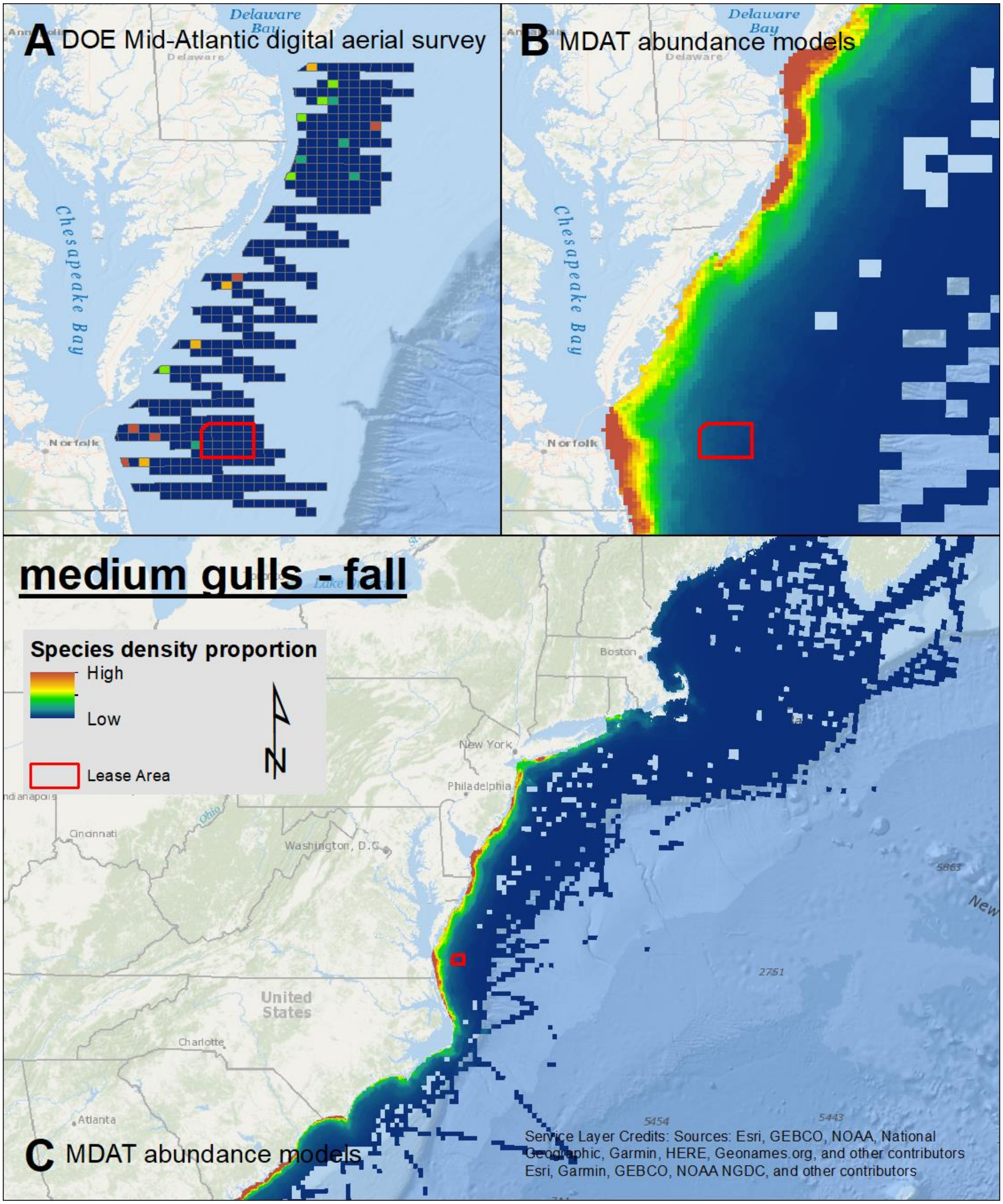
Map 18. Winter medium gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Laughing Gull, Unidentified medium gull and MDAT maps: Laughing Gull.



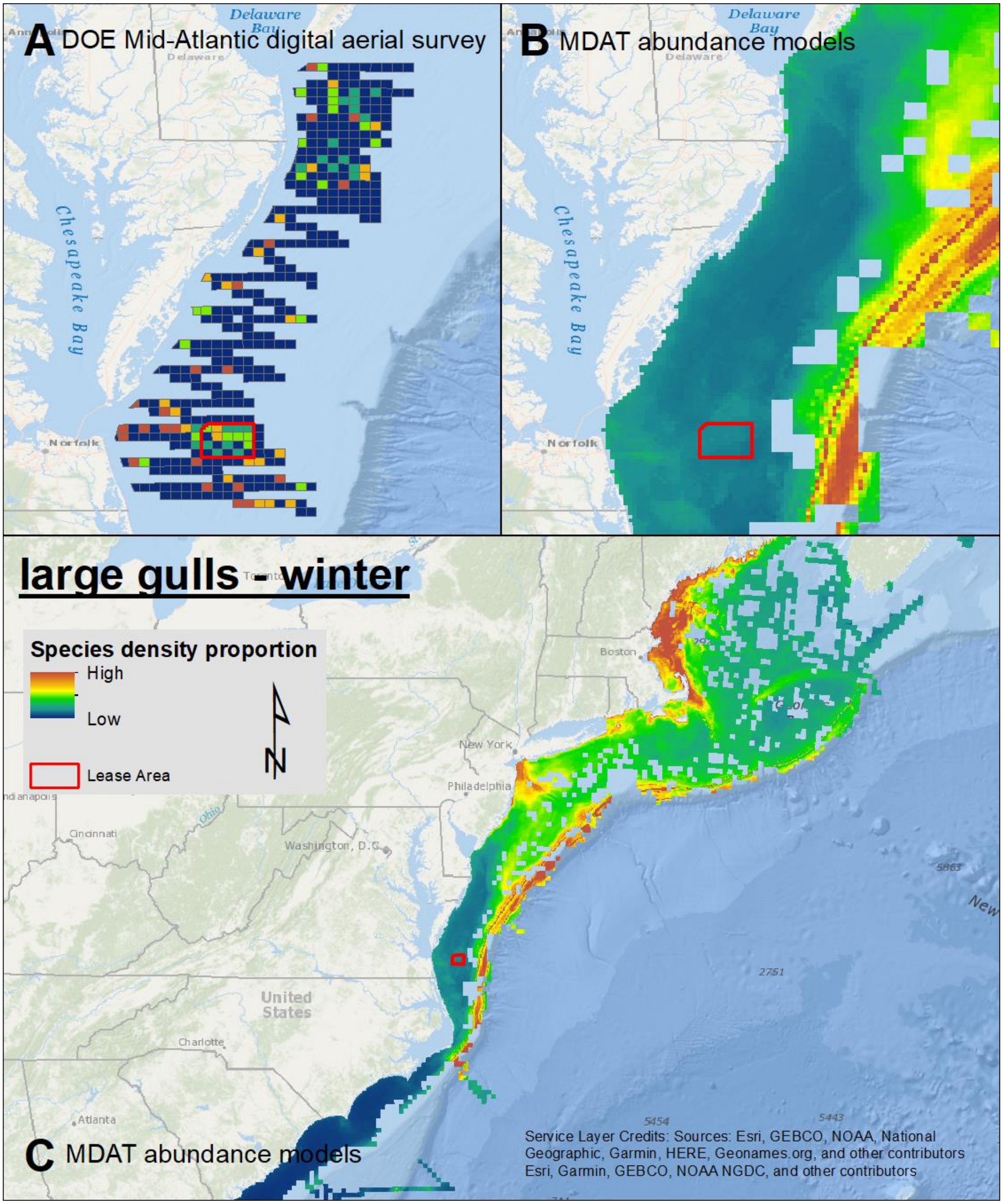
Map 19. Spring medium gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Laughing Gull, Ring-billed Gull, Unidentified medium gull and MDAT maps: Laughing Gull.



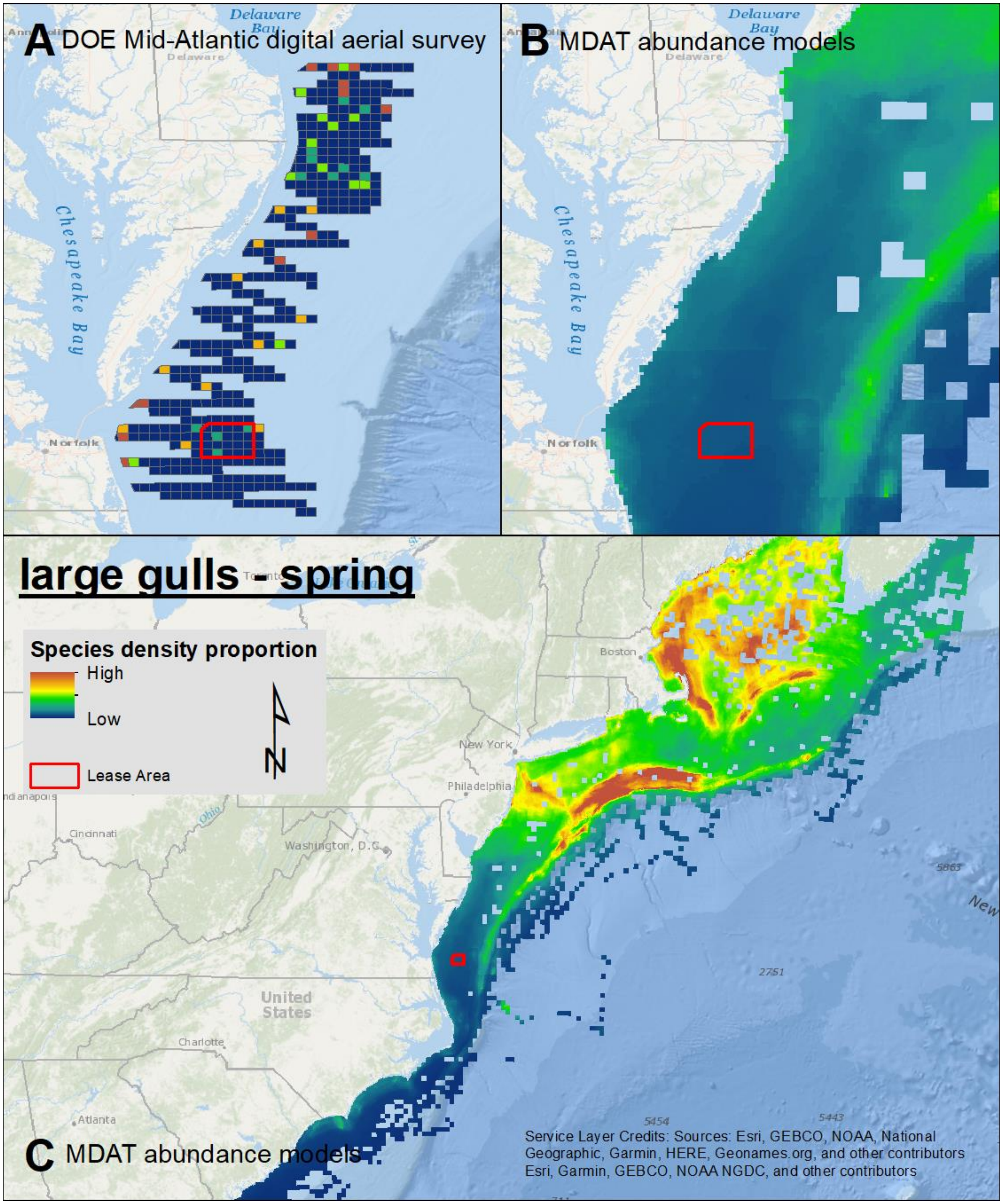
Map 20. Summer medium gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Laughing Gull, Unidentified medium gull and MDAT maps: Laughing Gull.



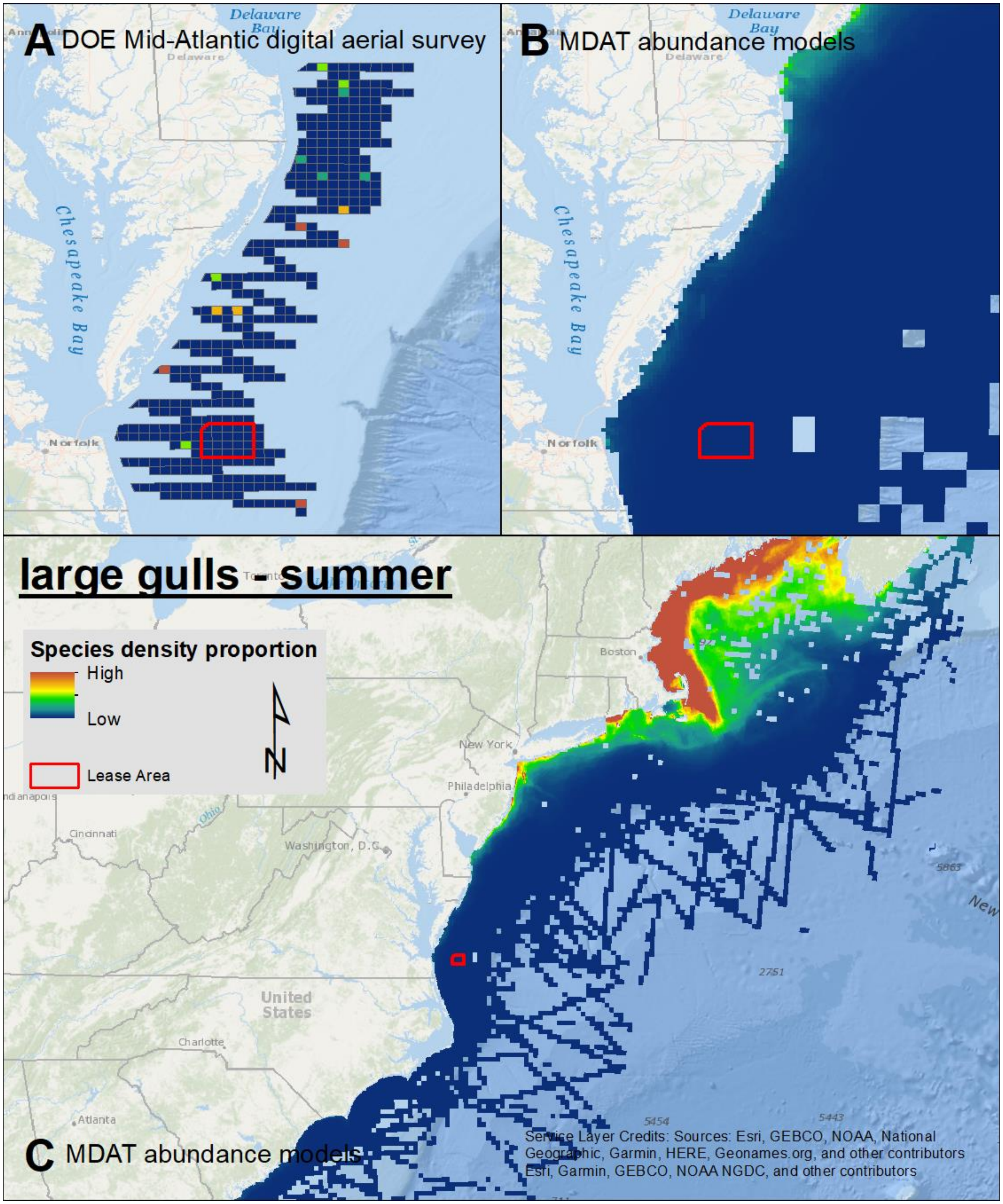
Map 21. Fall medium gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Laughing Gull, Unidentified medium gull and MDAT maps: Laughing Gull.



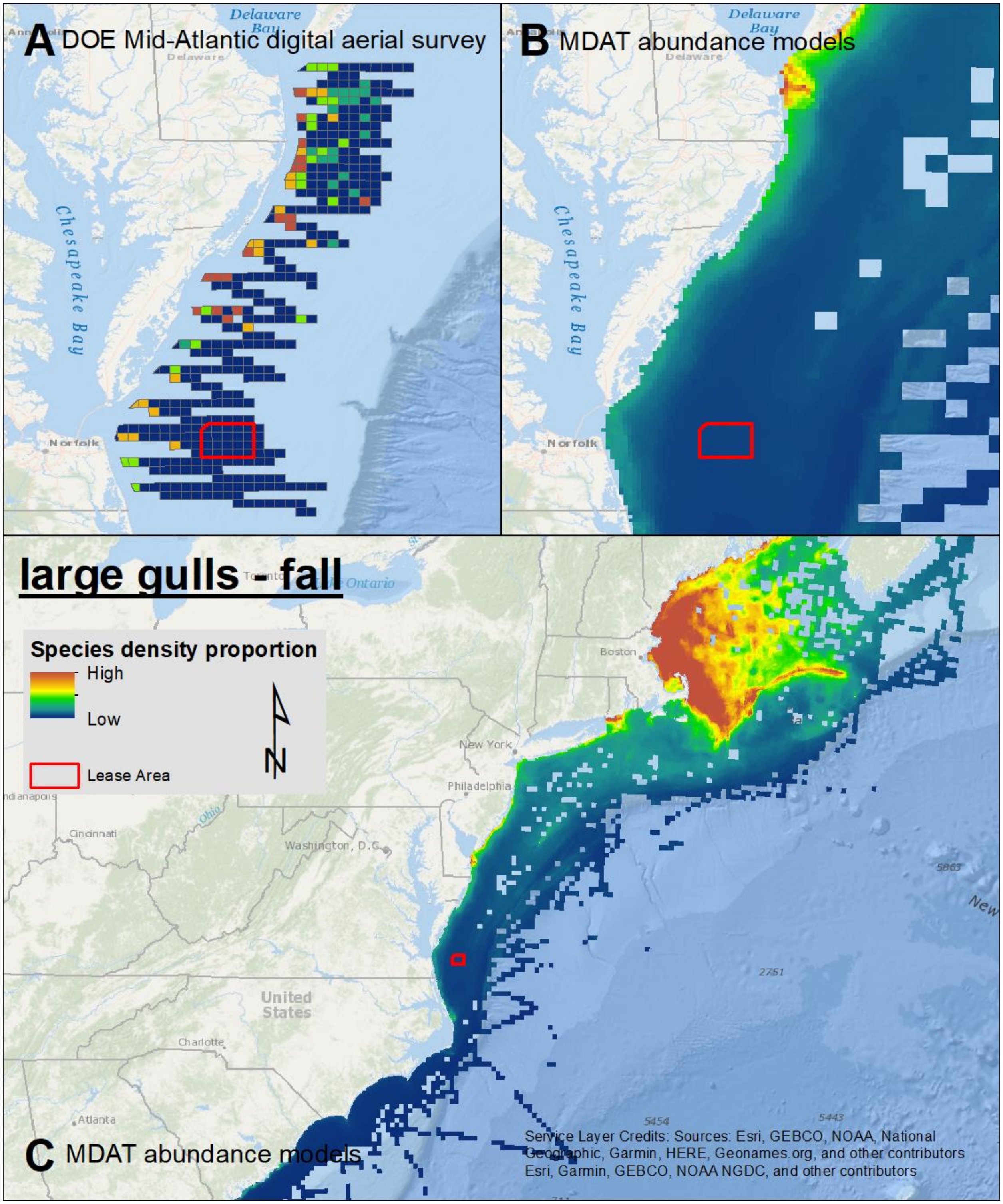
Map 22. Winter large gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull and MDAT maps: Great Black-backed Gull, Herring Gull.



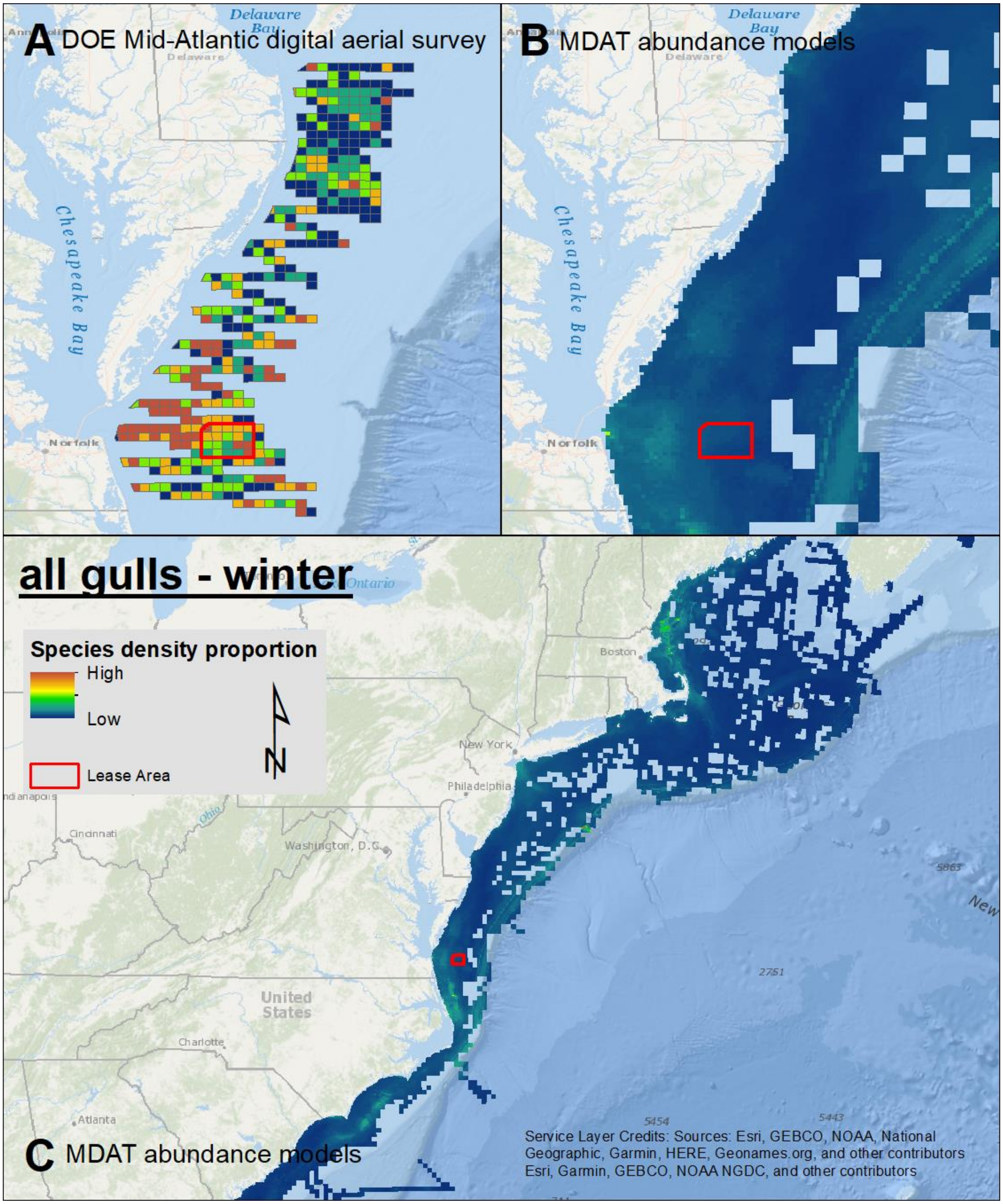
Map 23. Spring large gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull and MDAT maps: Great Black-backed Gull, Herring Gull.



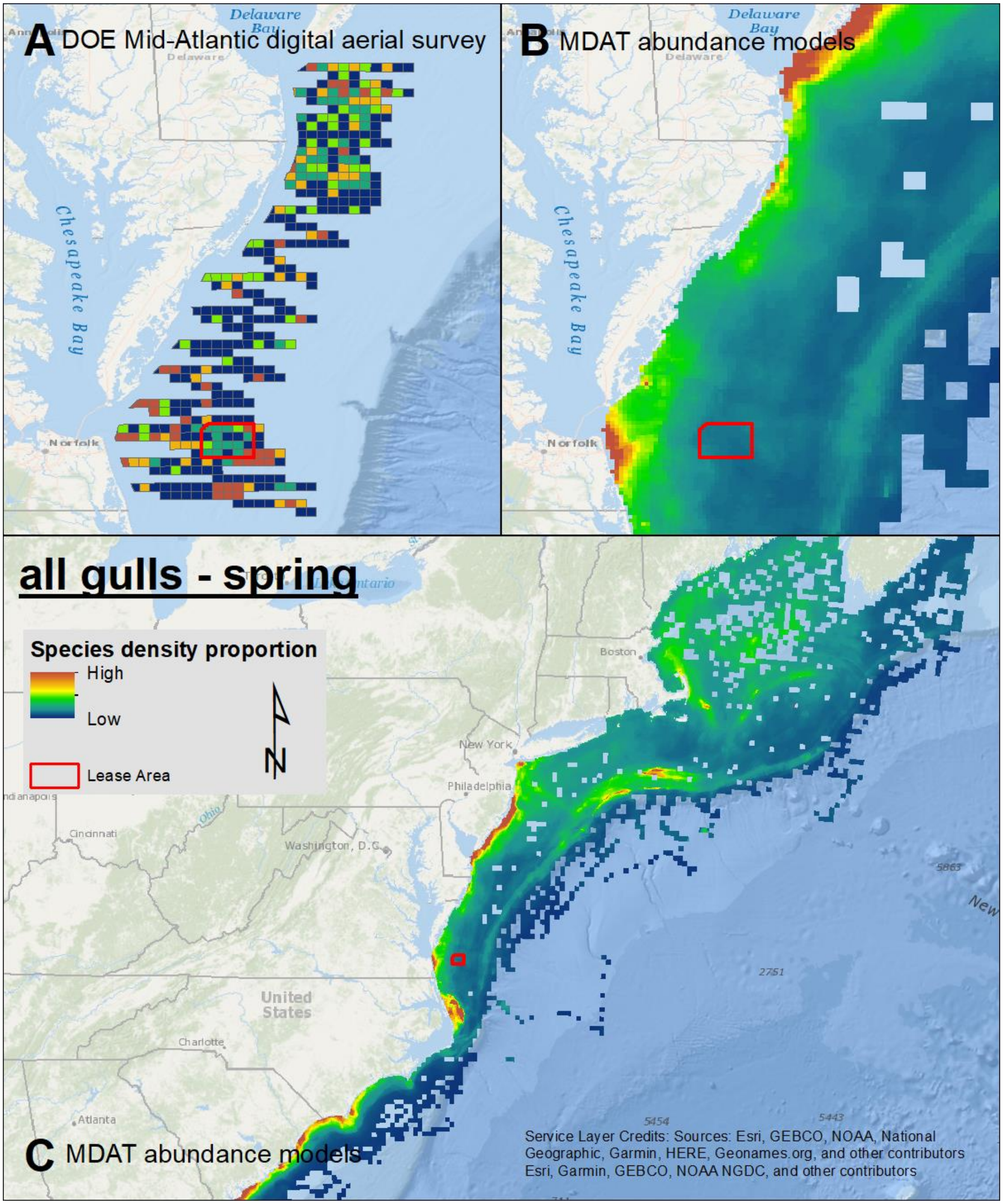
Map 24. Summer large gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull and MDAT maps: Great Black-backed Gull, Herring Gull.



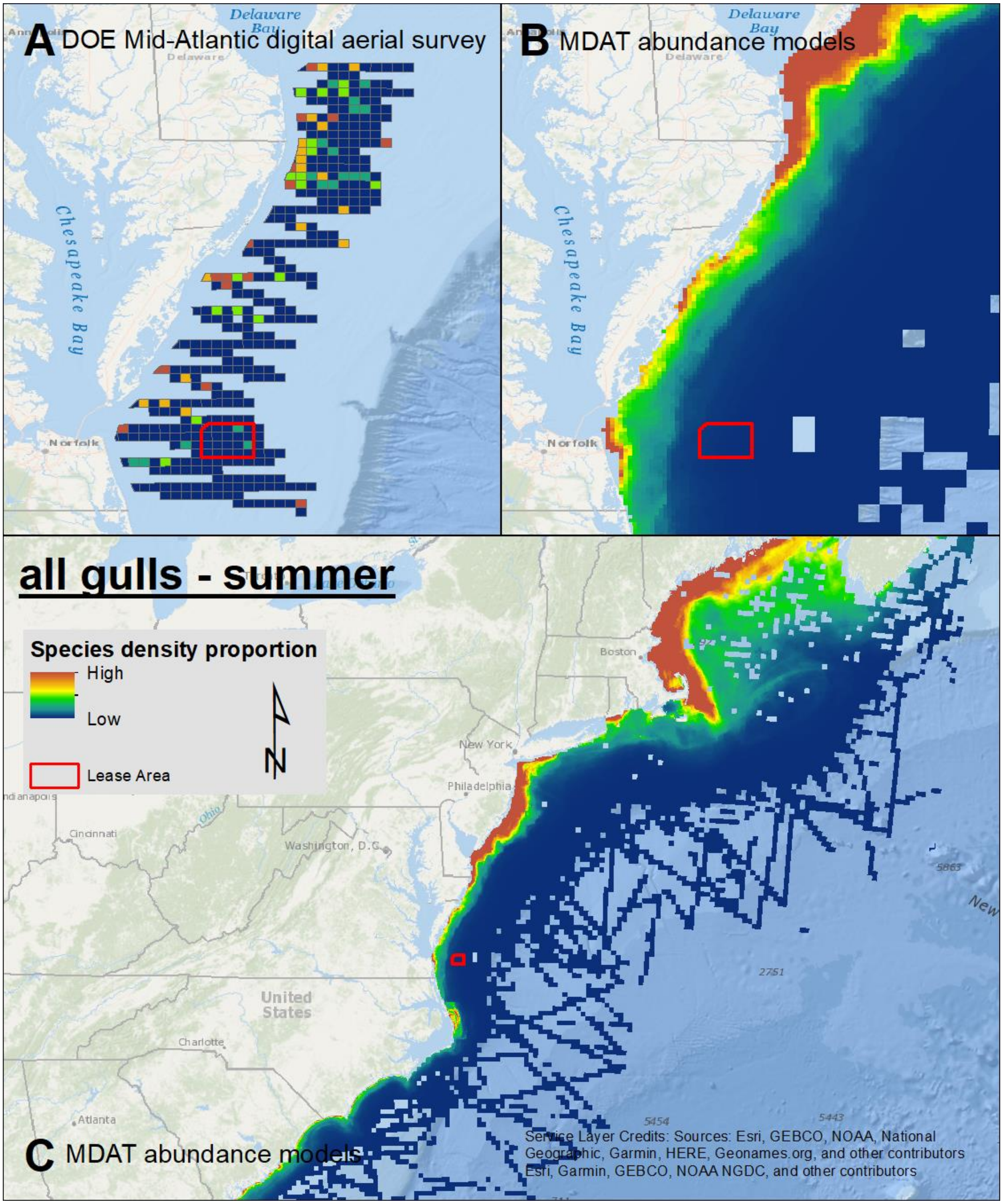
Map 25. Fall large gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull and MDAT maps: Great Black-backed Gull, Herring Gull.



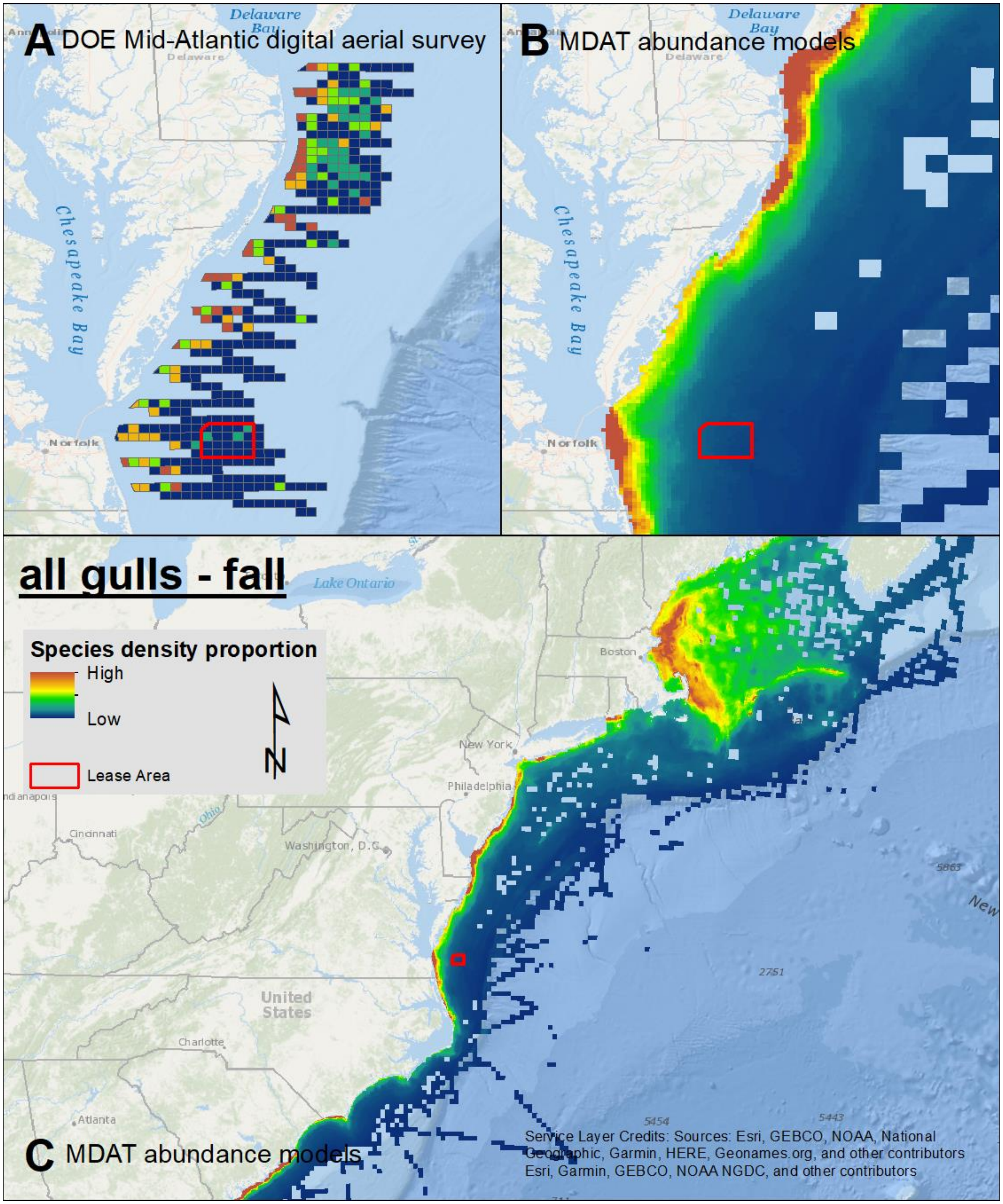
Map 26. Winter all gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Bonaparte's Gull, Unidentified Small Gull/Tern, Unidentified small gull, Laughing Gull, Unidentified medium gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull, Unidentified Gull and MDAT maps: Bonaparte's Gull, Laughing Gull, Great Black-backed Gull, Herring Gull.



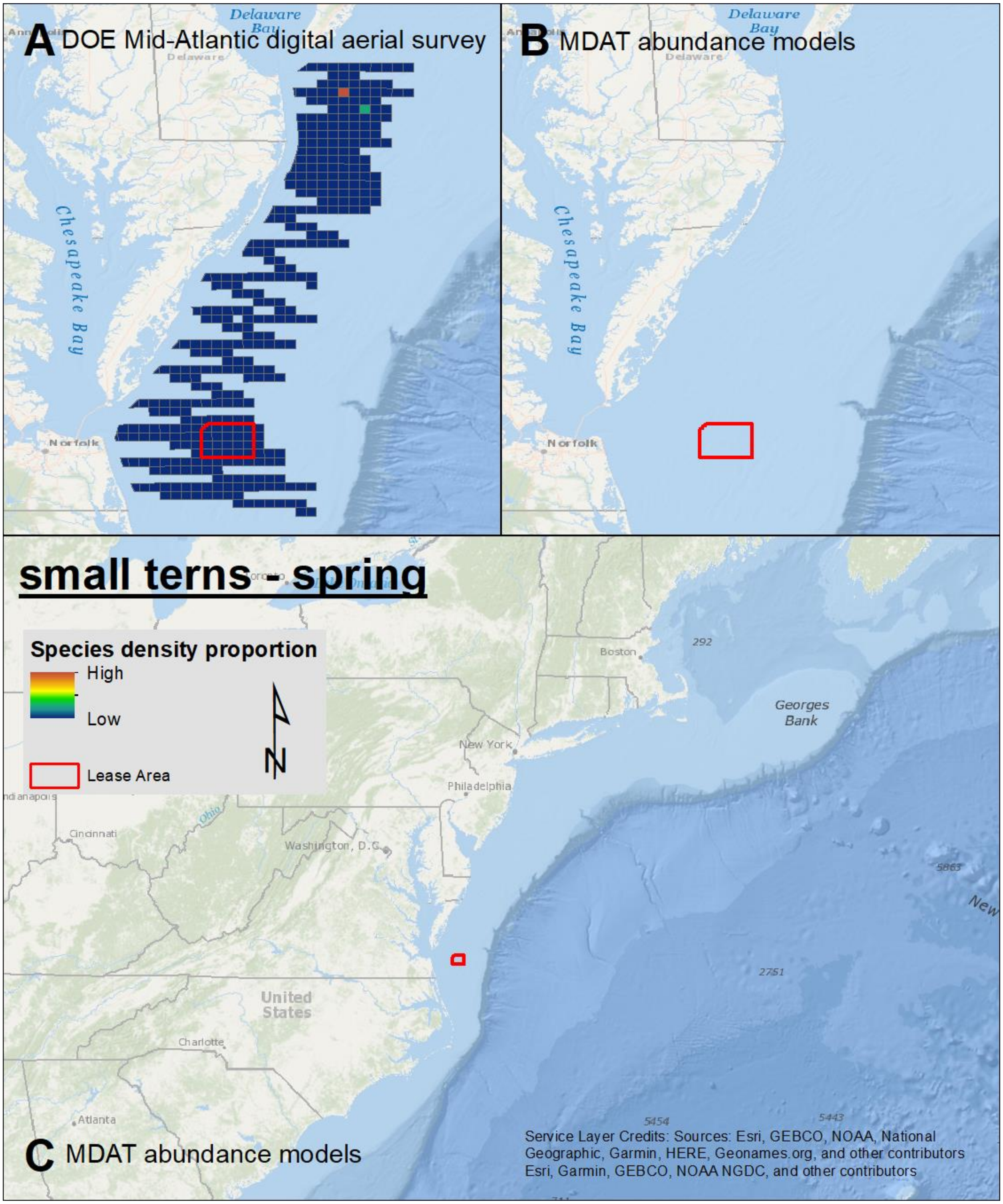
Map 27. Spring all gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Bonaparte's Gull, Unidentified Small Gull/Tern, Unidentified small gull, Laughing Gull, Ring-billed Gull, Unidentified medium gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull, Unidentified Gull and MDAT maps: Bonaparte's Gull, Laughing Gull, Great Black-backed Gull, Herring Gull.



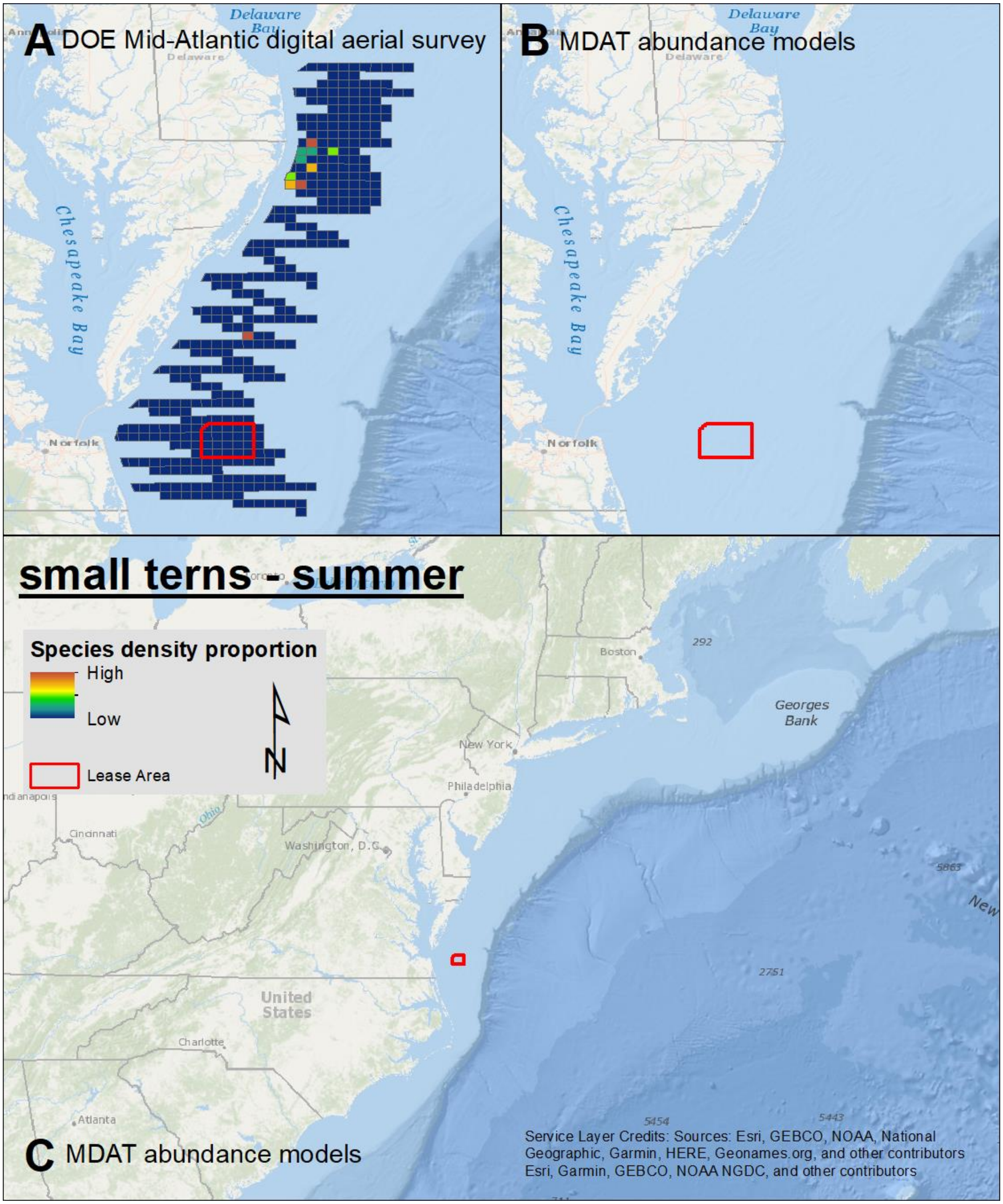
Map 28. Summer all gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Small Gull/Tern, Unidentified small gull, Laughing Gull, Unidentified medium gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull, Unidentified Gull and MDAT maps: Laughing Gull, Great Black-backed Gull, Herring Gull.



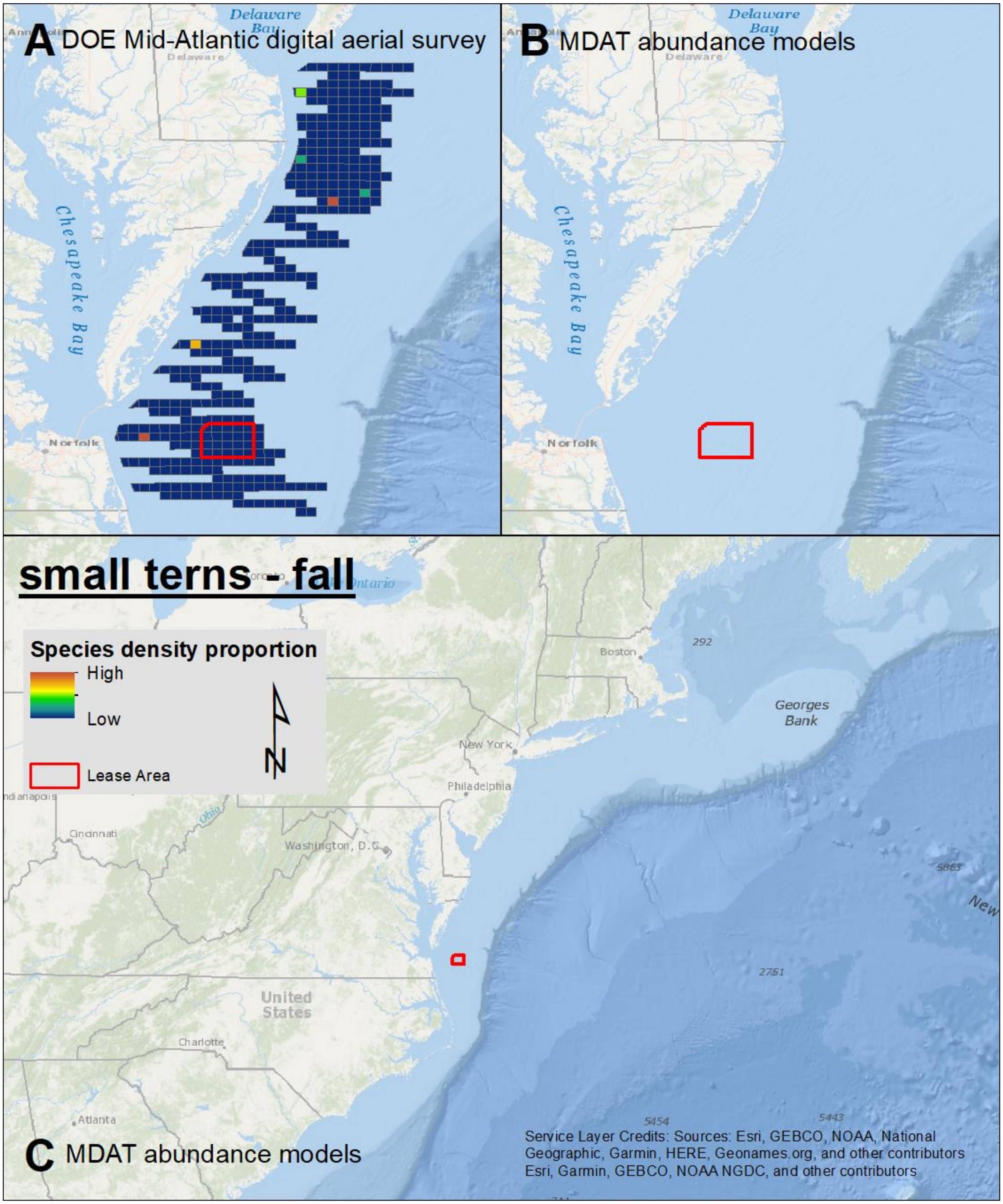
Map 29. Fall all gulls density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Sabine's Gull, Unidentified Small Gull/Tern, Unidentified small gull, Laughing Gull, Unidentified medium gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull, Unidentified Gull and MDAT maps: Laughing Gull, Great Black-backed Gull, Herring Gull.



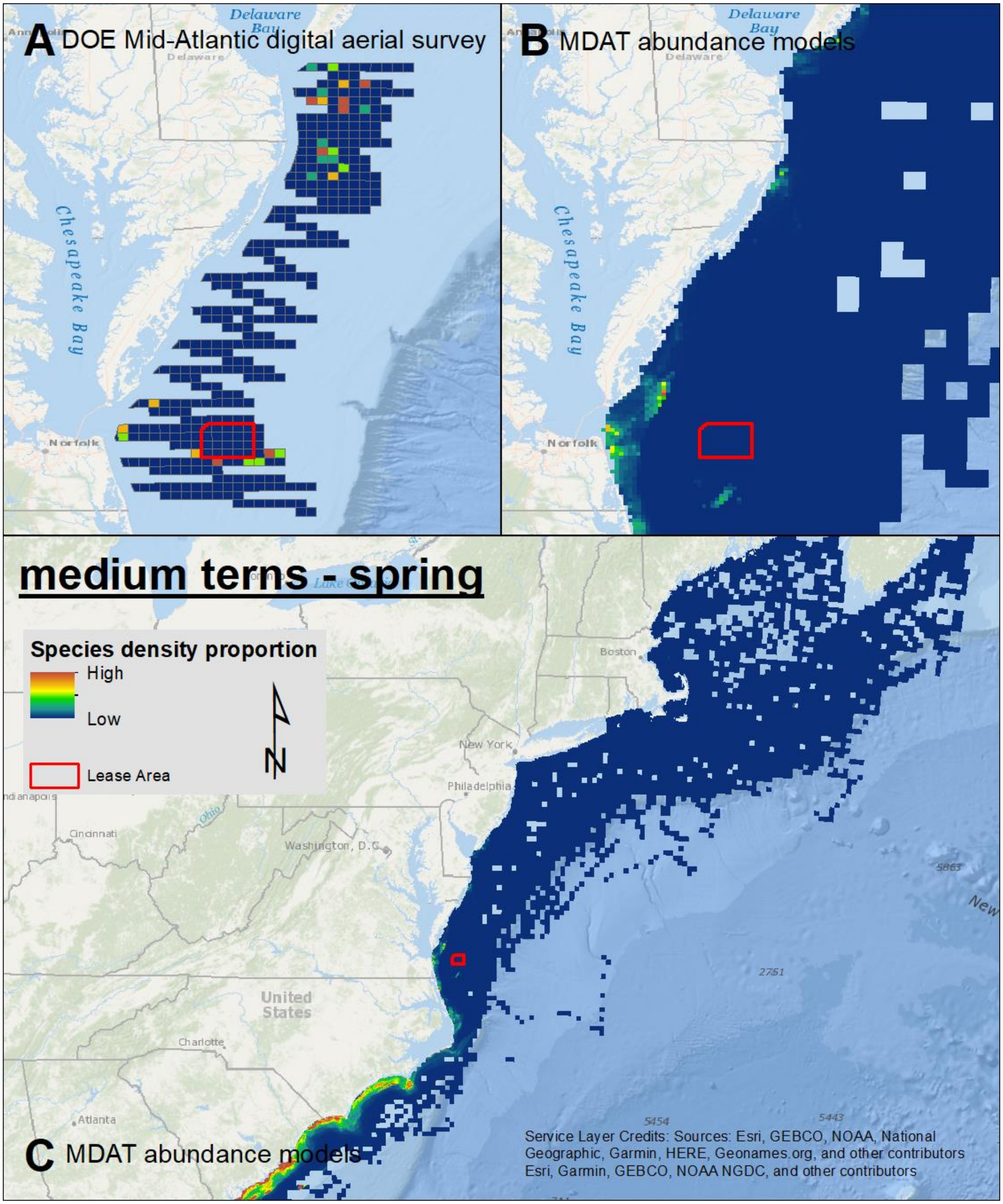
Map 30. Spring small terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified small Tern and MDAT maps: NA.



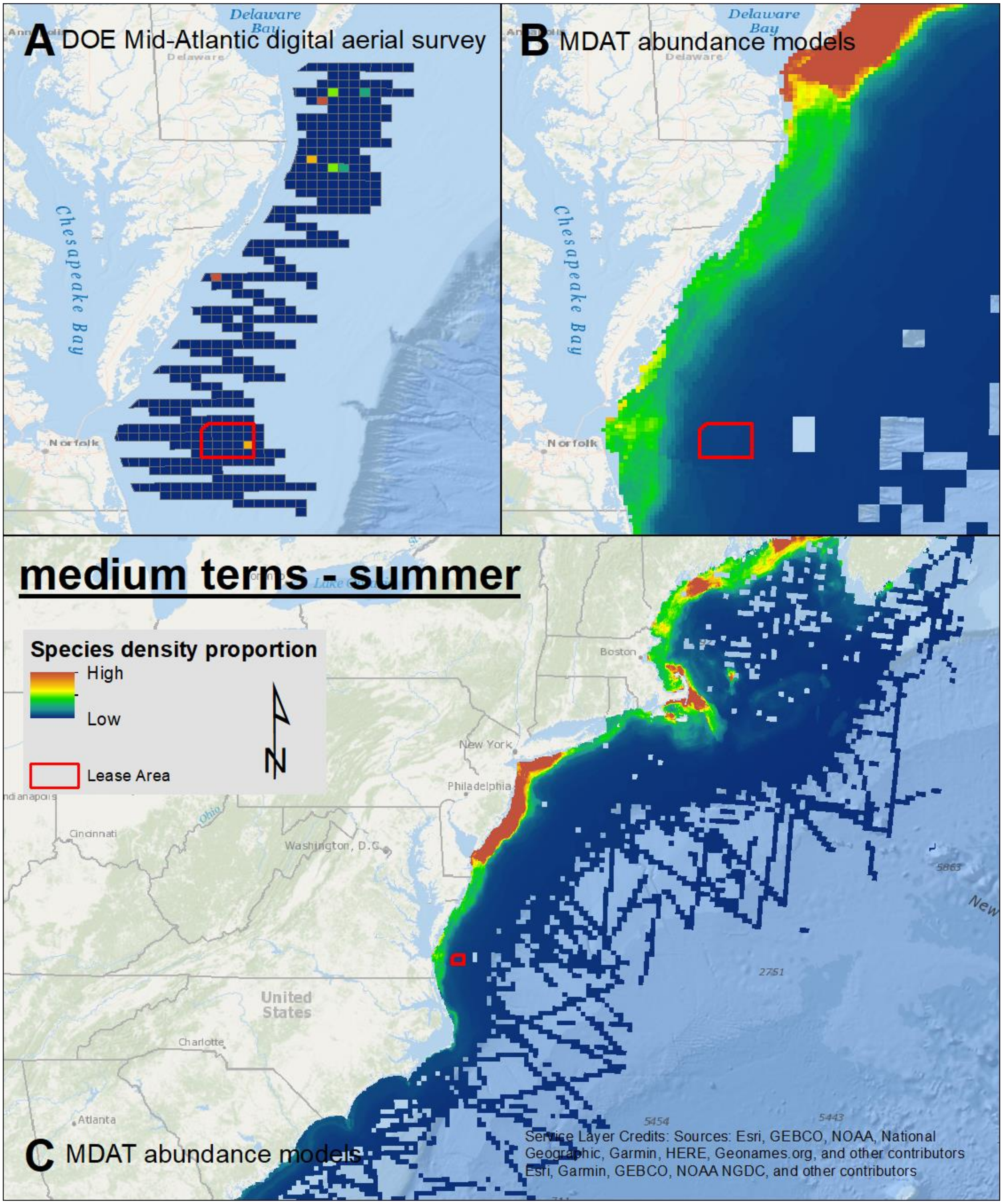
Map 31. Summer small terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Black Tern, Unidentified small Tern and MDAT maps: NA.



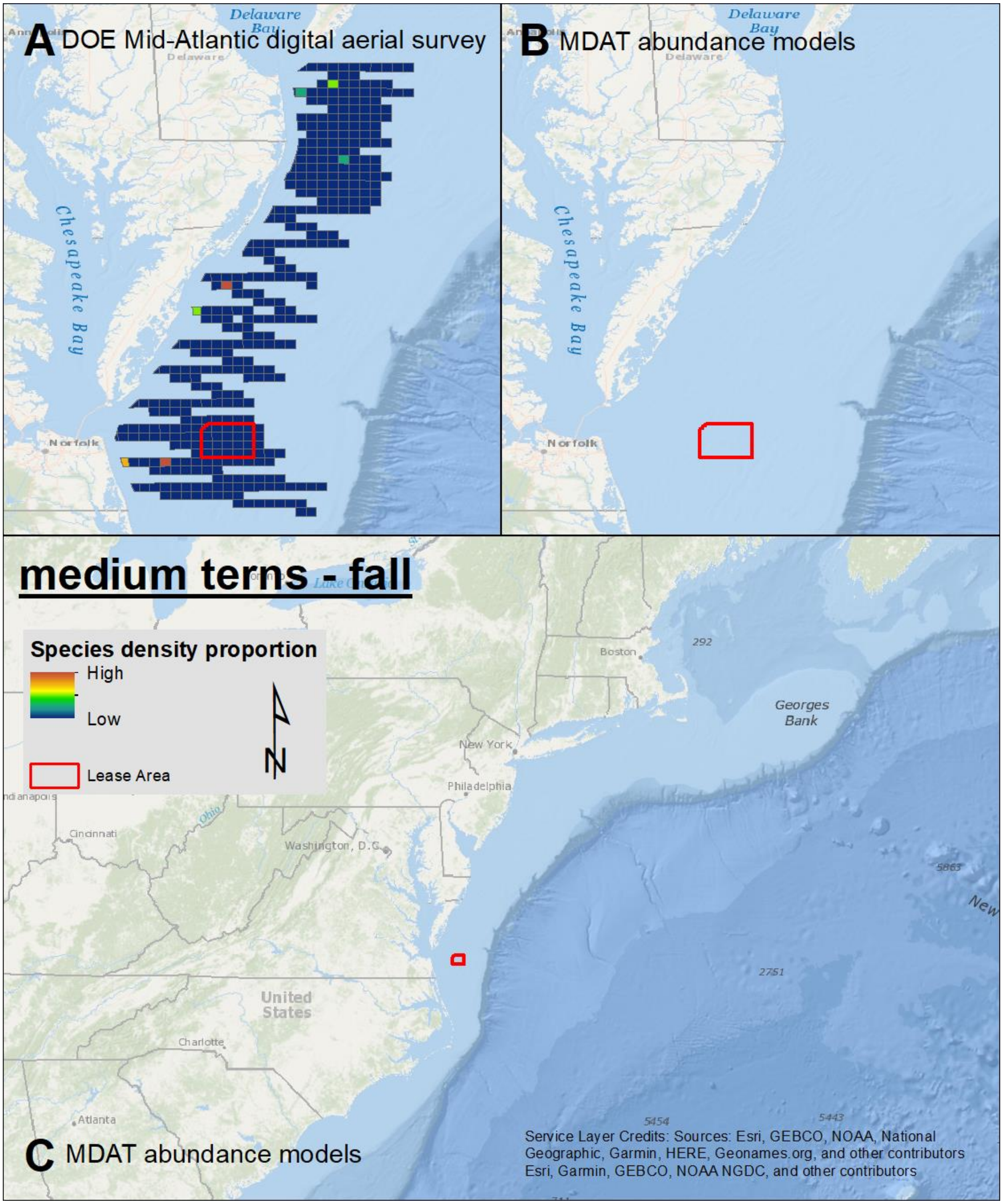
Map 32. Fall small terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Black Tern, Unidentified small Tern and MDAT maps: NA.



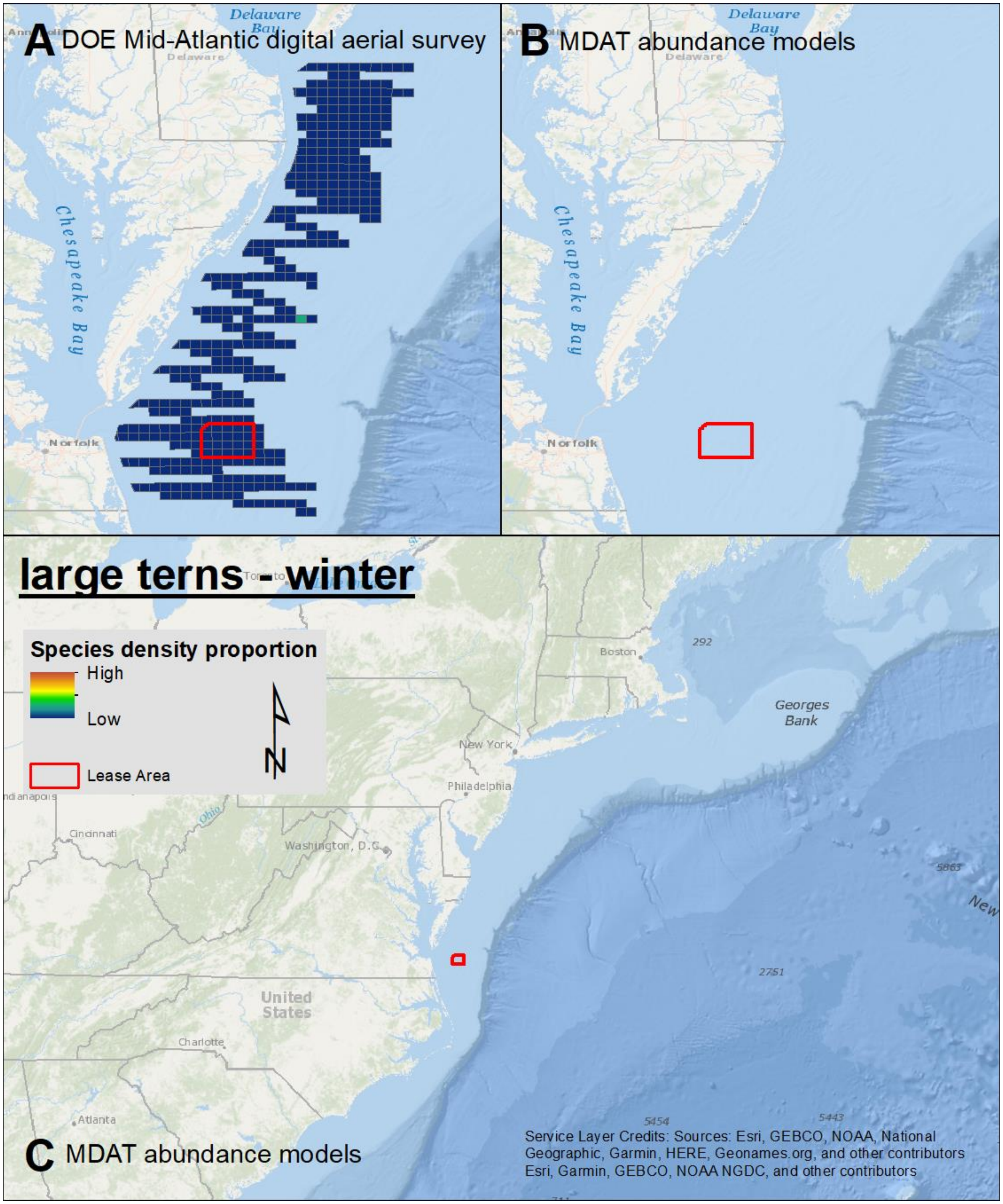
Map 33. Spring medium terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Royal Tern, Unidentified medium tern and MDAT maps: Royal Tern.



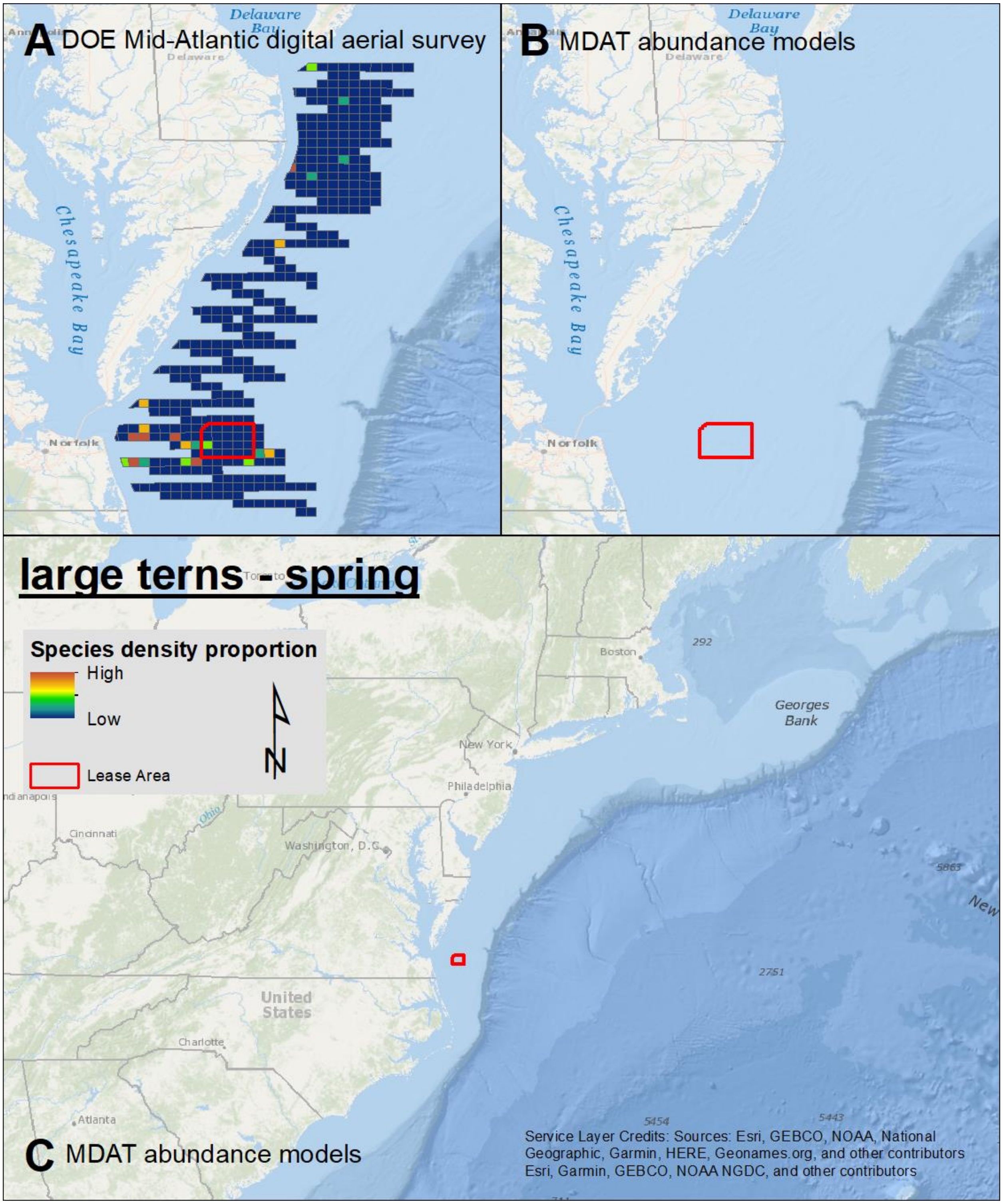
Map 34. Summer medium terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Common Tern, Unidentified medium tern and MDAT maps: Common Tern.



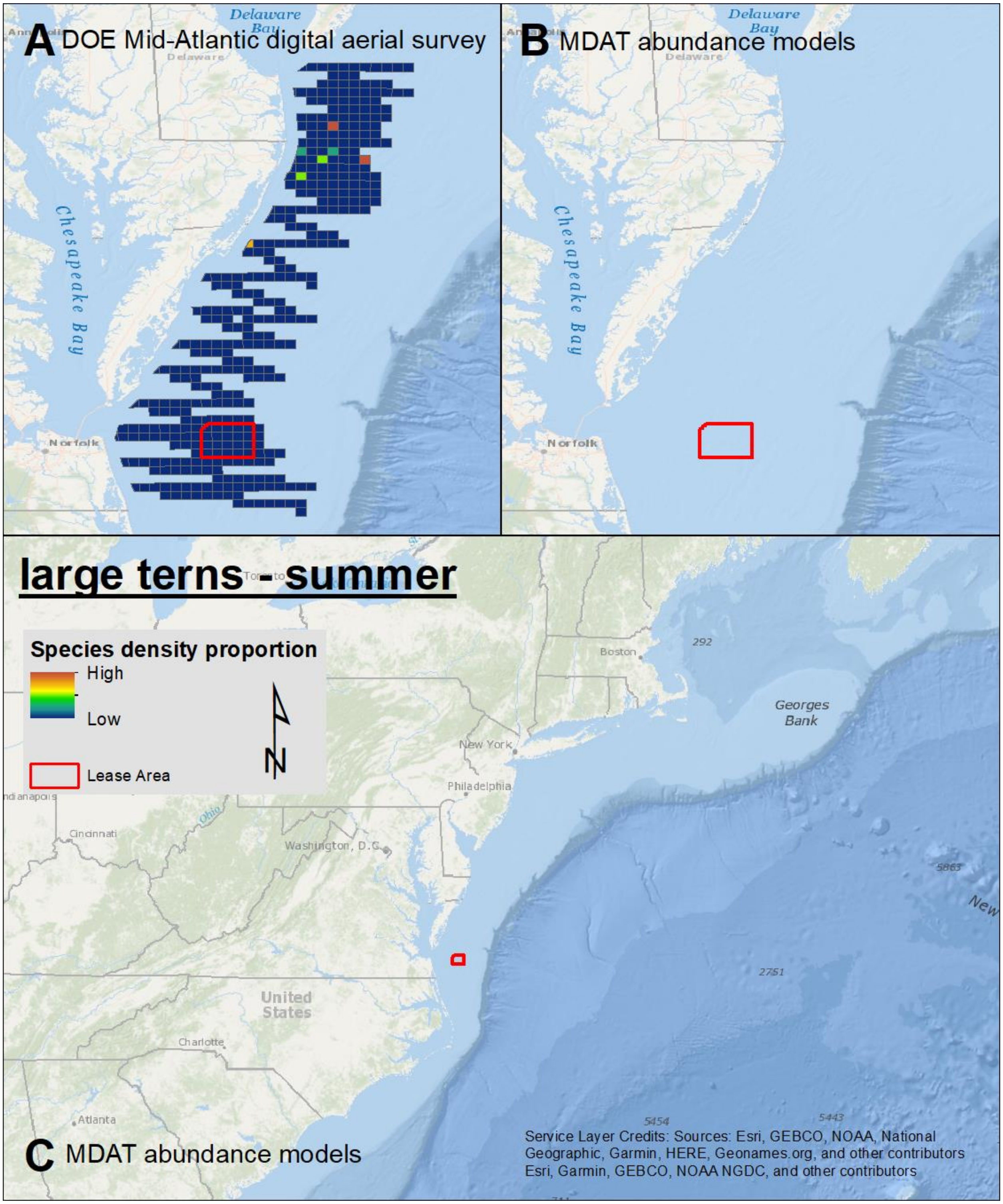
Map 35. Fall medium terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified medium tern and MDAT maps: NA.



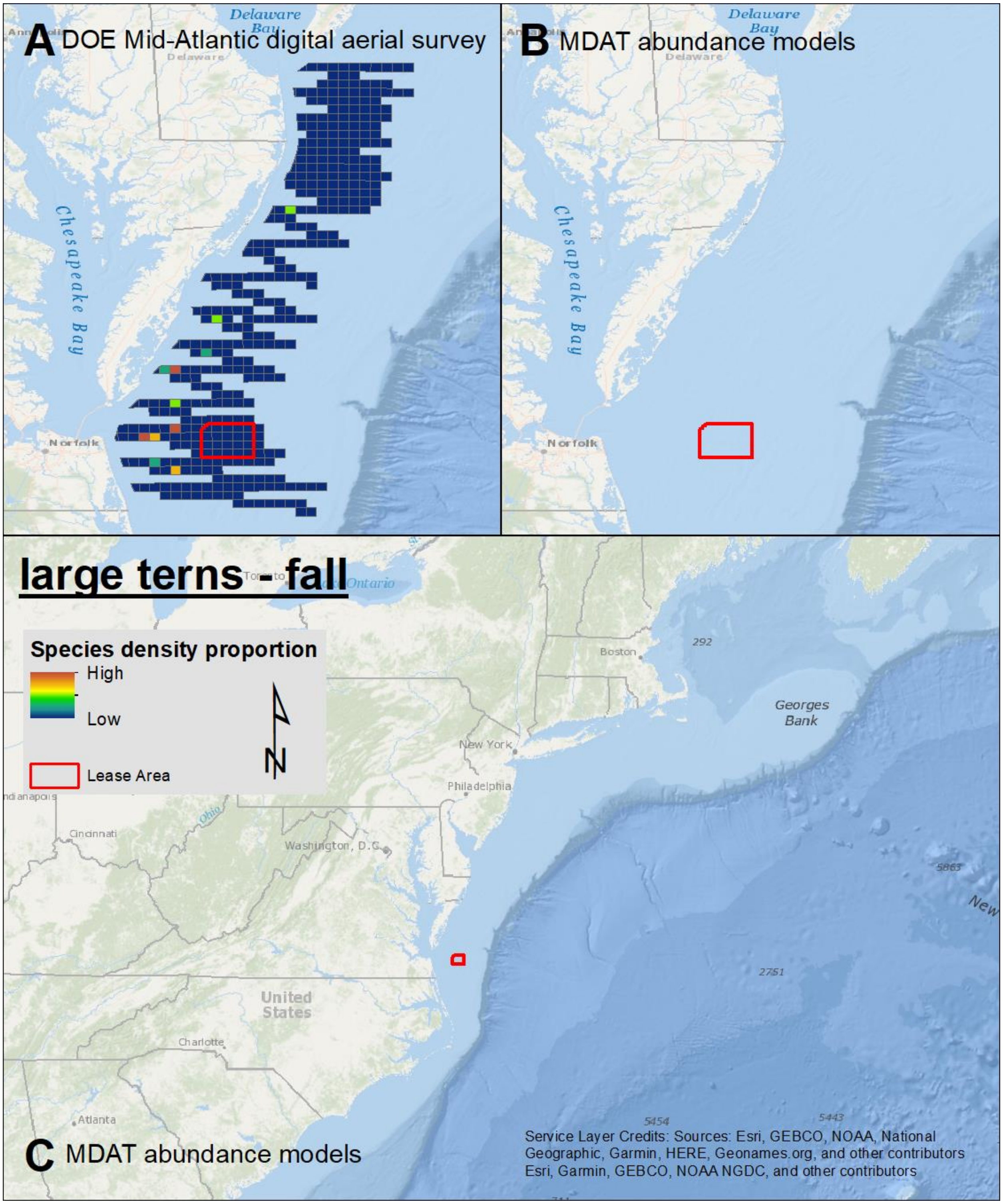
Map 36. Winter large terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified large Tern and MDAT maps: NA.



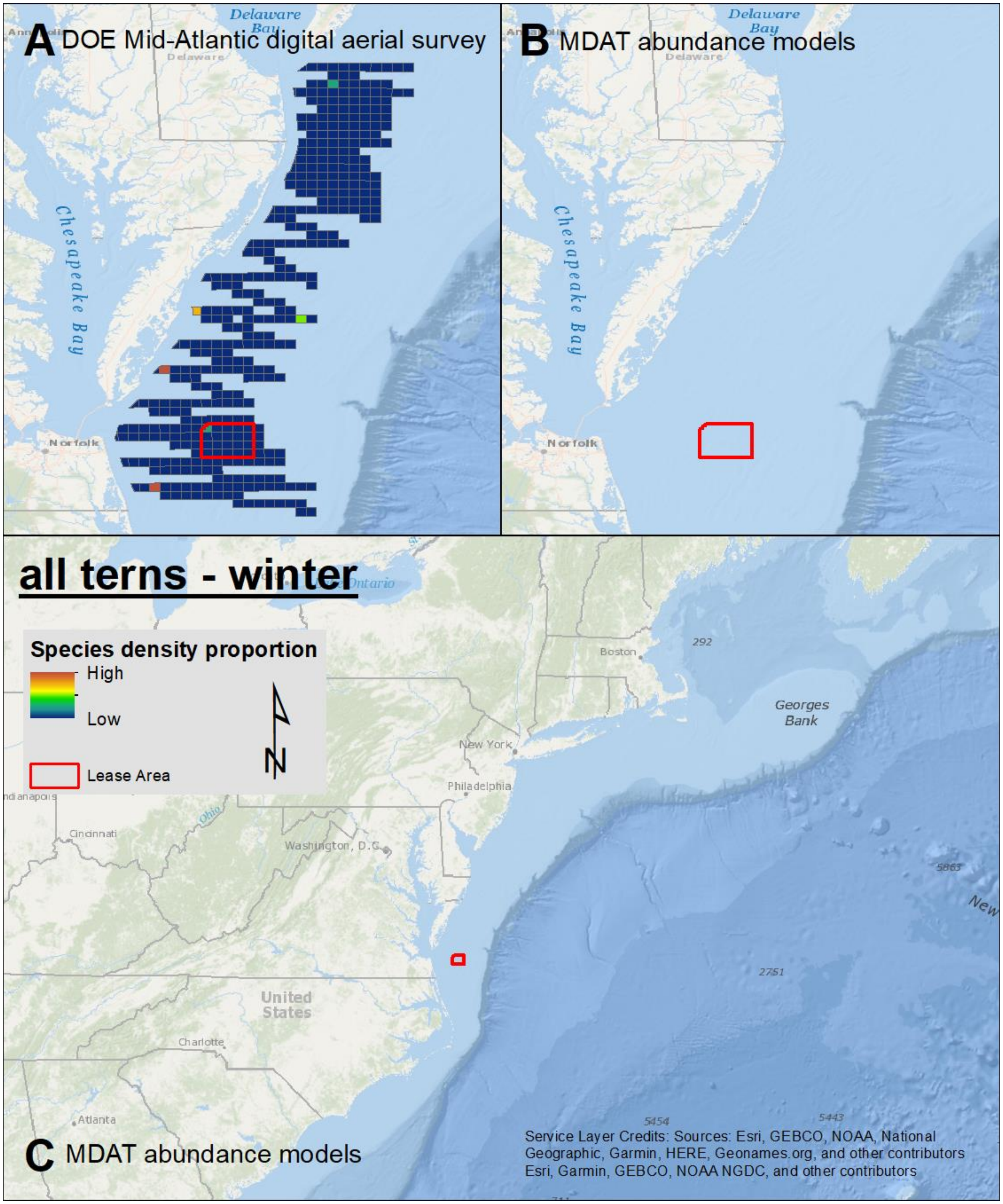
Map 37. Spring large terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified large Tern and MDAT maps: NA.



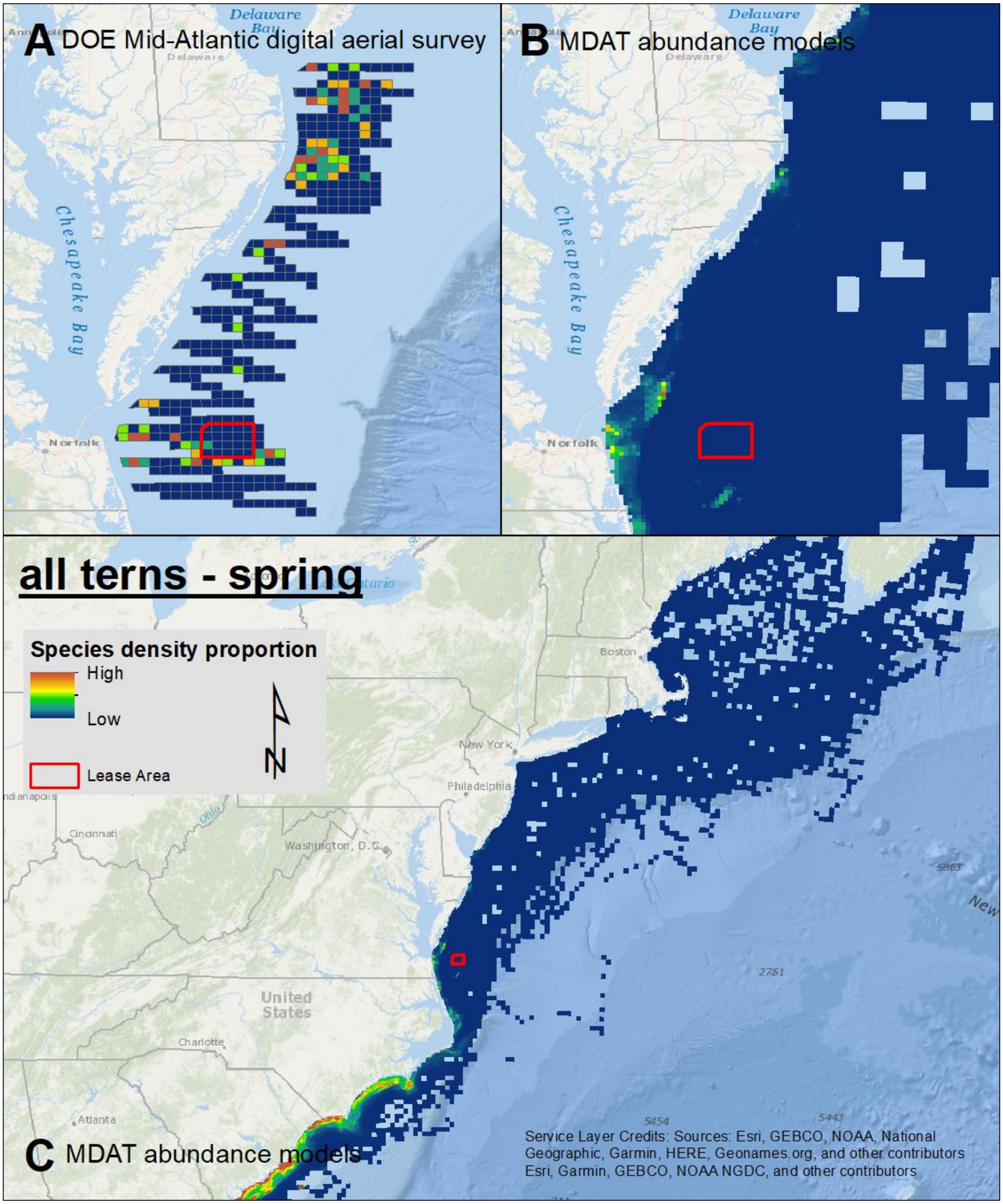
Map 38. Summer large terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Caspian Tern, Unidentified large Tern and MDAT maps: NA.



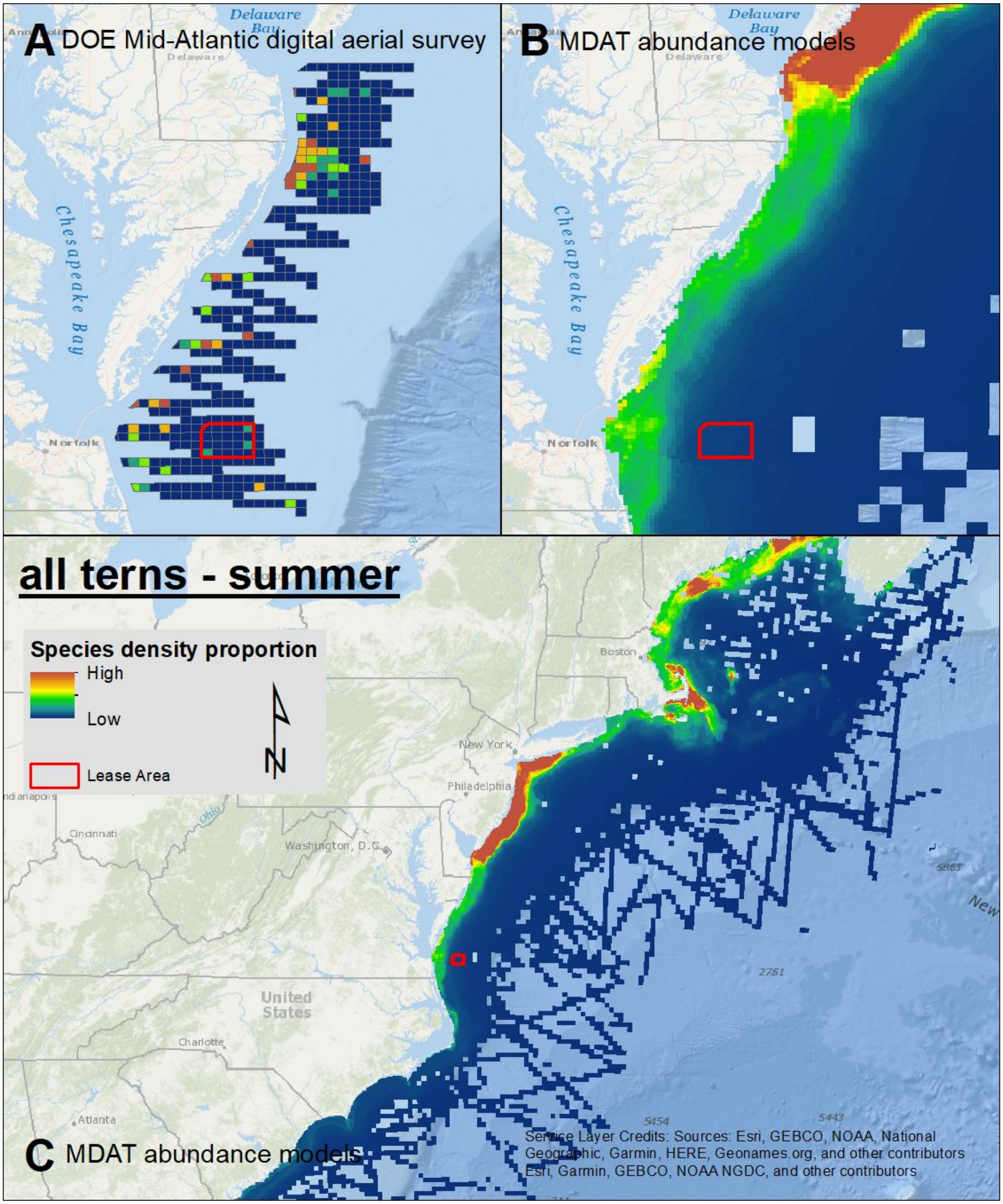
Map 39. Fall large terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Caspian Tern, Unidentified large Tern and MDAT maps: NA.



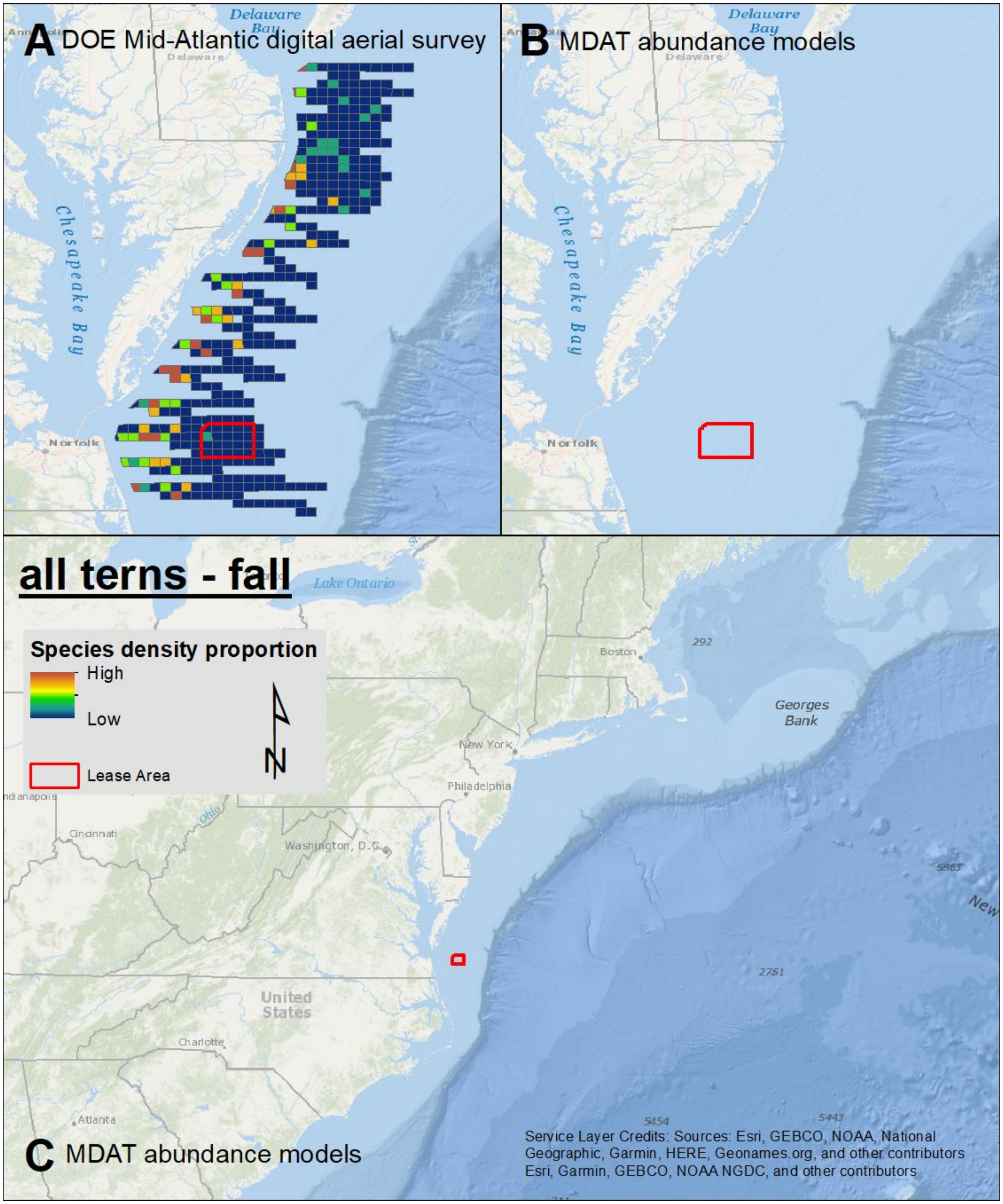
Map 40. Winter all terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified large Tern, Unidentified Tern and MDAT maps: NA.



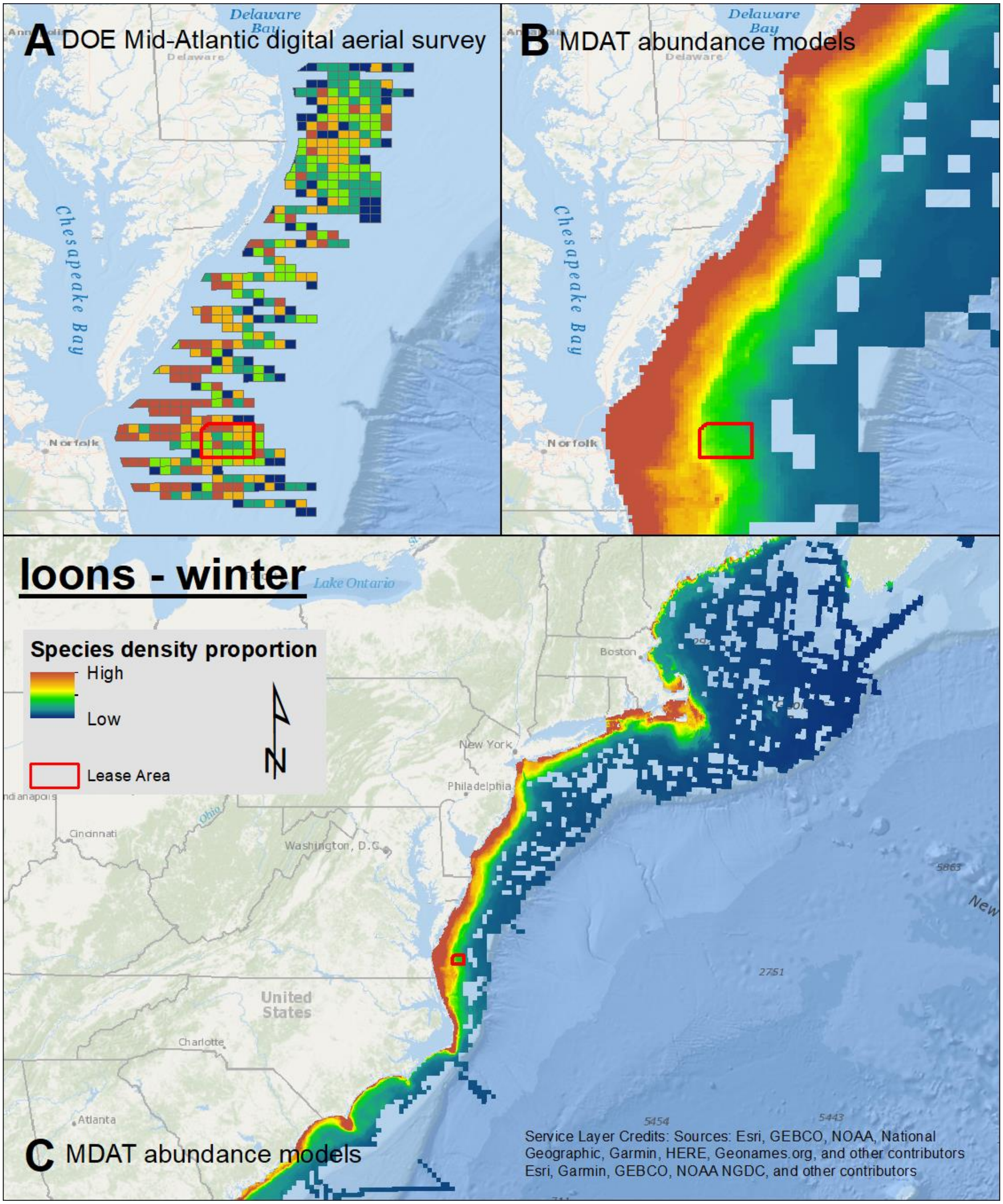
Map 41. Spring all terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified small Tern, Royal Tern, Unidentified medium tern, Unidentified large Tern, Unidentified Tern and MDAT maps: Royal Tern.



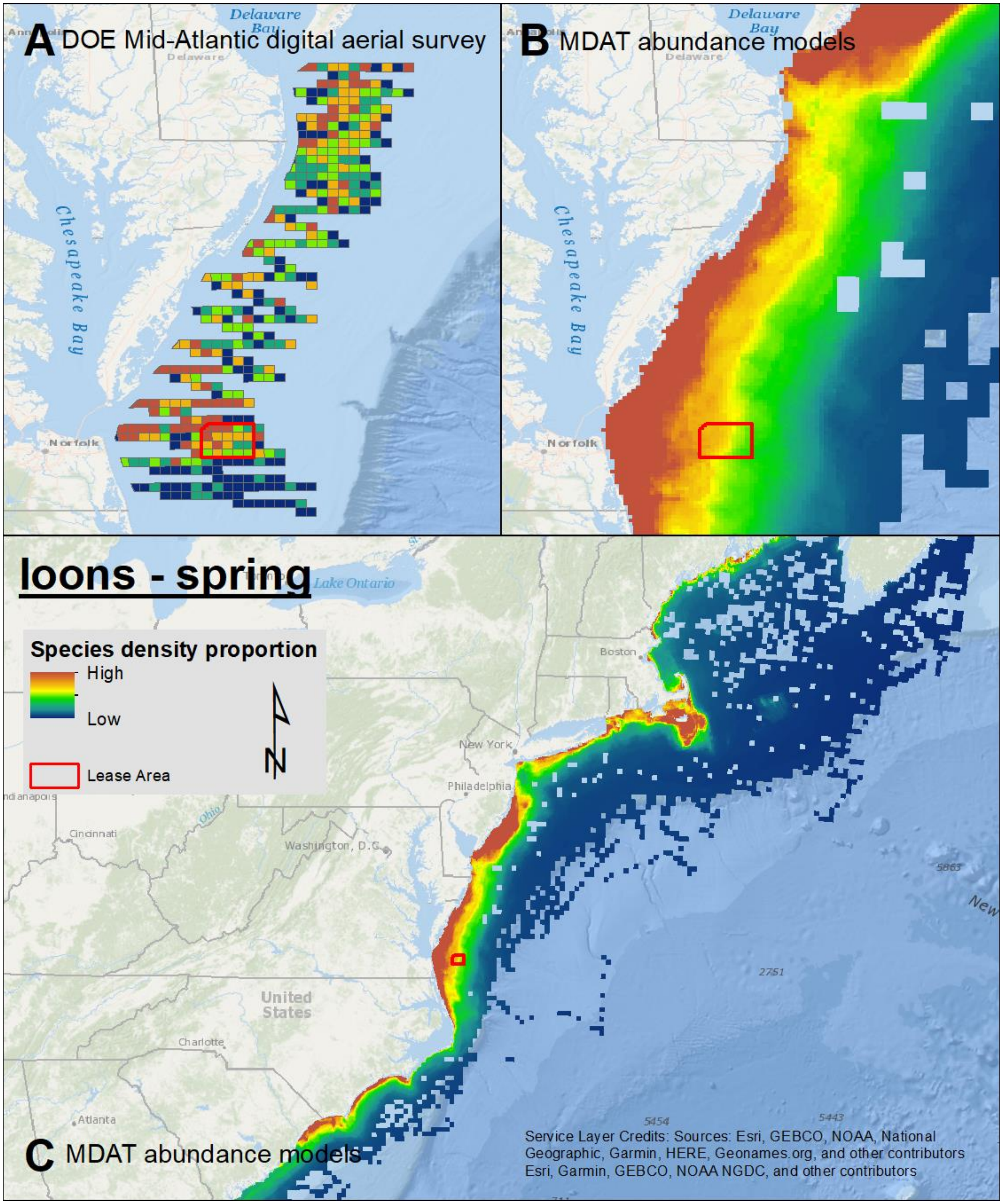
Map 42. Summer all terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Black Tern, Unidentified small Tern, Common Tern, Unidentified medium tern, Caspian Tern, Unidentified large Tern, Unidentified Tern and MDAT maps: Common Tern.



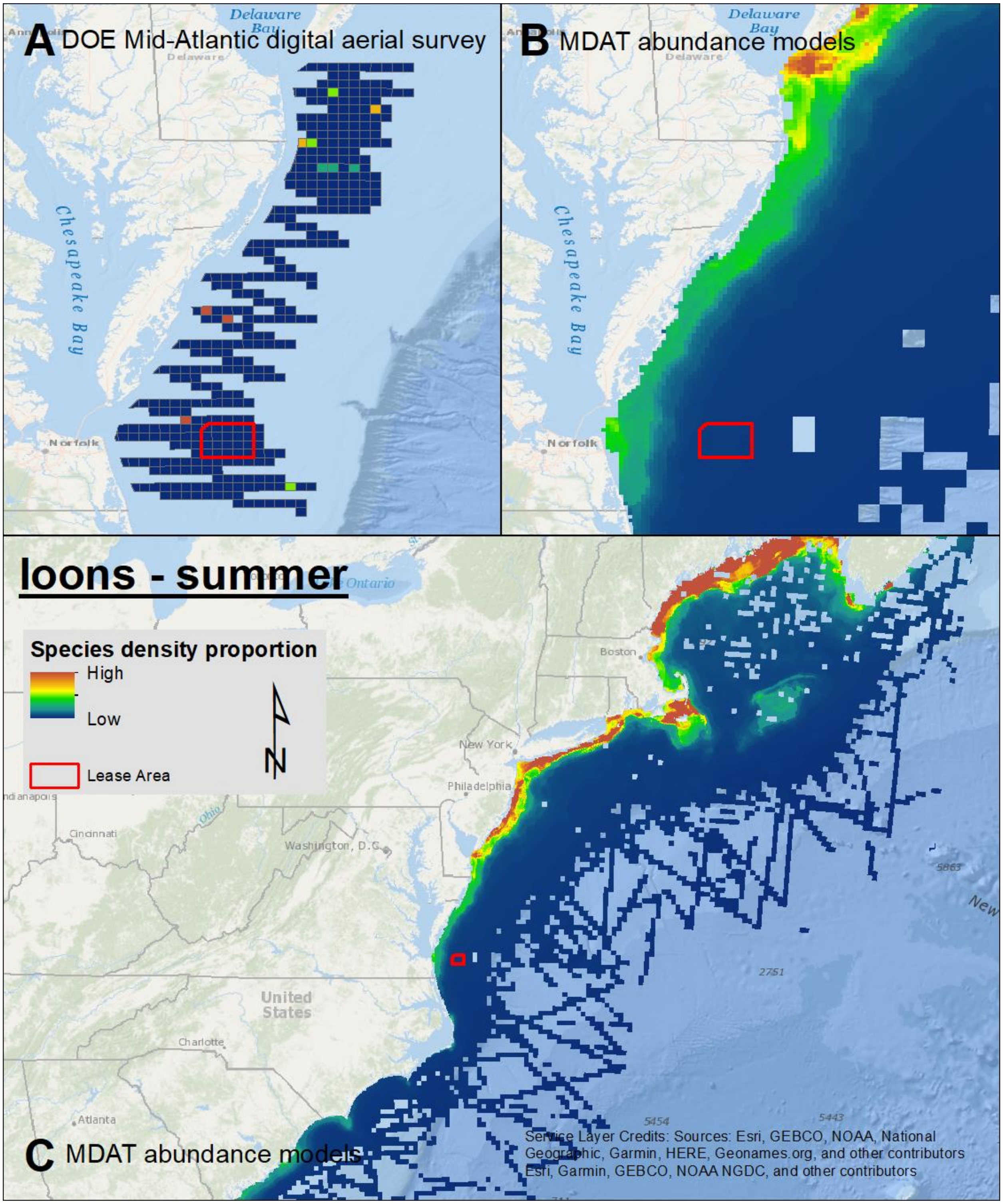
Map 43. Fall all terns density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Black Tern, Unidentified small Tern, Unidentified medium tern, Caspian Tern, Unidentified large Tern, Unidentified Tern and MDAT maps: NA.



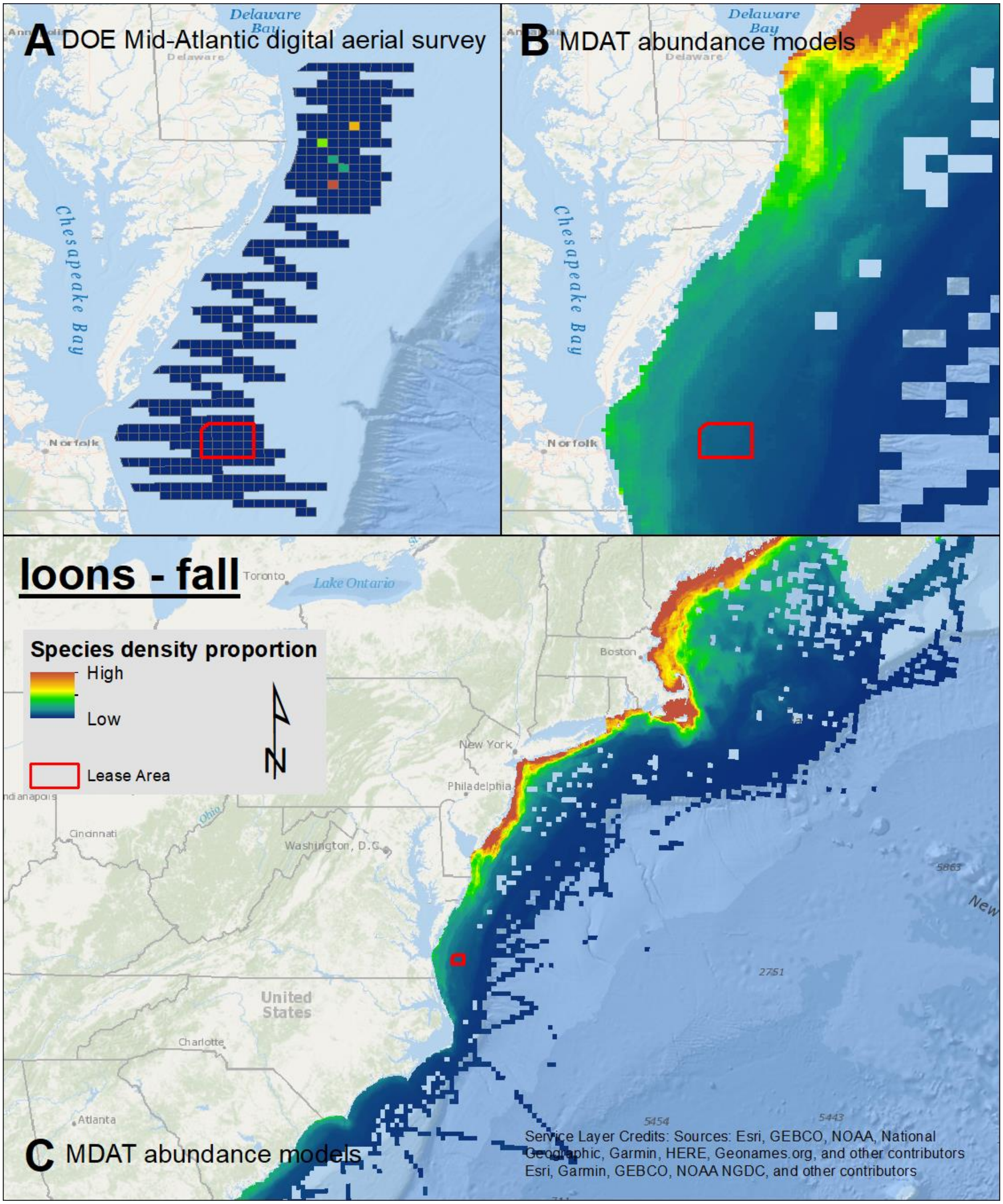
Map 44. Winter loons density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Red-throated Loon, Common Loon, Unidentified Loon and MDAT maps: Common Loon, Red-throated Loon.



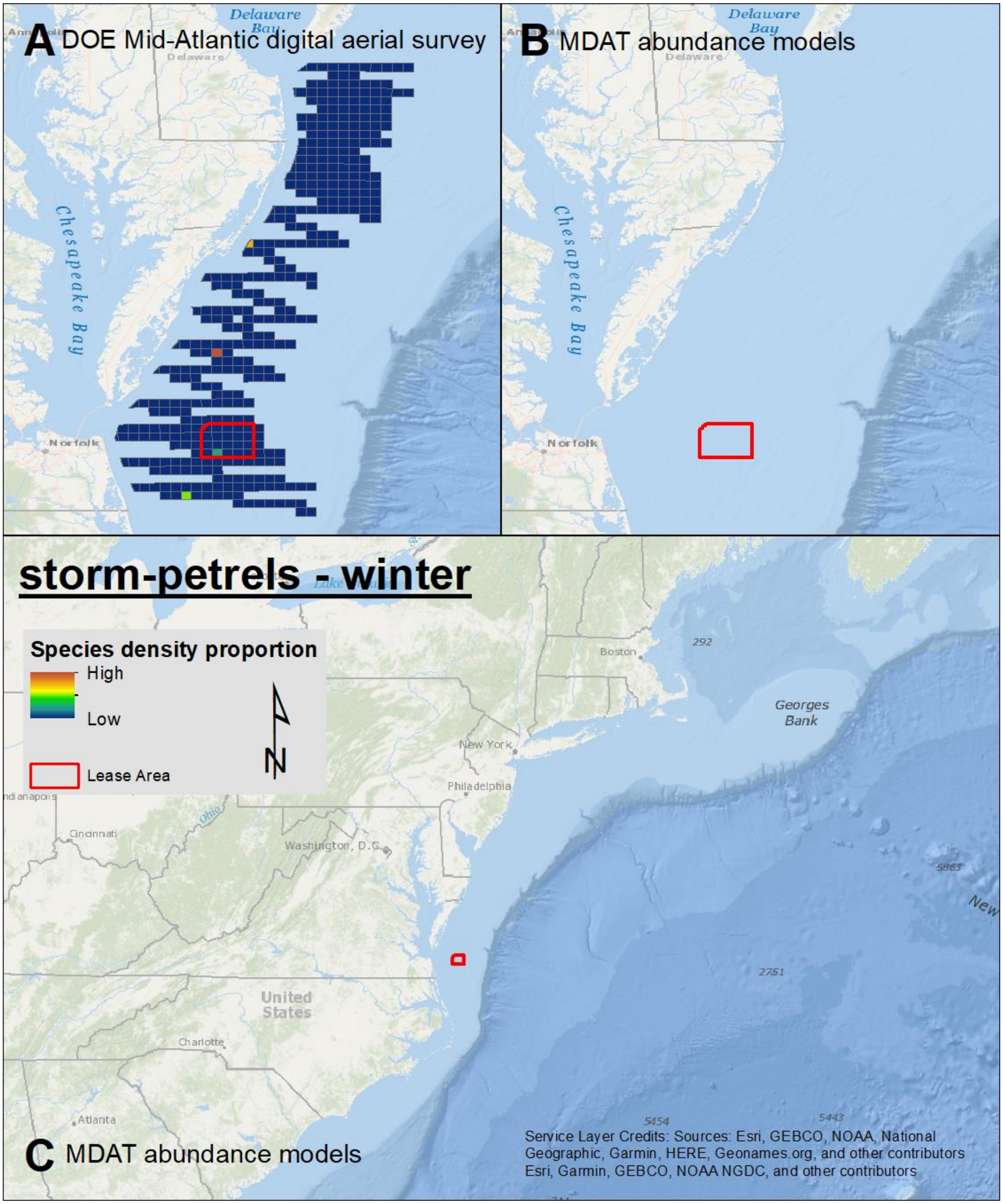
Map 45. Spring loons density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Red-throated Loon, Common Loon, Unidentified Loon and MDAT maps: Common Loon, Red-throated Loon.



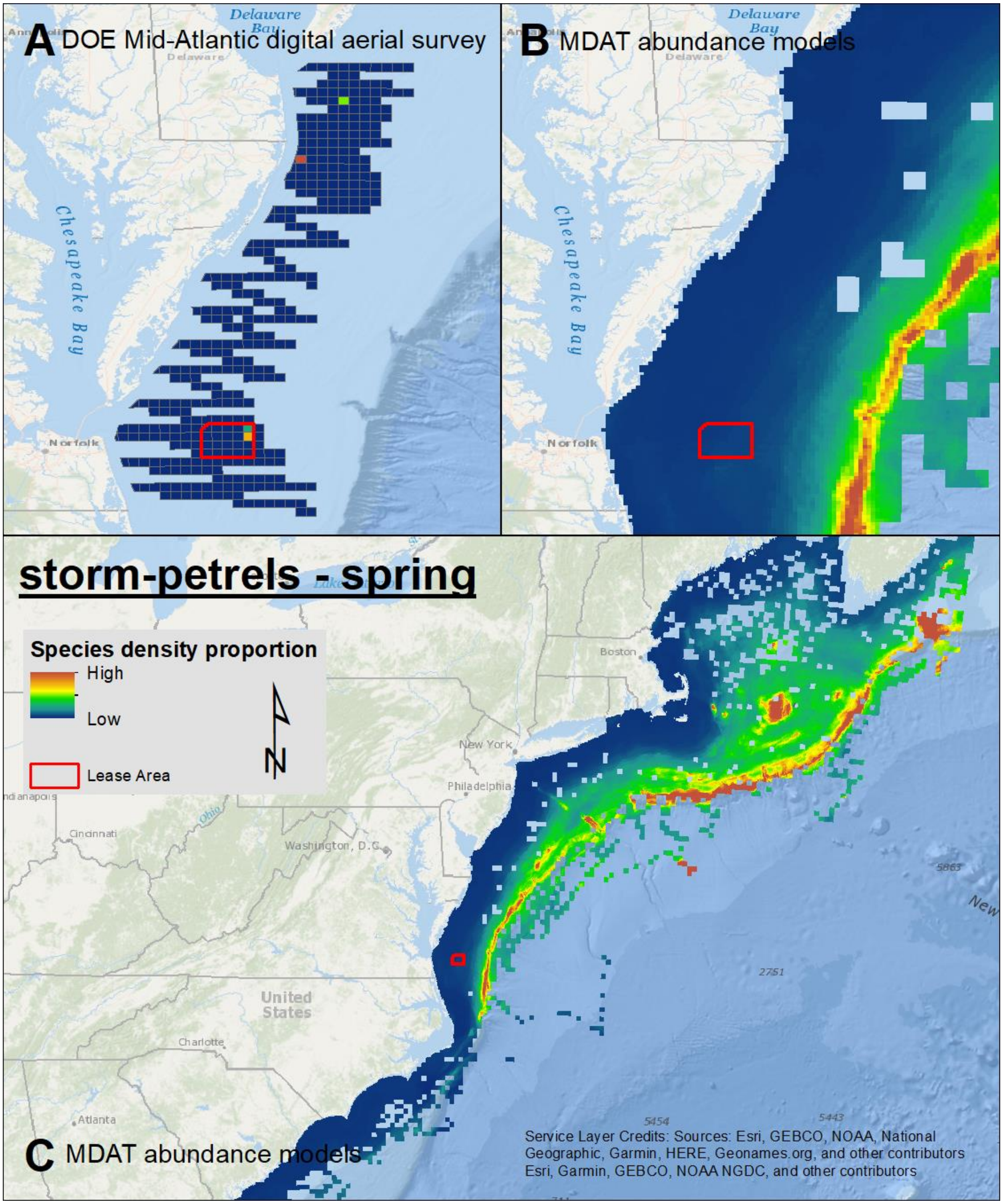
Map 46. Summer loons density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Red-throated Loon, Common Loon, Unidentified Loon and MDAT maps: Common Loon.



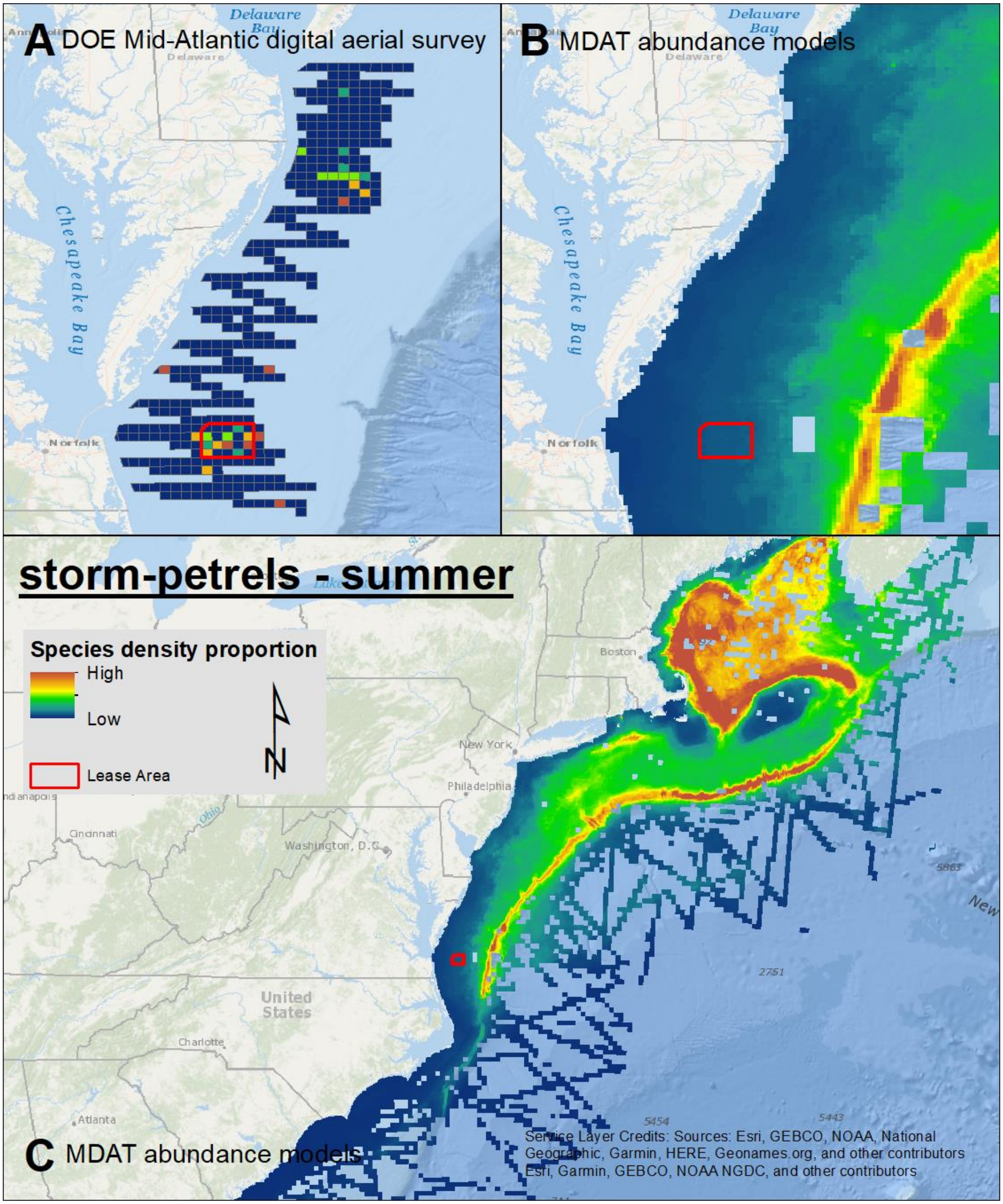
Map 47. Fall loons density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Common Loon, Unidentified Loon and MDAT maps: Common Loon.



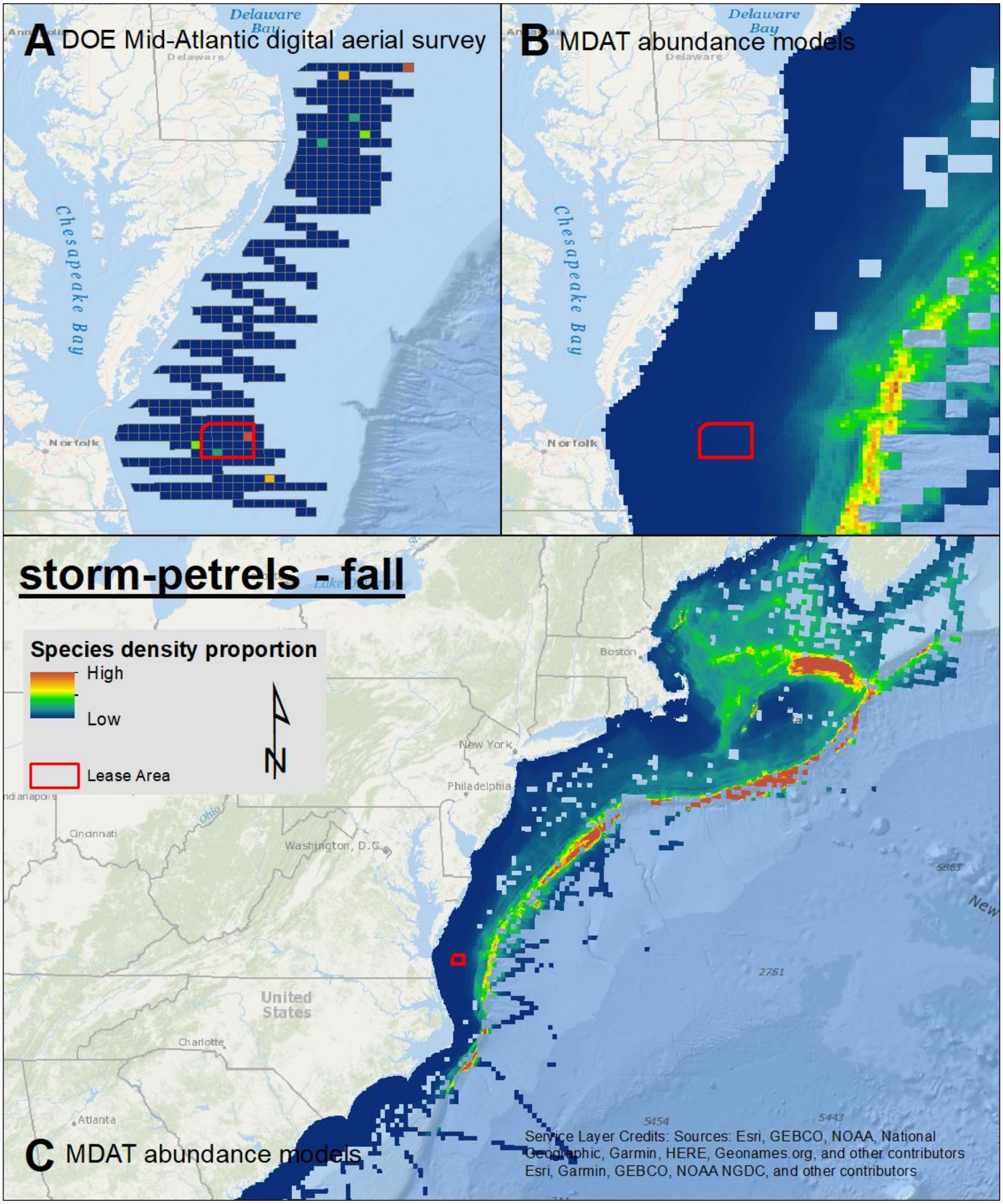
Map 48. Winter storm-petrels density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Storm-petrel and MDAT maps: NA.



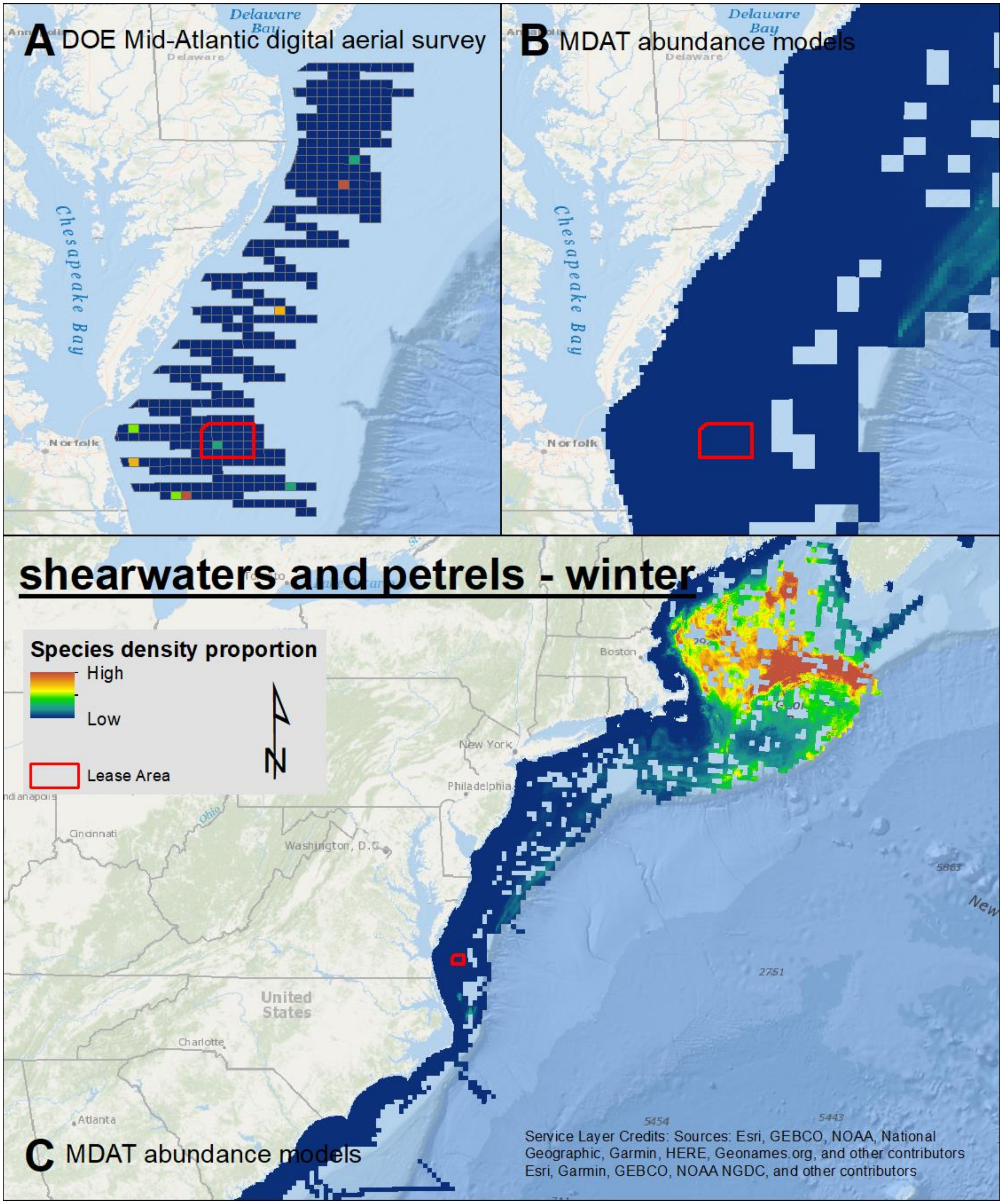
Map 49. Spring storm-petrels density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Wilson's Storm-Petrel and MDAT maps: Wilson's Storm-Petrel.



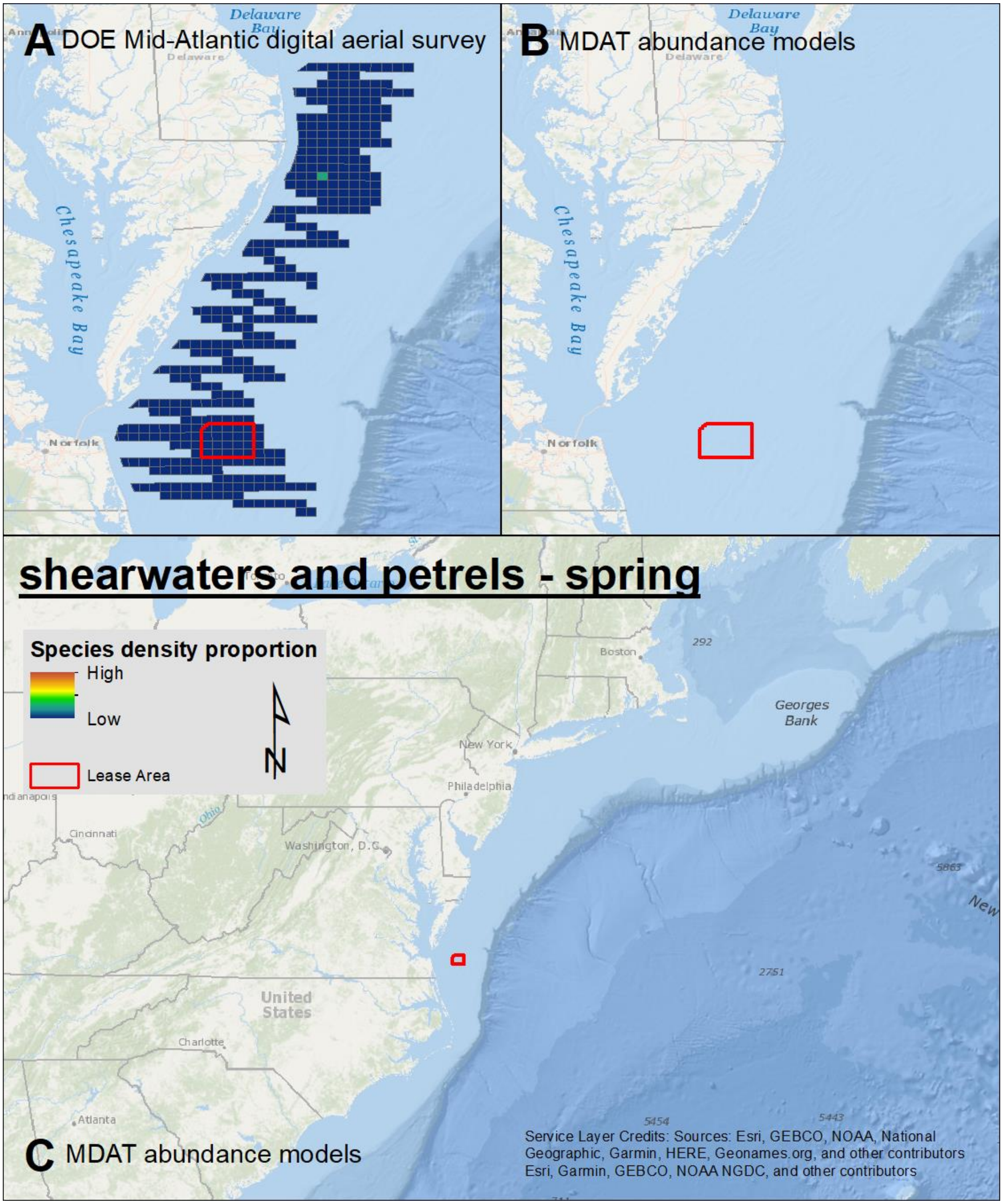
Map 50. Summer storm-petrels density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Wilson's Storm-Petrel, Unidentified Storm-petrel and MDAT maps: Wilson's Storm-Petrel.



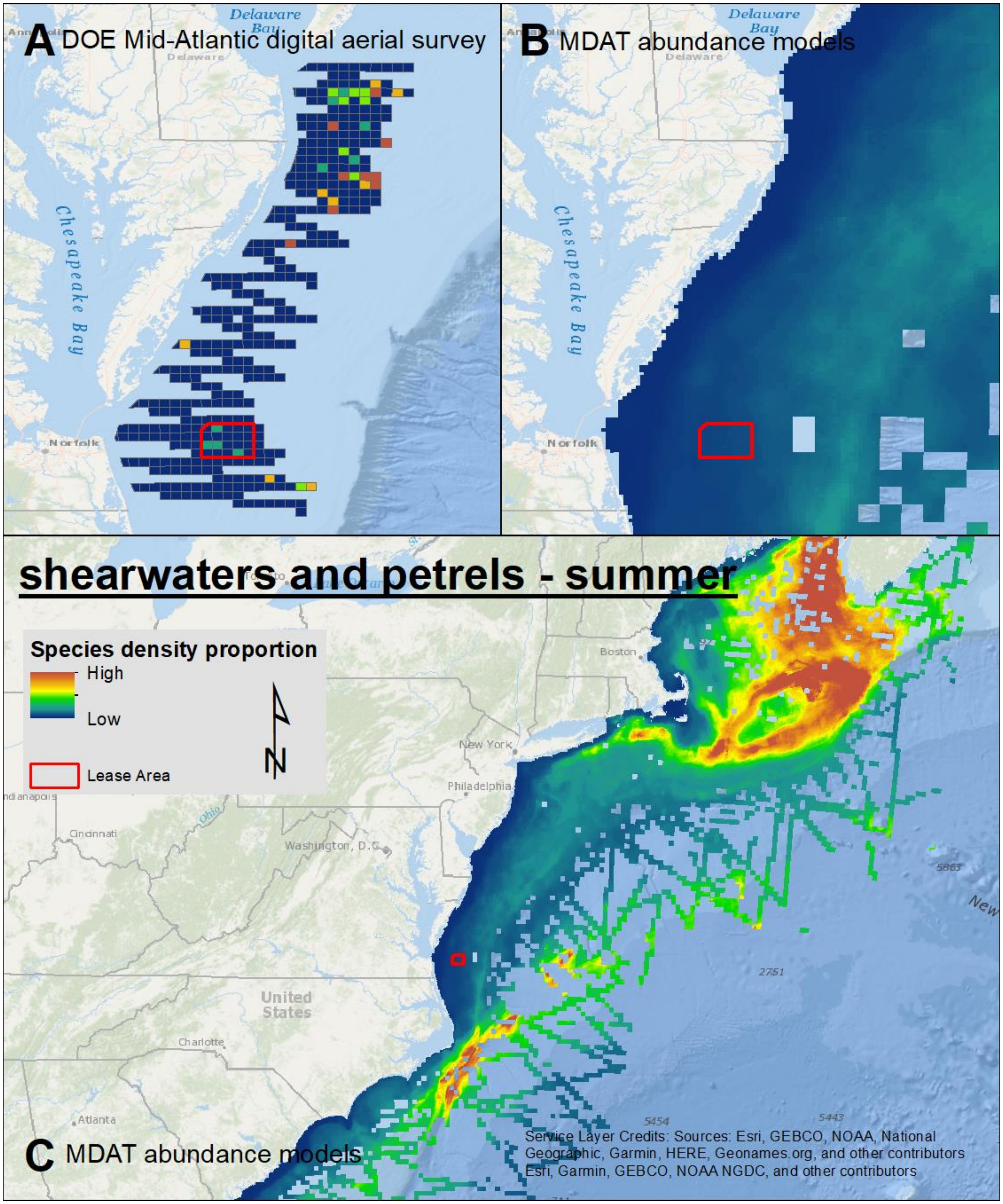
Map 51. Fall storm-petrels density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Wilson's Storm-Petrel, Unidentified Storm-petrel and MDAT maps: Wilson's Storm-Petrel.



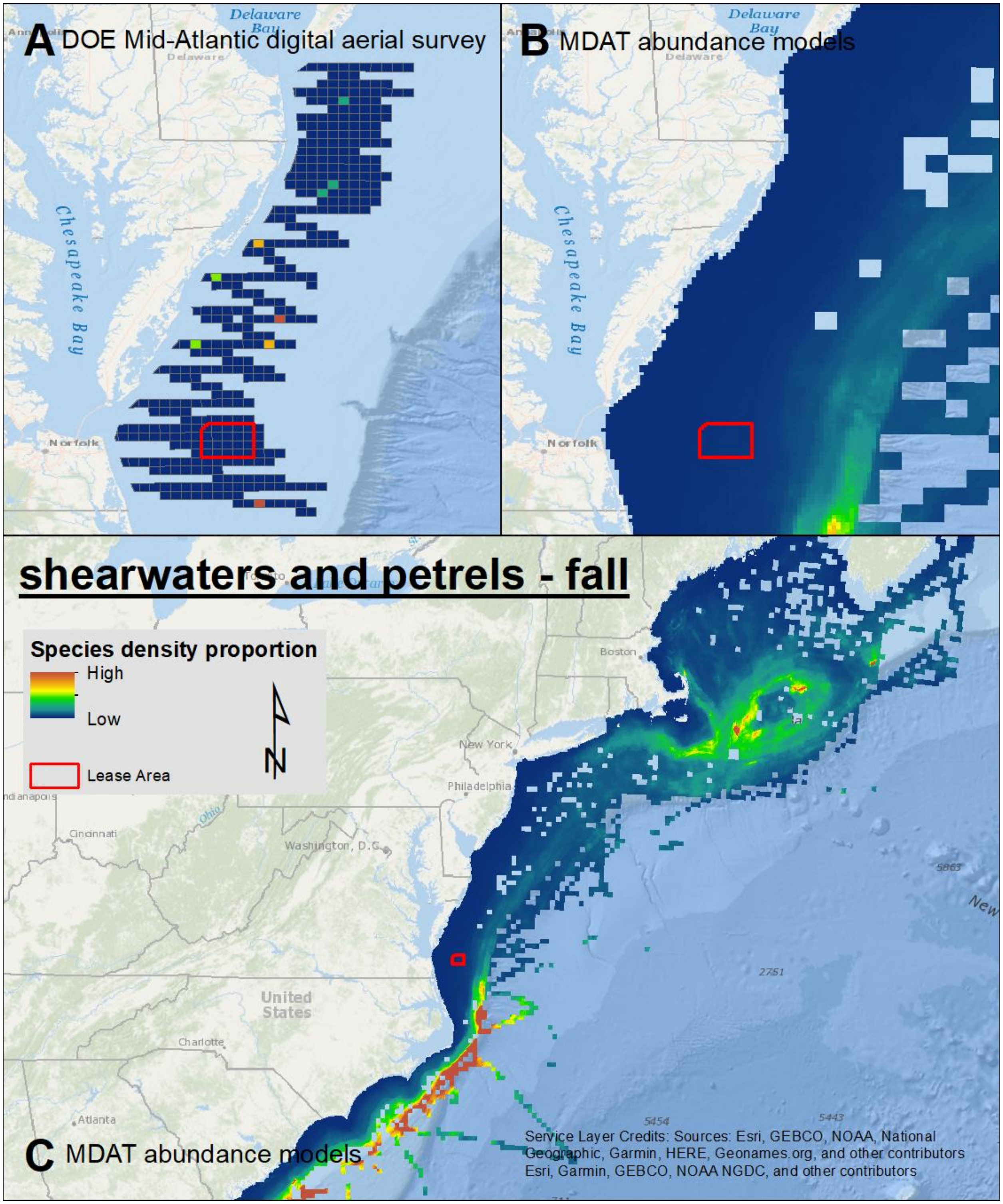
Map 52. Winter shearwaters and petrels density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Northern Fulmar, Great Shearwater, Manx Shearwater, Unidentified Shearwater, Unidentified Petrel and MDAT maps: Northern Fulmar.



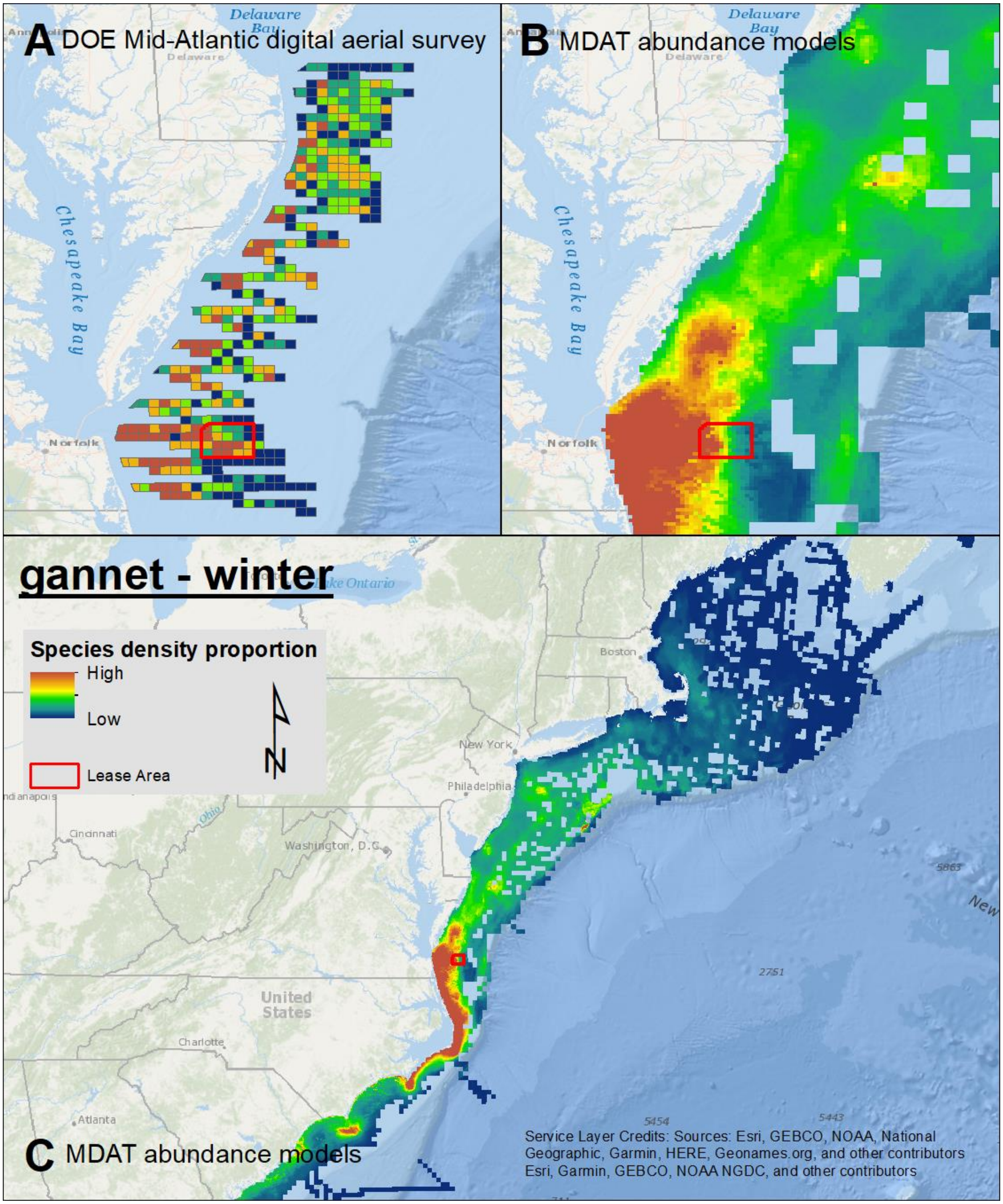
Map 53. Spring shearwaters and petrels density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Shearwater and MDAT maps: NA.



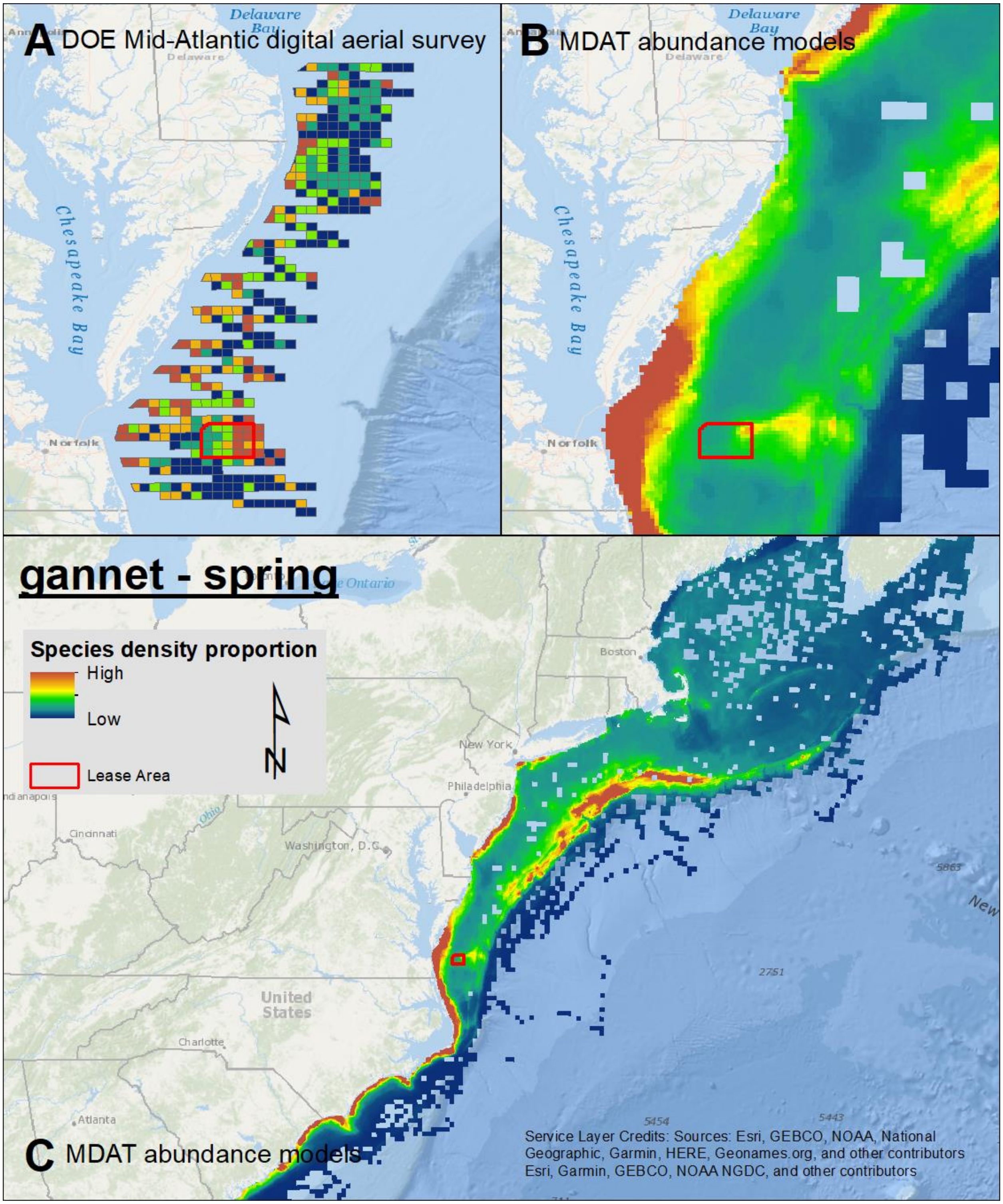
Map 54. Summer shearwaters and petrels density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Northern Fulmar, Cory's Shearwater, Sooty Shearwater, Great Shearwater, Unidentified Shearwater, Unidentified Large Shearwater and MDAT maps: Cory's Shearwater, Great Shearwater.



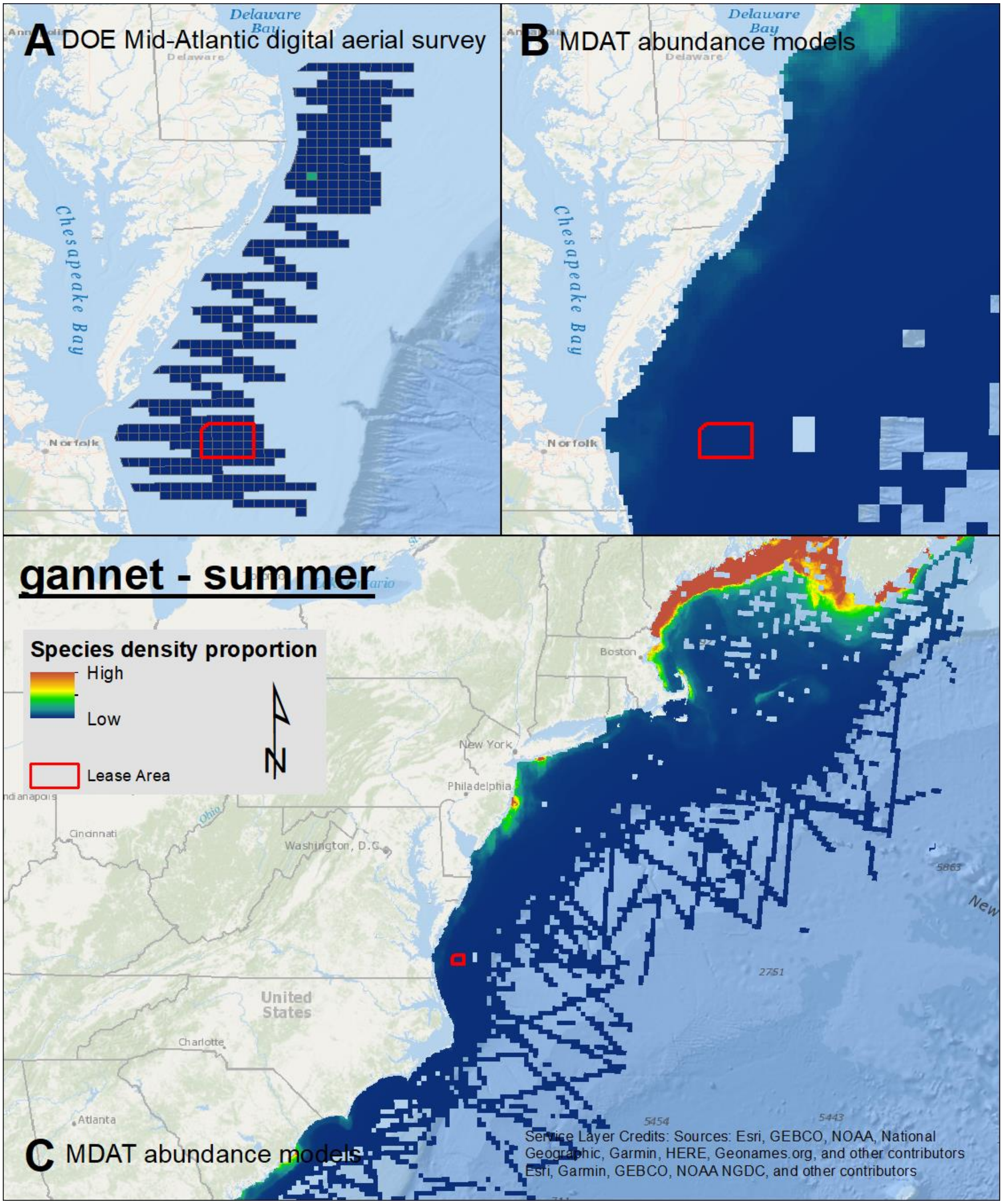
Map 55. Fall shearwaters and petrels density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Cory's Shearwater, Unidentified Shearwater, Unidentified Large Shearwater and MDAT maps: Cory's Shearwater.



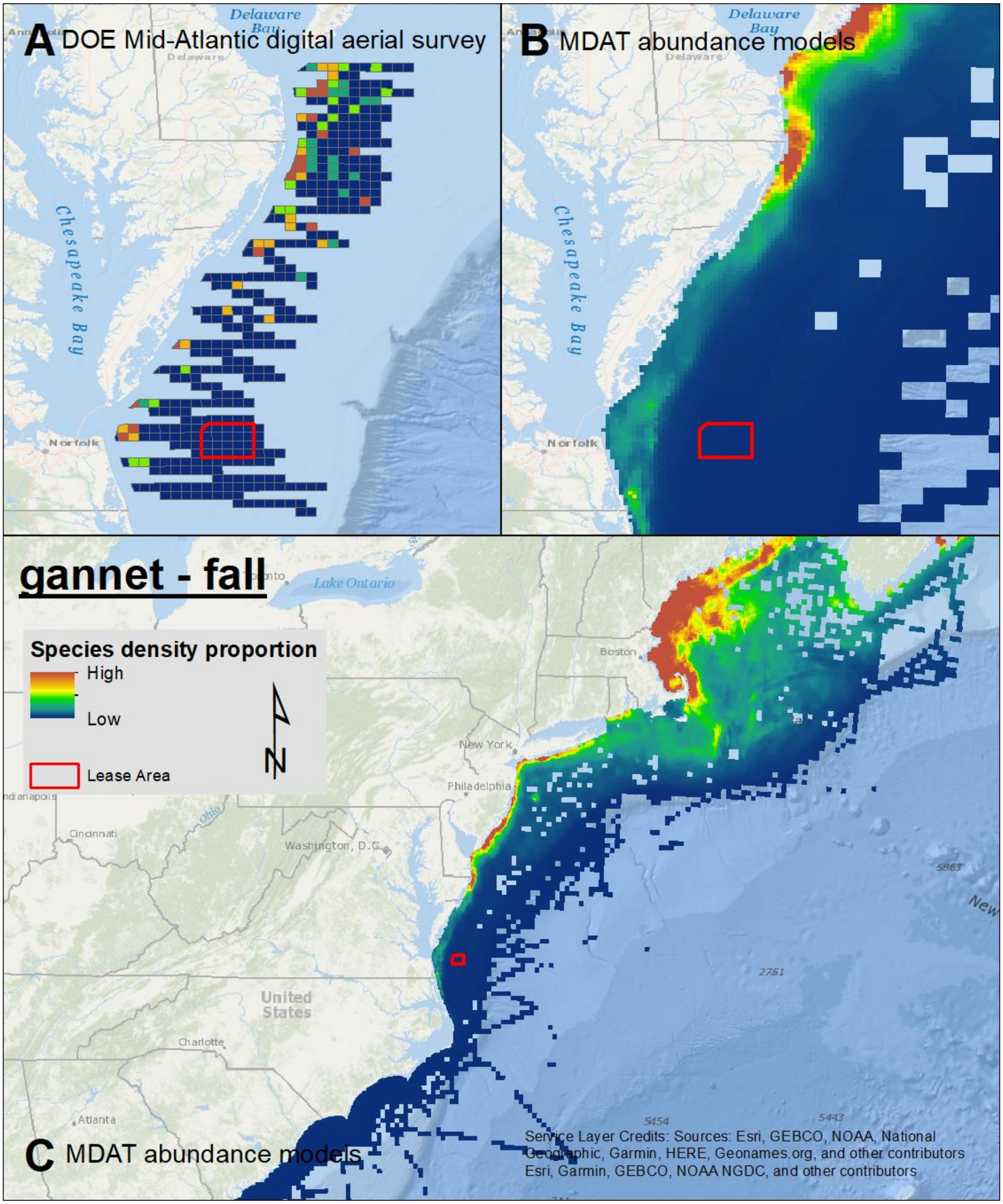
Map 56. Winter gannet density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Northern Gannet and MDAT maps: Northern Gannet.



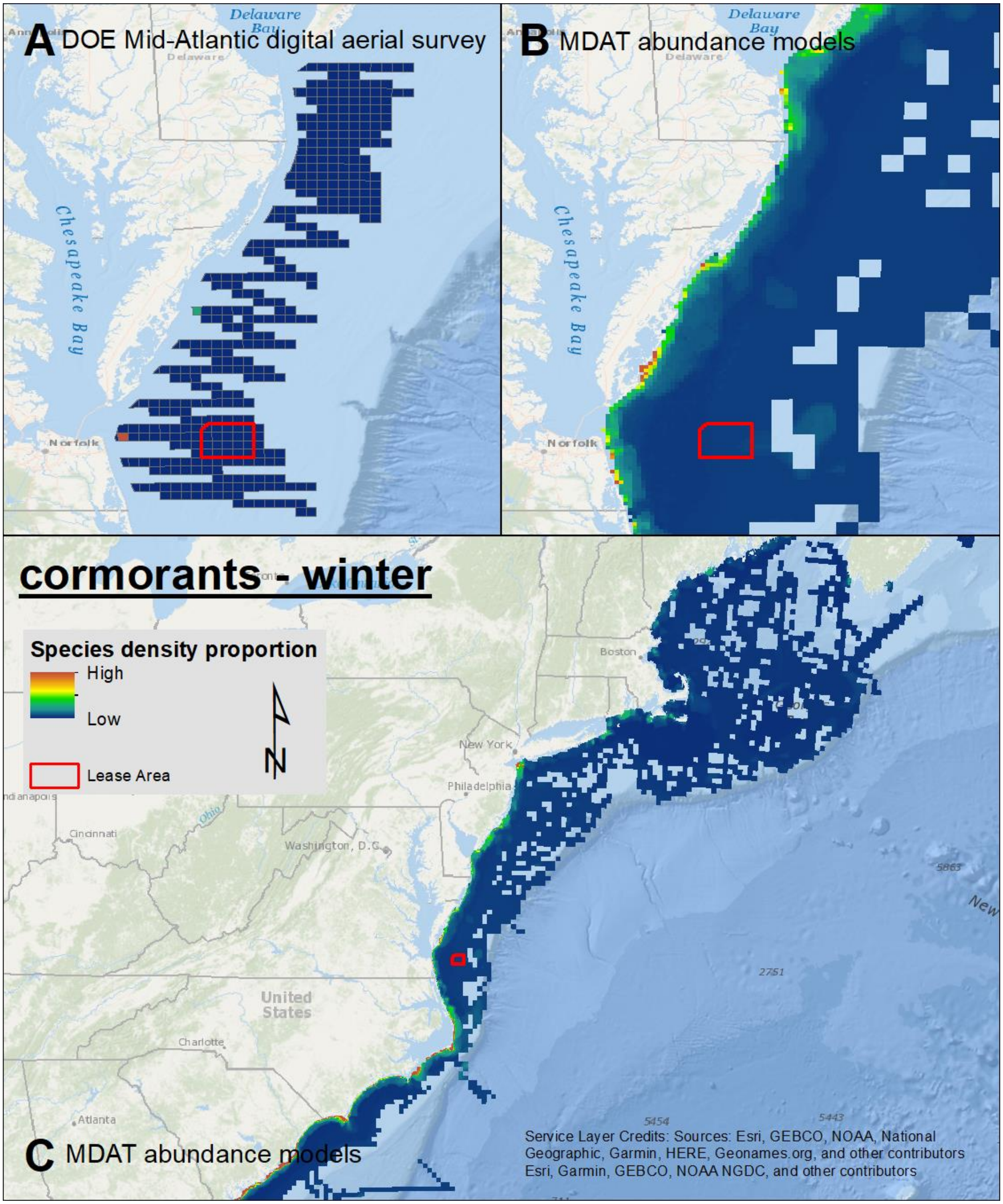
Map 57. Spring gannet density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Northern Gannet and MDAT maps: Northern Gannet.



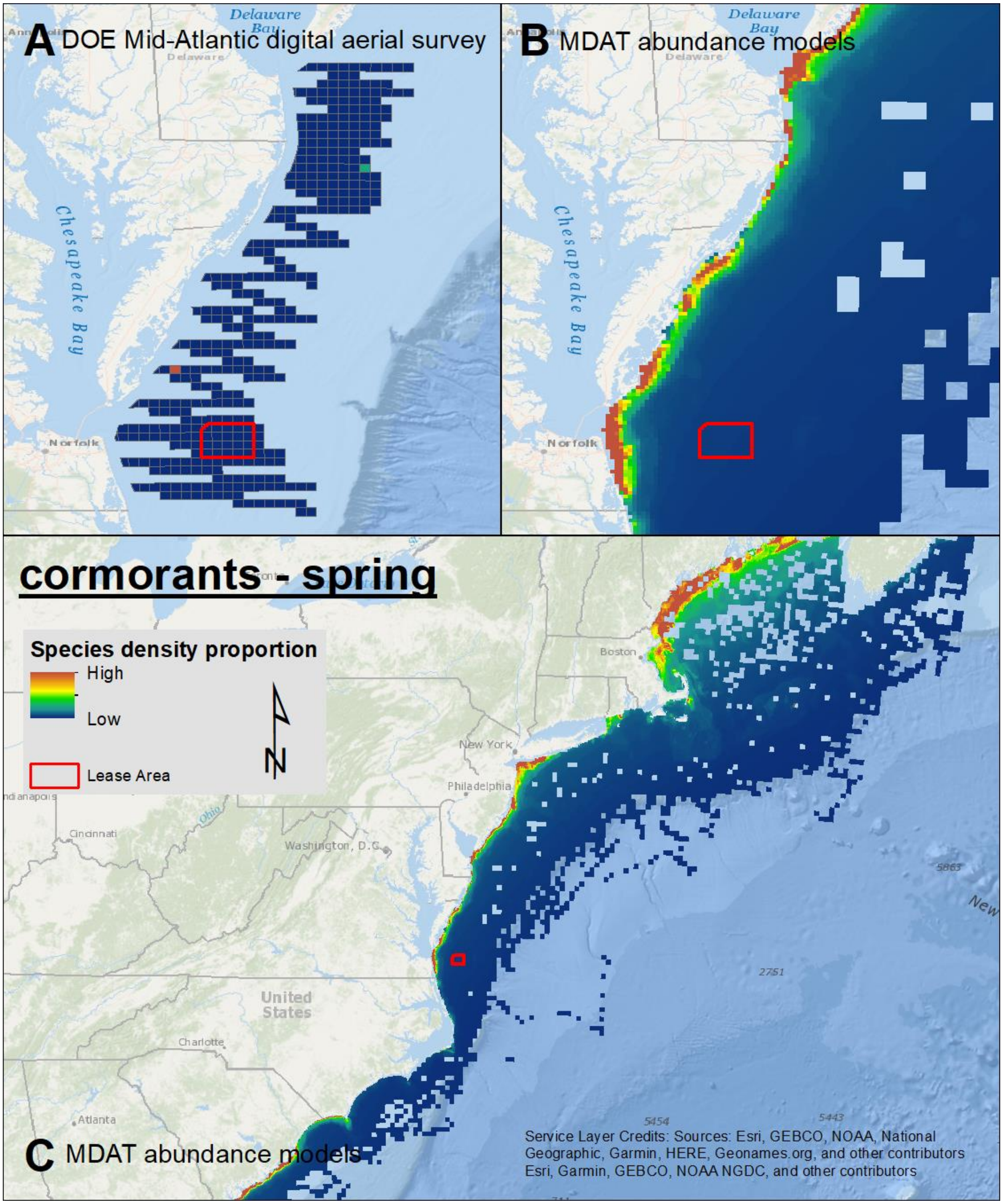
Map 58. Summer gannet density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Northern Gannet and MDAT maps: Northern Gannet.



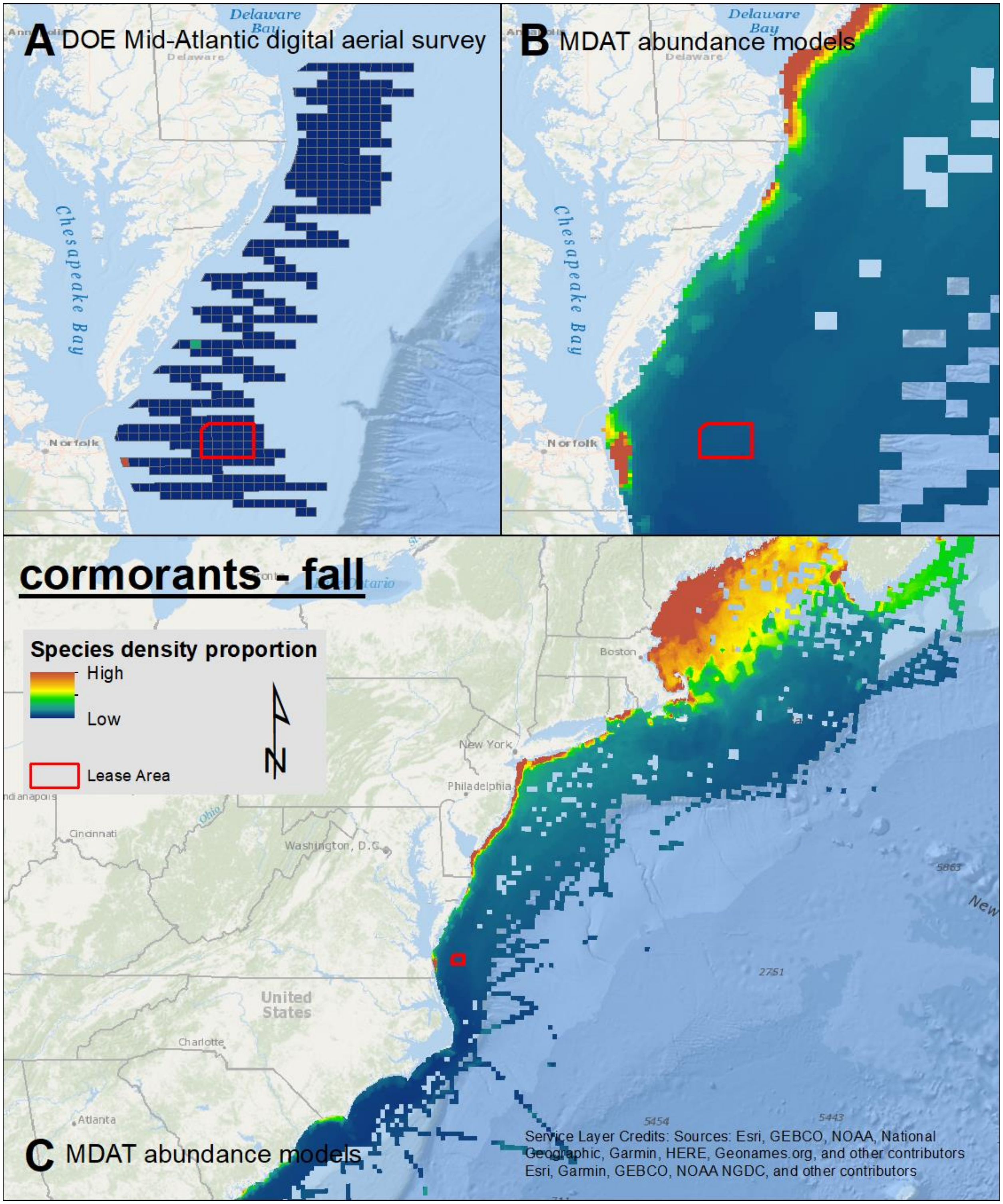
Map 59. Fall gannet density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Northern Gannet and MDAT maps: Northern Gannet.



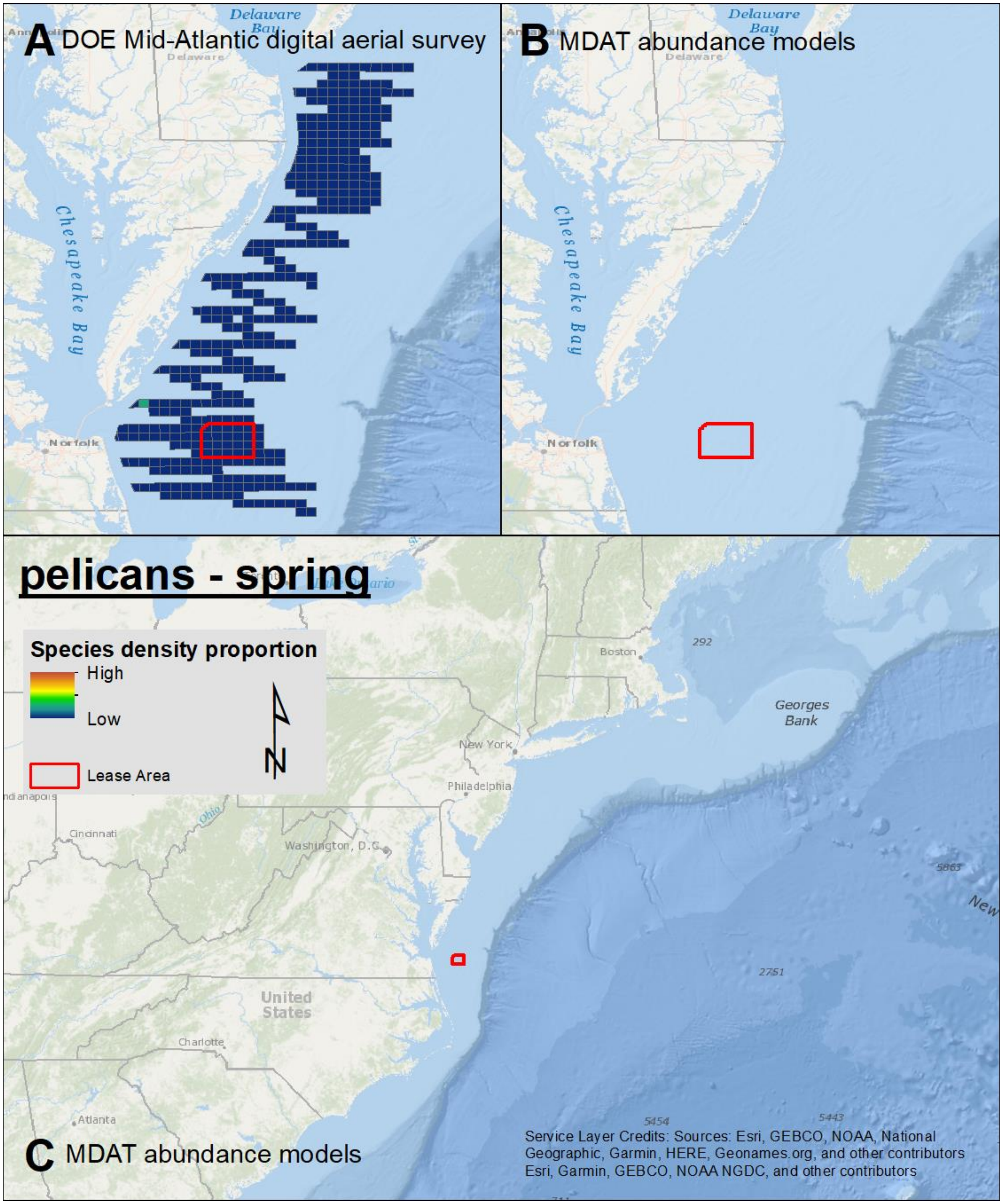
Map 60. Winter cormorants density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Double-crested Cormorant and MDAT maps: Double-crested Cormorant.



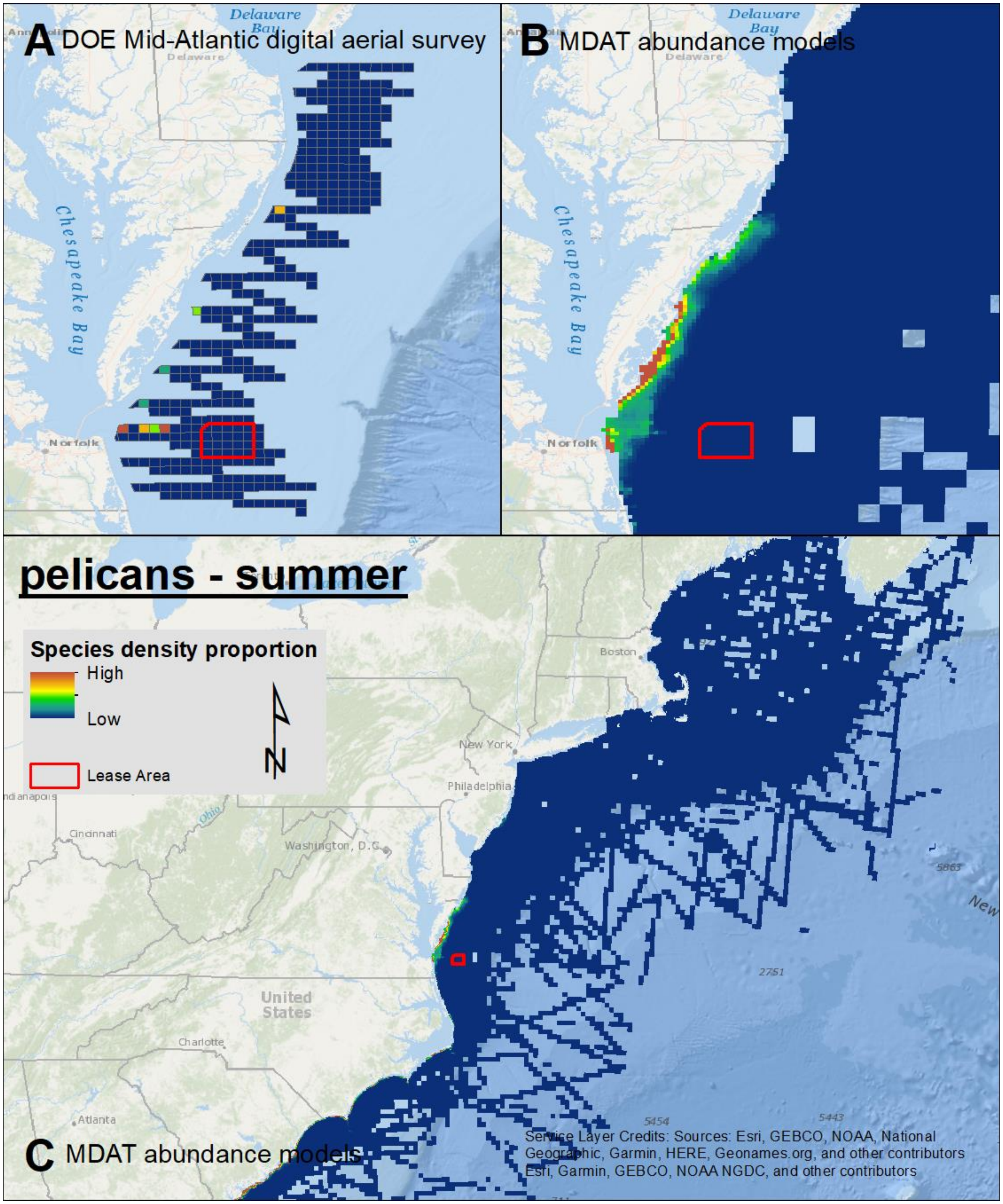
Map 61. Spring cormorants density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Double-crested Cormorant and MDAT maps: Double-crested Cormorant.



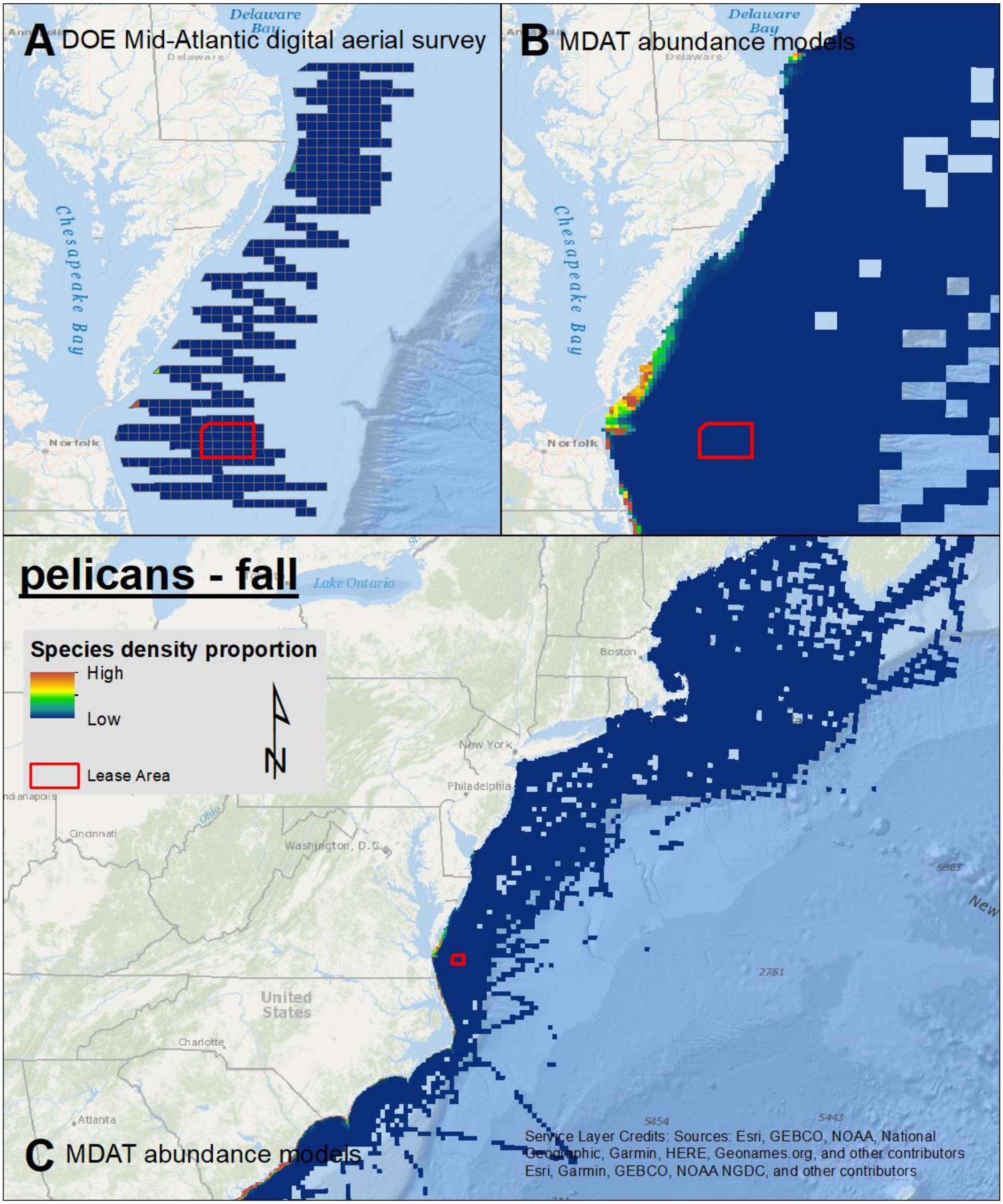
Map 62. Fall cormorants density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Double-crested Cormorant and MDAT maps: Double-crested Cormorant.



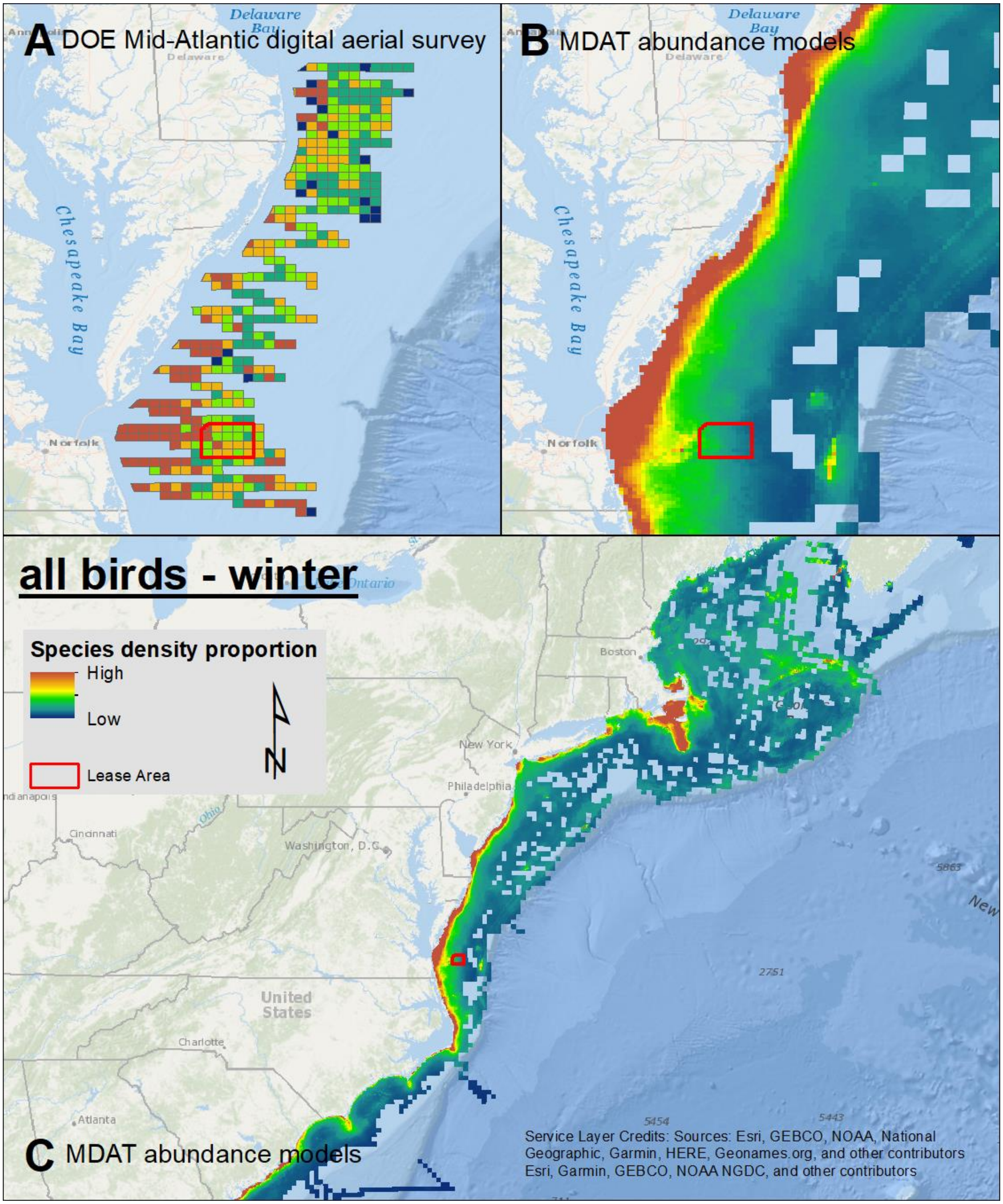
Map 63. Spring pelicans density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Brown Pelican and MDAT maps: NA.



Map 64. Summer pelicans density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Brown Pelican and MDAT maps: Brown Pelican.

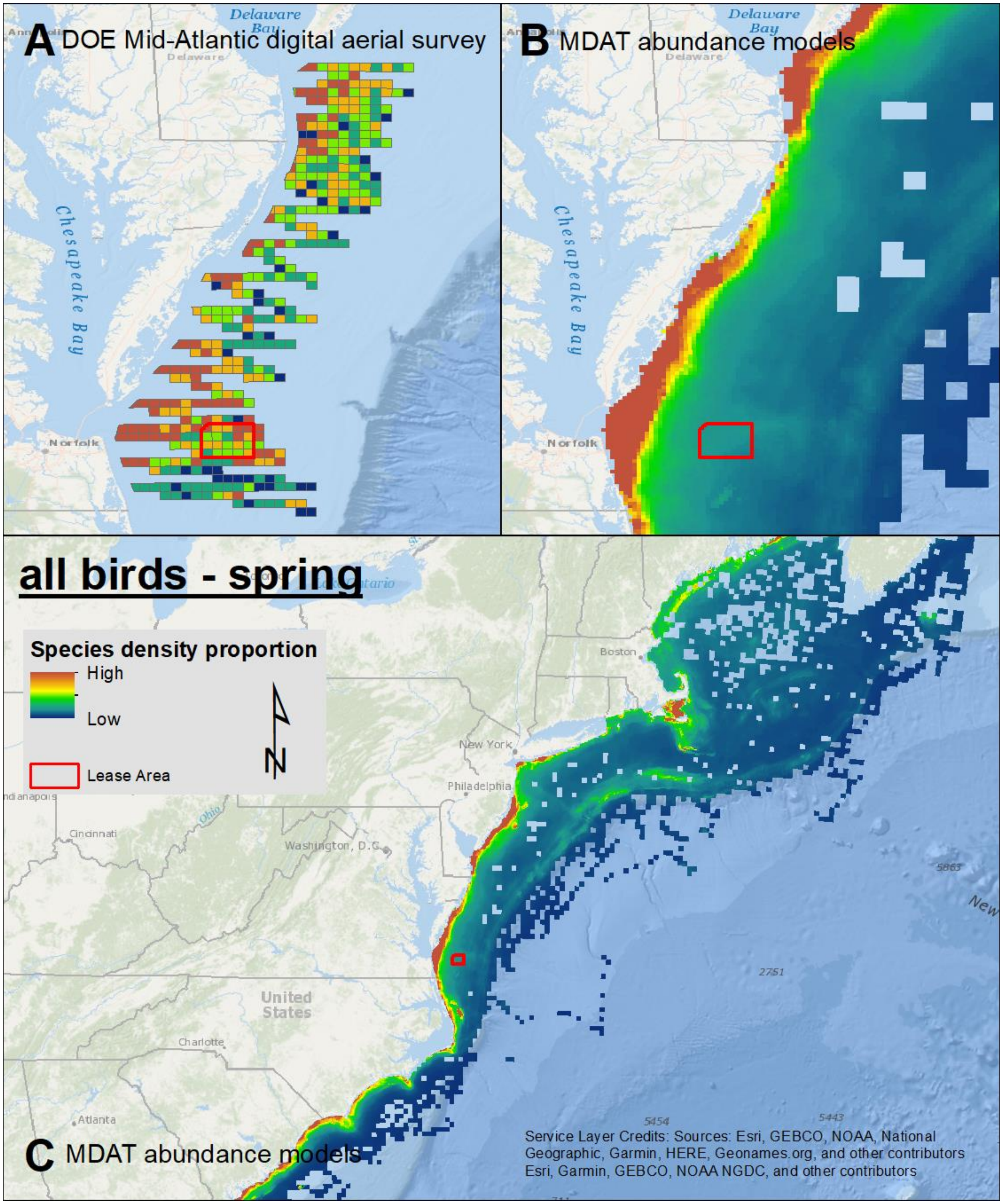


Map 65. Fall pelicans density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Brown Pelican and MDAT maps: Brown Pelican.



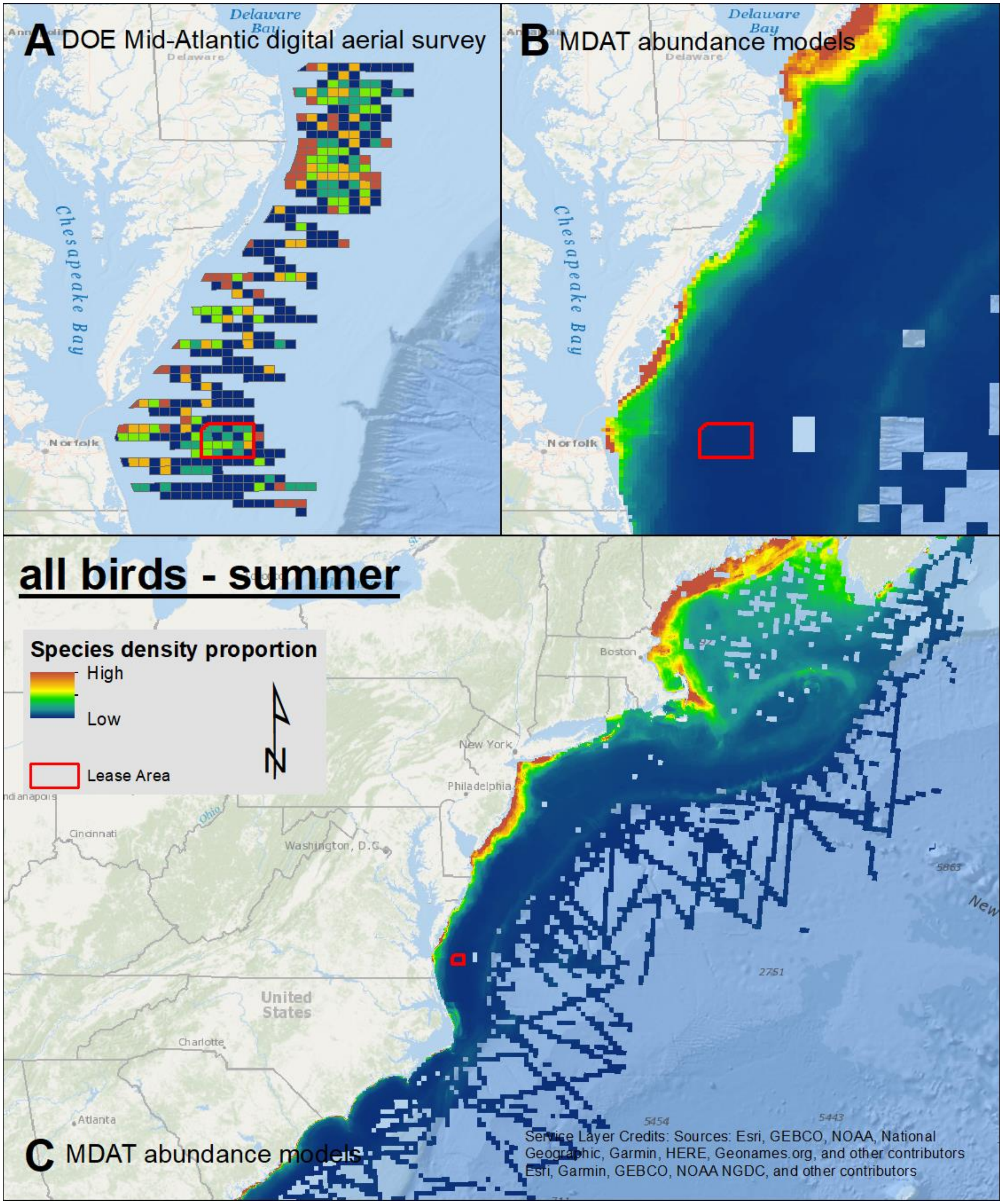
Map 66. Winter all birds density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Brant, Unidentified Duck, Unidentified Goose, Surf Scoter, White-winged Scoter, Black Scoter, Unidentified Scoter, Unidentified Grebe, Dovekie, Razorbill, Atlantic Puffin, Unidentified Alcid, Unidentified large alcid (Razorbill or Murre), Unidentified small alcid (Puffin/Dovekie), Bonaparte's Gull, Unidentified

Small Gull/Tern, Unidentified small gull, Laughing Gull, Unidentified medium gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull, Unidentified Gull, Unidentified large Tern, Unidentified Tern, Red-throated Loon, Common Loon, Unidentified Loon, Unidentified Storm-petrel, Northern Fulmar, Great Shearwater, Manx Shearwater, Unidentified Shearwater, Unidentified Petrel, Northern Gannet, Double-crested Cormorant, Osprey, Unidentified Bird and MDAT maps: Surf Scoter, White-winged Scoter, Black Scoter, Dovekie, Razorbill, Atlantic Puffin, Bonaparte's Gull, Laughing Gull, Herring Gull, Great Black-backed Gull, Red-throated Loon, Common Loon, Northern Fulmar, Northern Gannet, Double-crested Cormorant.



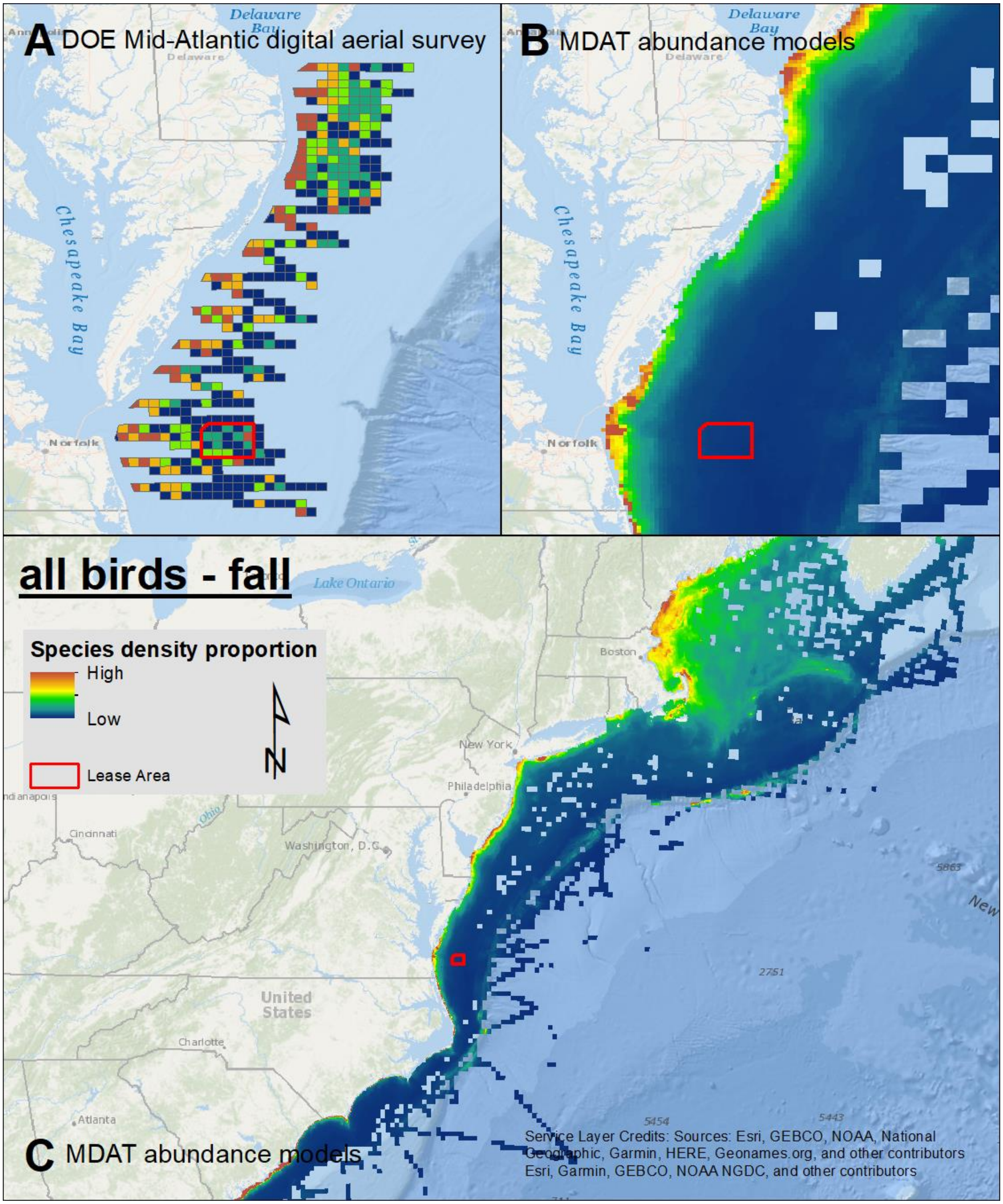
Map 67. Spring all birds density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Surf Scoter, White-winged Scoter, Black Scoter, Unidentified Scoter, Horned Grebe, Parasitic Jaeger, Unidentified Jaeger, Unidentified Alcid, Unidentified small alcid (Puffin/Dovekie), Bonaparte's Gull, Unidentified Small Gull/Tern, Unidentified small gull, Laughing Gull, Ring-billed Gull, Unidentified medium gull,

Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull, Unidentified Gull, Unidentified small Tern, Royal Tern, Unidentified medium tern, Unidentified large Tern, Unidentified Tern, Red-throated Loon, Common Loon, Unidentified Loon, Wilson's Storm-Petrel, Unidentified Shearwater, Northern Gannet, Double-crested Cormorant, Brown Pelican, Snowy Egret, Cedar Waxwing, Unidentified Bird and MDAT maps: Surf Scoter, White-winged Scoter, Black Scoter, Parasitic Jaeger, Bonaparte's Gull, Laughing Gull, Herring Gull, Great Black-backed Gull, Royal Tern, Red-throated Loon, Common Loon, Wilson's Storm-Petrel, Northern Gannet, Double-crested Cormorant.



Map 68. Summer all birds density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Dowitcher spp., Unidentified Phalarope, Pomarine Jaeger, Unidentified Jaeger, Unidentified Small Gull/Tern, Unidentified small gull, Laughing Gull, Unidentified medium gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull, Unidentified Gull, Black Tern,

Unidentified small Tern, Common Tern, Unidentified medium Tern, Caspian Tern, Unidentified large Tern, Unidentified Tern, Red-throated Loon, Common Loon, Unidentified Loon, Wilson's Storm-Petrel, Unidentified Storm-petrel, Northern Fulmar, Cory's Shearwater, Sooty Shearwater, Great Shearwater, Unidentified Shearwater, Unidentified Large Shearwater, Northern Gannet, Brown Pelican, Great Blue Heron, Osprey, Common Nighthawk, Barn Swallow, Unidentified Bird and MDAT maps: Pomarine Jaeger, Laughing Gull, Herring Gull, Great Black-backed Gull, Common Tern, Common Loon, Wilson's Storm-Petrel, Cory's Shearwater, Great Shearwater, Northern Gannet, Brown Pelican.



Map 69. Fall all birds density proportions in the DOE Mid-Atlantic high-resolution video aerial baseline survey data (A) and the combined taxonomic group level standardized MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source. Mid-Atlantic aerial maps contain the following species: Unidentified Duck, Black Scoter, Unidentified Scoter, Unidentified Phalarope, Sabine's Gull, Unidentified Small Gull/Tern, Unidentified small gull, Laughing Gull, Unidentified medium gull, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Unidentified Large Gull, Unidentified Gull, Black Tern,

Unidentified small Tern, Unidentified medium tern, Caspian Tern, Unidentified large Tern, Unidentified Tern, Common Loon, Unidentified Loon, Wilson's Storm-Petrel, Unidentified Storm-petrel, Cory's Shearwater, Unidentified Shearwater, Unidentified Large Shearwater, Northern Gannet, Double-crested Cormorant, Brown Pelican, American Bittern, Great Blue Heron, Osprey, Belted Kingfisher, Baltimore Oriole, Unidentified Passerine (perching birds, songbirds), Unidentified Swallow, Unidentified Bird and MDAT maps: Black Scoter, Laughing Gull, Herring Gull, Great Black-backed Gull, Common Loon, Wilson's Storm-Petrel, Cory's Shearwater, Northern Gannet, Double-crested Cormorant, Brown Pelican.