Assessment of the Potential Effects of the Revolution Wind Offshore Wind Farm on Birds & Bats

– Lease Area OCS-A-0486 –

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Executive Summary

Revolution Wind, LLC (Revolution Wind), a 50/50 joint venture between Orsted North America, Inc. (Orsted NA) and Eversource Investment, LLC (ESI), proposes to construct and operate the Revolution Wind Farm Project (hereafter referred to as the Project). The wind farm portion of the Project will be located on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0486 (Lease Area). The Lease Area is approximately 20 statute miles (mi) (17.4 nautical miles [nm], 30 kilometers [km]) south of the coast of Rhode Island. The Biodiversity Research Institute (BRI) was contracted by VHB to support an assessment of potential effects of the Project on birds and bats. This assessment has been developed as part of the Construction and Operation Plan (COP) for the Project. This assessment also serves to provide information for environmental review under the National Environmental Policy Act (NEPA) and support agency consultations.

Specifically, the purpose of this assessment is to evaluate the potential effects of all Project phases (construction, operation and decommissioning) within the Project's offshore Lease Area (as of March 2020) on birds and bats. This assessment provides an overview of the species of birds and bats that have the potential to be affected by the proposed Project's offshore structures and activities, with detailed consideration for federally listed or protected species. Potential direct and indirect impacts, including habitat modification, collision and displacement, have been evaluated for each phase of the Project.

The assessment of bats included migratory tree roosting bats and cave hibernating bats. The northern long-eared bat (*Myotis septentrionalis*) was individually assessed based on its conservation status. The assessment of birds included migratory shorebirds, wading birds, raptors, songbirds, coastal waterbirds, and marine birds. Marine birds were assessed by major taxonomic group, which included loons, sea ducks, petrels and allies, gannets and allies, gulls and allies, terns, and auks. Avian species that were individually assessed based on conservation status include the Bald Eagle (*Haliaeetus leucocephalus*), Golden Eagle (*Aquila chrysaetos*), Roseate Tern (*Sterna dougallii*), Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus*), and Black-capped Petrel (*Pterodroma hasitata*).

The assessments described herein rely on a weight-of-evidence approach that included an analysis of exposure of birds and bats to each specific Project-related impact producing factor, and behavioral vulnerability to each of those factors. Numerous references and data sets were drawn upon, including (but not limited to) the Rhode Island Ocean Special Area Management Plan (OSAMP) Surveys, NOAA Marine Bird Distribution Models, occurrence data, individual tracking data, relevant literature, and species accounts.

Part I of this document provides background information on the Project. Part II provides the assessment of potential Project-related effects on bats. Part III provides the assessment of potential Project-related effects on birds. Part IV presents the list of references. Part V presents a table of seasonal and annual effort corrected counts for all avian species or unidentified species

groups within the Lease Area as compared to the OSAMP aerial survey area. Part VI provides maps of exposure for marine birds.

Overall, the assessment of bats found that Project construction, operation, and decommissioning within the Lease Area are not expected to affect the populations of any species or taxonomic groups of bats. The assessment of northern long-eared bat determined that the risk of impacts to individuals of this species is minimal. To the extent practicable, the Project will avoid attracting bats to offshore structures by minimizing lighting on wind turbines and substations, and by using alternate lighting technologies (e.g., low-intensity strobe lights) that minimize impacts.

The assessment of birds found that Project construction, operation, and decommissioning within the Lease Area are not expected to affect the populations of any species or taxonomic groups of migratory, coastal or marine birds, including federally listed species. In general, exposure of bird populations has been avoided by siting the Project offshore in a wind energy area designated by BOEM. To minimize or mitigate the potential for bird strikes and habitat loss, the Project will use best practices identified in the Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (Bureau of Ocean Energy Management 2016b). The Project will comply with Federal Aviation Administration (FAA) and United States Coast Guard (USCG) requirements for lighting while, to the extent practicable, using lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian species.

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List of Acronyms and Abbreviations

AC	alternating current
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
CFA	Conservation focal area
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
CSV	comma-separated value
EBS	Ecological Baseline Studies
ESA	Endangered Species Act
FAA	Federal Aviation Administration
ft	feet
ha	hectare
HDD	horizontal direction drilling
JSON	JavaScript Object Notation
km	kilometer
kW	kilowatt
m	meter
MBTA	Migratory Bird Treaty Act
MDAT	Marine-life Data and Analysis Team
MMS	Minerals Management Service
MW	megawatt
NCCOS	National Centers for Coastal Ocean Science
NEPA	National Environmental Policy Act
NE RPB	Northeast Regional Planning Body
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
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
WNS	white-nose syndrome

1 Part I: Introduction and Background

1.1 Introduction

Biodiversity Research Institute (BRI) was contracted by VHB to support an assessment of birds and bats for the proposed Revolution Wind Farm Project (hereafter referred to as the "Project"). Revolution Wind LLC (Revolution Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (ESI), is proposing development of the Project pursuant to the Bureau of Ocean Energy Management (BOEM) requirements for the commercial lease of submerged lands for renewable energy development on the outer continental shelf (OCS).

The Project's offshore facilities will be located within BOEM Lease Area OCS-A-0486 (Lease Area). The Lease Area is located approximately 20 statute miles (mi) (17.4 nautical miles [nm], 30 kilometers [km]) south of the coast of Rhode Island, along the southern periphery of Rhode Island Sound, and approximately midway between Block Island, Rhode Island and Martha's Vineyard, Massachusetts (Figure 1-1). This area is within the Mid-Atlantic Bight, which is an oceanic region that spans 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.

The Lease Area also encompasses another proposed wind installation known as the South Fork Wind Farm. The area of the proposed South Fork Wind Farm is generally located within a small portion of the southwestern section of the Lease Area. This assessment considered the entirety of the Lease Area, including the portion that is associated with the proposed South Fork Wind Farm.

The Project will specifically include the following offshore and onshore components:

- Offshore:
    - up to 100 WTGs connected by a network of IAC measuring up to 155 mi (250 km) in total length;
    - up to two OSSs connected by an up to 9-mi (15-km)-long OSS-Link Cable; and
    - up to two submarine export cables (referred to as the RWEC), generally co-located within a single corridor up to 50 mi (80 km) in length.[1]

- Onshore:
    - a landfall location located at Quonset Point in North Kingstown, Rhode Island (referred to as the Landfall Work Area);

[1] A relatively short segment of the RWEC (up to 500 ft [152 m]) will be located onshore (i.e., from the Mean High Water Line [MHWL], as defined by the USACE [(33 CFR 329], to the Landfall Work Area).

- up to two underground transmission circuits (referred to as the Onshore Transmission Cable), co-located within a single corridor up to 1 mi (1.6 km) in length; and
- a new Onshore Substation (OnSS) and Interconnection Facility (ICF) located adjacent to the existing TNEC Davisville Substation. The ICF is an expansion of TNEC's existing Davisville Substation; and
- New Interconnection right-of-way (ROW) connecting the OnSS to the ICF (underground); and
- Overhead ROW (TNEC ROW) connecting the ICF to TNEC's Davisville Substation. The overhead transmission line is a reconfiguration of existing overhead lines.

This assessment focuses solely on potential impacts associated with the Project's offshore components, specifically the WTGs and OSSs. Construction and operation of the offshore and onshore export cable corridors are not expected to result in impacts to birds and bats (Epsilon Associates Inc. 2018); for this reason, this assessment solely focuses on potential impacts associated with the Project's offshore wind farm area (i.e., the Lease Area). A separate study was performed to evaluate potential impacts associated with onshore components (COP Appendix K). Impacts associated with sedimentation/water quality impacts, spills/trash, etc. are not discussed in this technical report.

Revolution Wind is considering a range of WTGs to be installed within the Lease Area for the Project. The minimum and maximum dimensions of WTGs under consideration are presented in Table 1-1. Due to the operational cut-in and cut-out wind speed limitations, the WTGs may not be operating approximately 2 percent of the time during winter months, approximately 5 to 9 percent of the time during spring months, approximately 6 to 8 percent of the time during summer months, and approximately 2 to 5 percent of the time during fall months.

Table 1-1. Minimum and maximum WTG characteristics under consideration for the Project.

WTG Characteristic	Minimum	Maximum
Hub Height (from MSL)	377 ft (115 m)	512 ft (156 m)
Turbine Height (from MSL)	646 ft (197 m)	873 ft (266 m)
Air Gap (MSL) to the Bottom of the Blade Tip	94 ft (28.5 m)	151 ft (46 m)
Base Height (foundation height – top of TP)	82 ft (25 m)	128 ft (39 m)
Base (tower) Width (at the bottom)	19.7 ft (6 m)	26 ft (8 m)
Base (tower) Width (at the top)	13 ft (4 m)	21 ft (6.4 m)
Nacelle Dimensions (length x width x height)	46 ft x 23 ft x 20 ft (14 m x 7 m x 6 m)	72 ft x 33 ft x 36 ft (22 m x 10 m x 11 m)
Blade Length	259 ft (79 m)	351 ft (107 m)
Maximum Blade Width	16 ft (5 m)	26 ft (8 m)
Rotor Diameter	538 ft (164 m)	722 ft (220 m)
Operation Cut-in Wind Speed	7 to 11 mph (3 to 5 m/s)	
Operational Cut-out Wind Speed	55 to 80 mph (25 to 35 m/s)	

The proposed Project consists of three temporal phases: construction, operation, and decommissioning. Potential impacts to birds and bats differ for each phase of the Project. For this reason, this assessment considers potential impacts relevant to each phase. While the details of decommissioning activities are not yet known, this assessment assumes that the activities associated with construction and decommissioning will be similar.

The overall purpose of this assessment is to evaluate the potential effects of Project construction, operation and decommissioning within the Lease Area on bats, migratory shorebirds, wading birds, raptors, songbirds, coastal waterbirds, and marine birds as part of the Construction and Operation Plan (COP) for the Project.

This assessment was developed to meet COP requirements, provide information for NEPA review, and support agency consultations.

The assessment under 30 CFR 585.626 requires the following information related to biological resources to be submitted with the COP:

- § 585.626: a description of the results of biological surveys of biological resources including threatened and endangered species.
- § 585.627: a description of those resources that could be affected by the proposed project activities, ESA-listed species, and sensitive habitats (i.e., maternity roosting habitat, hibernacula, and foraging areas).

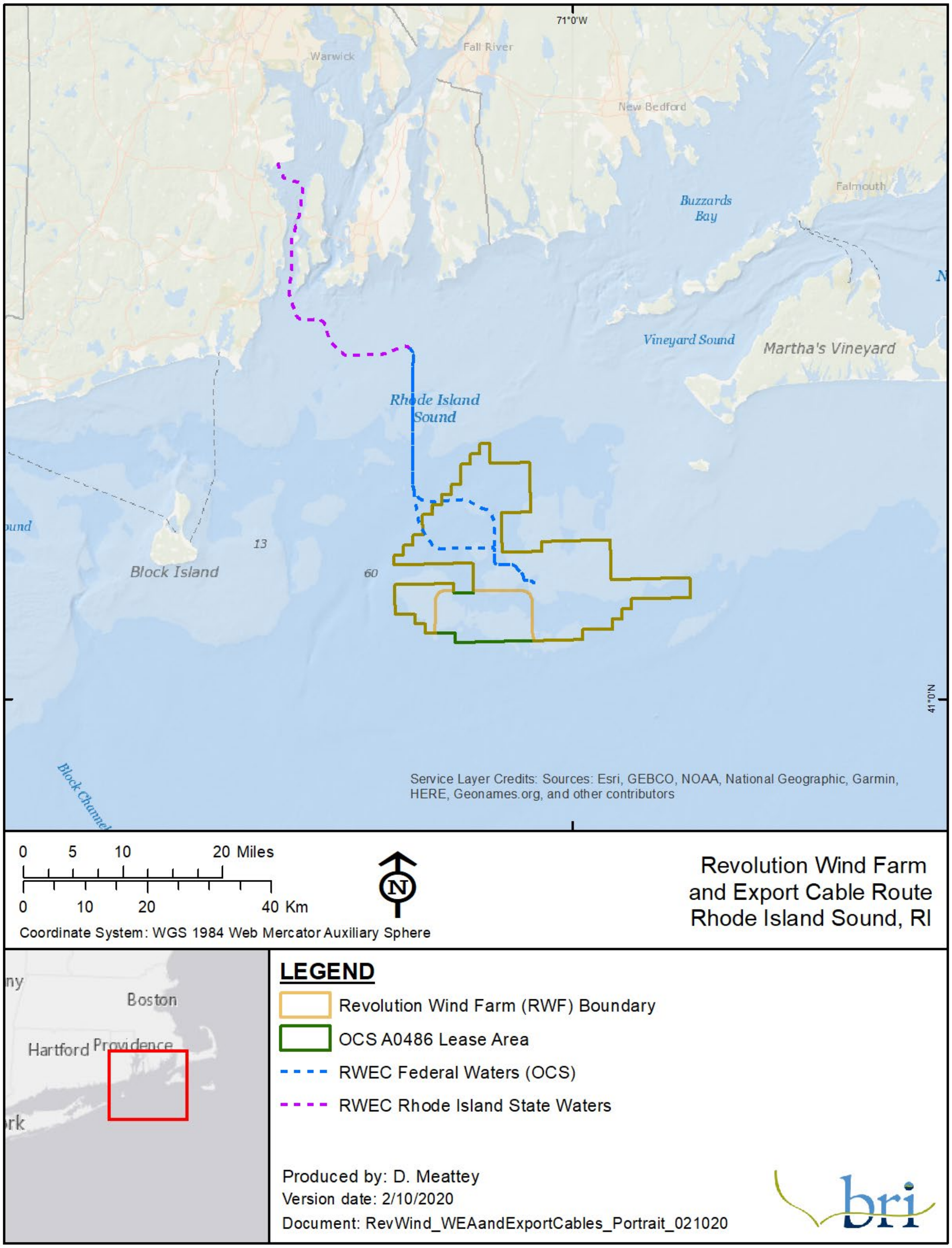

Figure 1-1. Project Location Overview.

1.2 Scope and Approach of Assessment

Impacts to birds are regulated 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 consequences of major federal actions. Major federal actions include issuance of federal permits that have the potential to affect the natural and human environments. Impacts to biological resources, including bats and birds, must therefore be identified and evaluated as part of the Project's environmental review process. This assessment was developed to provide adequate data and analysis to BOEM and other federal and state agencies for NEPA review.

This assessment provides an overview of the species of birds and bats that have the potential to be affected by the proposed Project's offshore structures and activities, with special attention provided to federally protected species. To do so, the potential direct and indirect impacts were evaluated for each phase of the Project, including habitat modification, collision, and displacement (Table 1-2).

A semi-quantitative approach was taken to evaluate potential impacts, the process of which included:

- *Impact-producing Factors* – The first step in the assessment was to describe the impact-producing factors, which are the Project activities or structures that have the potential to pose a hazard to bats or birds.

- *Exposure* – The next step in this process is an assessment of 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 Project footprint. The assessment included the entire Lease Area (as of March 2020) and was inclusive of the South Fork Wind Farm. For species where site-specific data were available, a semi-quantitative exposure assessment was conducted. The exposure of birds to the Project was assessed using multiple datasets, species accounts, and existing literature. This assessment of exposure was focused exclusively on the horizontal, or two-dimensional, likelihood that a bird would use the Lease Area.

- *Vulnerability* – Potential effects are then assessed qualitatively by combining the exposure assessment with the best information available on behavioral vulnerability to operating WTGs and other structures associated with offshore wind energy development. 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 wind energy developments. This assessment of behavioral vulnerability focused on documented avoidance behaviors, estimated flight heights, and estimated collision risks published in existing literature.

- *Risk* – The likelihood that the Project would impact bats and birds 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., bats and birds) 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 Wind Energy Areas (Bureau of Ocean Energy Management 2016) and project specific EISs (Bureau of Ocean Energy Management 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 similar loss for non-listed species.

Table 1-2: Primary potential effects and the Project phases for which they are assessed.

Potential Effect	Description	Construction & Decommissioning[1]	Operation
Collision	Mortality and injury caused by collision with Project structures	✓	✓
Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	✓	
Displacement (Permanent)	Permanent avoidance and/or displacement from habitat		✓

[1]Effects of decommissioning are expected to be less than or equal to construction activities.

1.3 Agency Coordination

Prior to beginning the assessment, Revolution Wind met with BOEM on July 10, 2019 to discuss the overall approach for assessment. At the meeting, available data on bird and bat use of the Lease Area was presented along with an overview of the assessment approach.

1.4 Contents of this Report

Part I of this document (this section) provides an introduction and background to the Project and a description of the approach and scope of the assessment. Part II is focused on bats, including a description of methods and evaluation of data sources, a general description of species present, and an assessment of their exposure to the Project. Part III is focused on birds, including a description of methods and evaluation of data sources, a general description of taxonomic groups present, and an assessment of their exposure and vulnerability to the Project. Part IV is a list of references to all literature cited. Part V provides seasonal and annual corrected counts for all marine bird species in the Lease Area. Part VI includes a series of maps, one for each of the marine birds for each season they may be present in the Lease Area.

2 Part II: Bats

This section provides an assessment of the bat community that has potential to be exposed to Project structures and activities within the offshore Lease Area. Specifically, methods for the assessment of bats are described, bat species with potential to occur within the Lease Area are identified, potential Project-related impacts to bats are discussed, and mitigation measures are presented. For the purpose of this assessment, bats are generally considered within two groups: migratory tree-bat species, and cave-hibernating species. Federally listed species are further described, individually.

2.1 Assessment methods and data sources

2.1.1 Impact-producing factors

The potential impacts of the Project to bats were evaluated by considering the exposure of bats to Project-related hazards. Hazards (i.e., impact producing factors) are defined as the changes to the environment caused by project activities during each offshore wind development phase (construction, operation, and decommissioning; Bureau of Ocean Energy Management 2012, Goodale and Milman 2016).

Bats may be exposed to the following hazards relevant to offshore wind development within the Lease Area: construction and maintenance vessels, wind turbines, and offshore substations (Table 2-1). For the analysis below, the full range of turbine sizes that may be used by the Project are considered, and it is assumed that foundation type will not significantly alter hazards during construction.
Due to the operational cut-in and cut-out wind speed limitations, the WTGs may not be operating approximately 2 percent of the time during winter months, approximately 5 to 9 percent of the time during spring months, approximately 6 to 8 percent of the time during summer months, and approximately 2 to 5 percent during fall months. Bat species would be at less risk of collision when the blades are not spinning, as bats are well known for their ability to detect objects with echolocation (Johnson and Arnett 2004, Horn et al. 2008), and are unlikely to collide with stationary structures (Cryan 2011).

Table 2-1: Potential hazards to bats exposed to the Lease Area during Project phases

Impact-producing Factor(s)	Potential Effect	Project Component	Description	Construction & Decommissioning[1]	Operation
Visible Structures/Lighting (Vessels, wind turbines, substations)	Collision	Offshore	Mortality and injury caused by collision with Project structures	✓	✓
	Displacement	Offshore	Avoidance and/or displacement from habitat	✓	✓

[1]Effects of decommissioning are expected to be less than or equal to construction activities.

2.1.2 Assessment methods

The impact assessment on bats was conducted by evaluating the potential *exposure* of bats to Project components within the Lease Area coupled with the known *vulnerability* of bats to collisions with wind turbines. This assessment is specific to the entire OCS-A-0486 Lease Area and is inclusive of the South Fork Wind Farm (Stantec 2018a). This is similar to the approach taken for the assessment of birds. Bat exposure was assessed using the best available data. Descriptions of these data are provided below. Due to general data gaps regarding bat use of the offshore environment and the vulnerability of bats to offshore wind turbines, the final risk assessment was conducted using a weight-of-evidence approach. If a species or species-group was highly unlikely to be exposed to a Project component, then that species or species-group was not considered in the effects assessment.

Exposure was determined based upon available data, existing literature, and species accounts. The following exposure categories were used in the assessment:

- Minimal: Little to no evidence of use of the offshore environment for breeding or wintering, and minimal predicted use during migration.
- Low: Little evidence of use of the offshore environment and a low proportion of the population is exposed.
- Medium: Moderate evidence of use of the offshore environment and a moderate proportion of the population is exposed.
- High: Strong evidence of use of the offshore environment, the offshore environment is primary habitat, and a high proportion of the population is exposed.

The **behavioral vulnerability** assessment used the following categories:

- Minimal: No evidence of collisions or displacement in the literature.
- Low: Little evidence of collisions or displacement in the literature.
- Medium: Moderate evidence of collisions or displacement in the literature.
- High: Significant evidence of collisions or displacement in the literature.

Then an initial **risk** determination was made using the following categories:

- Minimal: Minimal ranking in exposure and/or vulnerability.
- Low: Low ranking in exposure and low-high vulnerability.
- Medium: Medium/medium, medium/high, or high/medium ranking in exposure and vulnerability, respectively.
- High: High/high ranking in exposure and vulnerability, respectively.

Final risk categories (Table 2-2) were assigned with consideration to other factors, such as broad population trends or general habitat use. Other critical information, such as expert opinion, was also considered.

Table 2-2. Matrix used for risk determination. The risk levels that can be adjusted based on additional information.

Exposure	Vulnerability			
	Minimal	*Low*	*Medium*	*High*
Minimal	Minimal	Minimal	Minimal	Minimal
Low	Minimal	Low	Low	Low
Medium	Minimal	Low	Medium	Medium
High	Minimal	Low	Medium	High

2.1.3 Data sources

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

In 2012, Hatch et al. (2013) conducted aerial and boat-based surveys for wildlife in the mid-Atlantic region. The information in this study provides information about bat distributions in the offshore environment. The 2012 study detected a possible migration event of eastern red bats in September of that year. One eastern red bat was observed 27.3 mi (44 km) east of Delaware during boat-based surveys, and eleven of these bats were observed 10.5–25.9 mi (~17–42 km) east of New Jersey, Delaware, and Virginia, during aerial surveys.

2.1.3.2 Regional surveys conducted by Stantec

From July 14–November 15, 2017, Stantec Consulting Services Inc. (Stantec) deployed two SM4 bat detectors on the R/V *Enterprise* to acoustically sample bat calls within and near the South Fork Wind Farm (SFWF), which is located approximately 19 mi (30.6 km) southeast of Block Island and 35 mi (56.3 km) east of Montauk Point, New York (Stantec 2018b). This survey area is adjacent to the Lease Area for the proposed Project. Stantec also recorded bat calls from two SM4 detectors mounted on the platforms of two wind turbines within the Block Island Wind Farm from 3 August 2017 to 9 January 2018 (Stantec 2018c). See Figure 2-1 for approximate locations of surveys. Additional reports summarizing the results of 2019 monitoring at Block Island Wind are being finalized and can be summarized upon request once the reports are finalized.

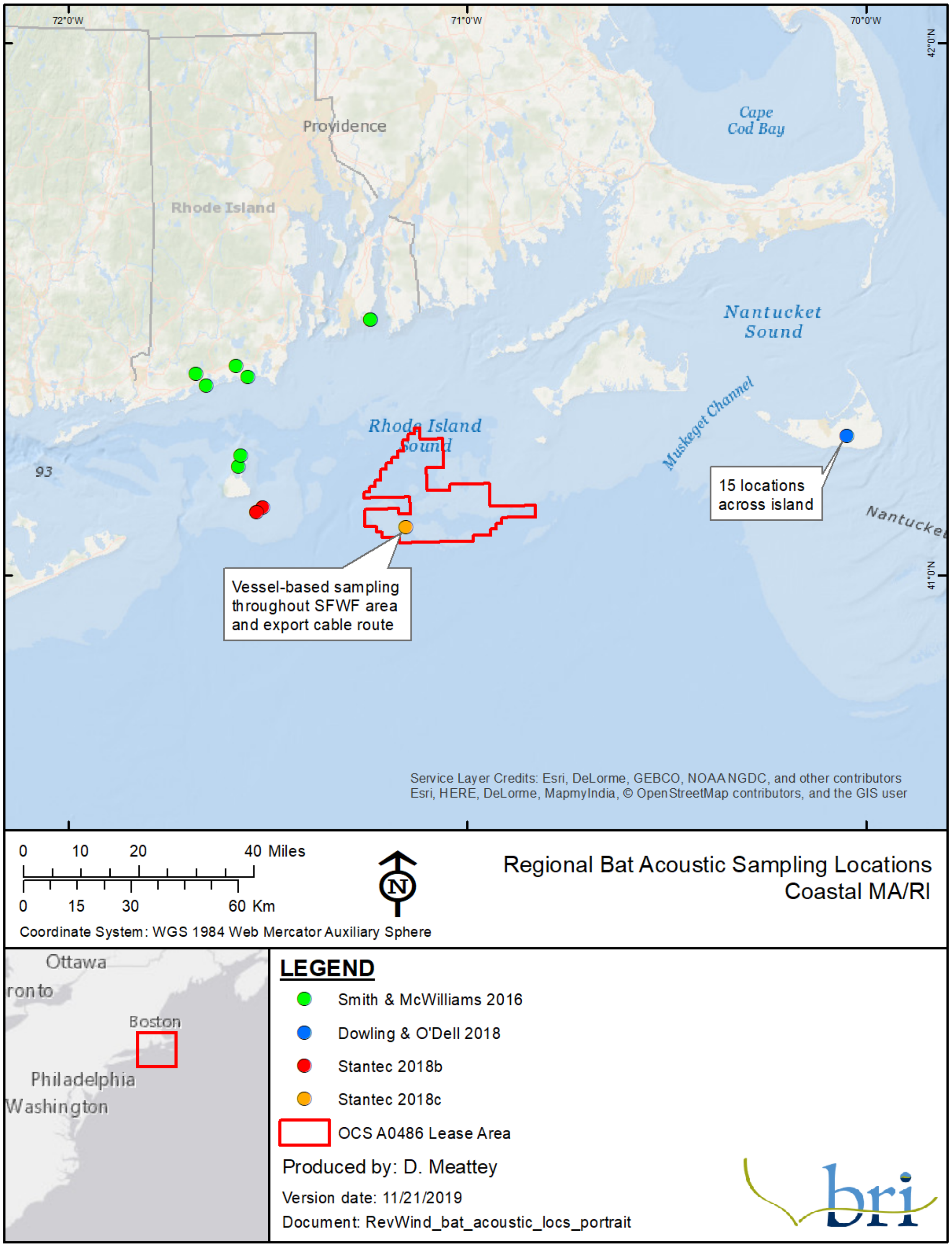

Figure 2-1: Locations of acoustic bat surveys in relation to the Lease Area. Points are approximations based on figures in cited literature and do not represent exact study locations.

2.1.3.3 *Autumn Coastal Bat Migration Relates to Atmospheric Conditions: Implications for Wind Energy Development*

Acoustic monitoring for bats was completed along the Atlantic Coast of southern New England during fall (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. See Figure 2-1 for approximate locations of surveys.

2.1.3.4 *Acoustics surveys on Nantucket Island*

Passive acoustic surveys were conducted at several locations across Nantucket Island during 2015 and 2016 (Dowling and O'Dell 2018). At least six species were detected, including likely migrants and suspected year-round residents. In addition, northern long-eared bats were mist-netted and radio-tagged in 2016, which confirmed this species reproducing and hibernating on the island. See Figure 2-1 for approximate locations of surveys.

2.2 Overview of bats in Rhode Island

There are eight species of bats present in the state of Rhode Island, five of which are likely year-round residents (Table 2-3; Rhode Island Department of Environmental management/Division of Fish and Wildlife 2019). These species can be divided into two major groups based on their wintering strategy: cave-hibernating bats and migratory tree bats. 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) and, in winter, migrate from summer habitat to hibernacula in the region (Maslo and Leu 2013). Migratory tree bats fly to southern parts of the U.S. in the winter and have been observed offshore during migration (Hatch et al. 2013, Stantec 2016, Stantec 2018c).

Table 2-3. Bat species present in Rhode Island and their conservation status.

Common Name	Scientific Name	Type[1]	RI Status	Federal Status[2]
Eastern small-footed bat	*Myotis leibii*	Cave-Hibernating Bat	SGCN	.
Little brown bat	*Myotis lucifugus*	Cave-Hibernating Bat	SGCN	.
Northern long-eared bat	*Myotis septentrionalis*	Cave-Hibernating Bat	SGCN	T[3]
Tri-colored bat	*Perimyotis subflavus*	Cave-Hibernating Bat	SGCN	SR
Big brown bat	*Eptesicus fuscus*	Cave-Hibernating Bat	SGCN	.
Eastern red bat	*Lasiurus borealis*	Migratory Tree Bat	SGCN	.
Hoary bat	*Lasiurus cinereus*	Migratory Tree Bat	SGCN	.
Silver-haired bat	*Lasionycteris noctivigans*	Migratory Tree Bat	SGCN	.

[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. [2]E=endangered; T=threatened; SGCN=species of greatest conservation need.
[2] T=threatened; SR = Status Review resulting from a petition for listing; SGCN=species of greatest conservation need.
[3] The final rule to reclassify northern long-eared bats from federally threatened to endangered was published in the Federal Register on November 30, 2022 and is scheduled to take effect March 31, 2023 (Federal Register, Vol. 87 No. 229).

2.2.1 Federally Listed Species

One federally listed bat species is present in Rhode Island, the northern long-eared bat, and has been documented in the vicinity of the Project. The range of the federally endangered Indiana bat (*Myotis sodalis*) does not include Rhode Island, and historical records of the Indiana bat demonstrate its presence only in Berkshire and Hampden counties in Massachusetts (last recorded in 1939; Mass.gov 2019). The Indiana Bat is also not among species of bats documented offshore (Pelletier et al. 2013, Stantec 2016). For these reasons, this assessment will focus solely on the potential occurrence of northern long-eared bats within the Project Lease Area.

2.2.1.1 Northern long-eared bat

Northern long-eared bats are an insectivorous species that hibernates in caves, mines, and other locations (possibly talus slopes) in winter and spends the remainder of the year in forested habitats. The species' range includes most of the eastern and mid-western U.S. and southern Canada. Due to impacts from the fungal disease white-nose syndrome (WNS), the species has declined by 90-100% in most locations where the disease has occurred, and declines are expected to continue as WNS spreads throughout the remainder of the species' range (U.S. Fish and Wildlife Service 2016). As a result, the northern long-eared bat was listed as threatened under the ESA in 2015 with a 4(d) Rule (U.S. Fish and Wildlife Service 2016) that tailors protections to those areas affected by WNS[2]. While the offshore environment where the Lease Area is located is not included in the WNS area, all surrounding counties are considered within the WNS Zone.

The species is active throughout early spring to late fall (March-November; Menzel et al. 2002, Brooks and Ford 2005). 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 fall swarm (Broders and Forbes 2004, Brooks and Ford 2005). During breeding and in summer, northern long-eared bats

[2] Note that protections under the 4(d) Rule will expire March 31, 2023 when the endangered status ruling goes into effect. New guidelines and protections to be issued by USFWS are pending.

have small home ranges (less than 25 acres [10 hectares]) and will switch roosts to avoid predators (Silvis et al. 2016 in Dowling et al. 2017). Their migratory movements can be up to 170.8 mi (275 km; Griffin 1945 in Dowling et al. 2017).

Northern long-eared bats are known to occur on Long Island in New York, on Mount Desert Island in Maine, and on Cape Cod in Massachusetts. Northern long-eared bats are also present on Nantucket and Martha's Vineyard (Dowling et al. 2017).

2.3 Risk Assessment for Bats

2.3.1 Exposure

While there is uncertainty on the specific movements of bats offshore, bats have been documented using the marine environment in the U.S. (Grady and Olson 2006, Cryan and Brown 2007, Johnson et al. 2011b, Bureau of Ocean Energy Management 2013, Hatch et al. 2013, Stantec 2016, Dowling and O'Dell 2018). Bats have been observed to temporarily roost on structures such as lighthouses on nearshore islands (Dowling et al. 2017) and there is historical evidence of bats, particularly eastern red bats, migrating offshore in the Atlantic (Hatch et al. 2013). 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 Maine, bats were detected on islands up to 25.8 mi (41.6 km) from the mainland (Peterson et al. 2014). In the mid-Atlantic acoustic study (Sjollema et al. 2014), eastern red bats comprised 78% (166 bat detections during 898 monitoring hours) of all bat detections offshore; this study also found that bat activity decreased as wind increased. In addition, eastern red bats were detected in the mid-Atlantic up to 27.3 mi (44 km) offshore, outside the vicinity of islands or other structures, by high resolution video aerial surveys (Hatch et al. 2013). Shipboard acoustic surveys conducted by Stantec in 2017 detected over 900 bat passes (primarily long-distance migratory tree bats) within the proposed South Fork Wind Farm Lease Area, export cable route, and adjacent offshore and coastal areas. Eastern red bats accounted for 69% of calls detected, while silver-haired bats accounted for 13%. All other species accounted for less than 5% of calls that were identified to species level. Peak detections for all species occurred during the month of August, suggesting that most offshore movement is associated with fall migration (Stantec 2018b).

Several studies have highlighted the relationship between bat activity and weather conditions. Acoustic monitoring within the footprint of the proposed South Fork Wind Farm in southern New England found 82% of recorded bat passes with corresponding weather data occurred when wind speeds were < 5.0 m/s and temperatures were ≥ 15.0 °C (Stantec 2018b). This occurred during 49% of nighttime hourly rounded weather data increments during the monitoring period from 14 July to 15 November. These weather conditions most often occurred from August through September. Bat activity occurred primarily during nights with warmer temperatures and low wind speeds, which has been likewise documented in several other studies (Fiedler 2004, Reynolds 2006, Stantec 2016). Similar monitoring at the operational Block Island Wind Farm in Rhode Island found that 90% of bat passes occurred at times when wind speeds were below 5.0 m/s and temperatures were at or above 15.0 °C (Stantec 2018c). Both of these studies reported very little activity at temperatures below 15.0 °C, and most activity was documented at wind speeds between 2-4 m/s.

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). This study found no association between wind speed and bat activity, which contrasts most other literature, though wind speed data was regional and not site-specific. Wind profit and temperature best predicted forthcoming bat activity in the models.

Cave-hibernating bats: Cave-hibernating bats hibernate regionally in caves, mines, and other structures and primarily feed 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 occurring during the fall. In the region, the maximum distance *Myotis* bats were detected offshore was 7.2 mi (11.5 km; Sjollema et al. 2014). A recent nanotag tracking study on Martha's Vineyard recorded little brown bat (*n*=3) movements off the island in late August and early September, with one individual flying from Martha's Vineyard to Cape Cod (Dowling et al. 2017). Big brown bats (*n*=2) were also detected migrating from the island later in the year (October–November; Dowling et al. 2017). These findings are supported by an acoustic study conducted on islands and buoys in the Gulf of Maine that indicated the greatest percentage of activity in July-October (Peterson et al. 2014). Given that the use of the coastline as a migratory pathway by cave-hibernating bats is likely limited to their fall migration period, that acoustic studies indicate lower use of the offshore environment by cave-hibernating bats, and that cave-hibernating bats do not regularly feed on insects over the ocean, exposure to the Lease Area is considered "minimal" to "low" for this group.

While limited research exists on the movements of northern long-eared bats over the ocean, northern long-eared bats are not expected to occur within the Lease Area. A recent tracking study on Martha's Vineyard (*n*=8; July-October 2016) did not record any offshore movements and bats were presumed to hibernate on the island (Dowling et al. 2017). However, shipboard acoustic sampling in the vicinity of the South Fork Wind Farm detected a single northern long-eared bat call, 21.1 mi (34 km) offshore (Stantec 2018b). Most other northern long-eared bat passes detected during these surveys were 3–9 mi (5–14 km) offshore. Stationary acoustic detectors positioned on two turbines within the operational Block Island Wind Farm did not detect any northern long-eared bat calls (Stantec 2018c). Similarly, vessel-based surveys at the construction site of Block Island Wind in 2016 did not identify any *Myotis* species (Stantec 2016). If northern long-eared bats were to migrate over water, most movements would likely be in close proximity to the mainland. The related little brown bat has been documented to migrate from Martha's Vineyard to Cape Cod, and northern long-eared bats may likewise migrate to mainland hibernacula from these islands in August-September (Dowling et al. 2017). Given that there is little evidence of use of the offshore environment by northern long-eared bats, exposure is expected to be "minimal" and this species is not further assessed. This conclusion is also consistent with the Vineyard Wind 1 Biological Assessment (Bureau of Ocean Energy Management 2019).

Migratory tree bats: Tree bats migrate south to overwinter and have been documented in the offshore environment (Hatch et al. 2013, Stantec 2018b, 2019). Eastern red bats have been detected migrating from Martha's Vineyard late in the fall, with one individual tracked as far south as Maryland (Dowling et al. 2017). These results are supported by historical observations of eastern red bats offshore as well as recent acoustic and survey results (Hatch et al. 2013, Peterson et al. 2014, Sjollema et al. 2014). While little local data are available, shipboard and stationary acoustic surveys recorded several observations of bats flying over the ocean, with detections of migratory tree bats in the vicinity of the Lease Area (Stantec 2018b). Tree bats may pass through the Lease Area during the migration period, as they have been detected in the offshore environment primarily during late summer and fall. However, since bat movement offshore is generally limited to fall migration, exposure is expected to be "low".

2.3.2 Impacts

2.3.2.1 Construction and Installation

Bats may demonstrate attraction to or avoidance of construction vessels installing offshore components (e.g., wind turbines, offshore sub-stations) particularly if insects are drawn to the lights of the vessels (Bureau of Ocean Energy Management 2014). Bats were observed roosting aboard support vessels during the construction of the Block Island Wind Farm (Stantec 2016), suggesting the presence of artificial roosting structures may provide some benefit to bats in the offshore environment. Bats are well known for their ability to detect objects with echolocation (Johnson and Arnett 2004, Horn et al. 2008), and are unlikely to collide with stationary structures (Cryan 2011). Tree bats at onshore wind facilities have been documented showing higher attraction and more frequent approaches to turbines in low wind conditions (Cryan et al. 2014). There are a number of hypotheses regarding why bats may show such attraction, including that stationary turbines may be mistaken for tall trees on the landscape, which bats are likely attracted to during fall mating activities (Cryan 2008). Overall, there is little evidence to suggest that stationary objects pose significant risk to bats (Bureau of Ocean Energy Management 2012). Further, exposure to vessels and installation infrastructure is temporally limited to the construction period, thus, behavioral vulnerability to collision with construction equipment is expected to be "minimal" to "low". While individual bats, particularly migratory tree bats, may be present in the Lease Area, the expectation is that the offshore environment is not providing important habitat for bats relative to areas available on shore and that few individuals from the overall population would be exposed to the project. Therefore, population-level impacts from construction and installation to all bat species are expected to be "minimal" to "low".

2.3.2.2 Operation and Maintenance

During Project operation and maintenance, injury or mortality from collision with wind turbines represents the greatest potential risk to bats. At onshore 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) and predominantly affects migratory tree-roosting bats (Kunz et al. 2007). There is some evidence from Europe to suggest that bats foraging over the surface of the ocean increase their altitude when foraging around obstacles (i.e., lighthouses and wind turbines; Ahlén et al. 2009). Lighting sources on the wind turbines decks and offshore substation may serve as an attractant to bats as they navigate, or bats may potentially be indirectly attracted to insect prey drawn to the lights. The wind turbines may also be lit with aviation lighting; however, aviation lighting has not been found to influence bat collision risk at onshore facilities in North America (Arnett et al. 2008). Based on collision mortalities documented at onshore wind farms, behavioral vulnerability to collision, for all bat species, is considered “medium”.

Based on available information, bats are more likely to be attracted to wind farm structures rather than displaced by them (Cryan et al. 2014). Limited research suggests that terrestrial wind farms can contribute to habitat loss and reduced foraging activity (Millon et al. 2018), though it is unlikely similar patterns would be observed in the offshore environment where bat activity is already scarce. Therefore, behavioral vulnerability to collision, for all bat species, is considered “minimal” and will not be discussed further.

In general, the bat species assessed are not expected to regularly forage in the Lease Area, but some may be present during migration, particularly in the fall (Bureau of Ocean Energy Management 2012, Stantec 2018a). As discussed above, the exposure of cave-hibernating bats to the Lease Area is expected to be “minimal” to “low” and would only occur during migration, if at all. Therefore, population-level impacts for cave-hibernating bats are considered “minimal” to “low”. As discussed above, northern-long eared bats are expected to have minimal exposure to the Lease Area thus individual impacts are unlikely. This finding is consistent with The Vineyard Wind 1 Biological Assessment that concluded that “it is extremely unlikely northern long-eared bats would traverse offshore portions” of the project (Bureau of Ocean Energy Management 2019).

Migratory tree bats have the highest potential to pass through the Lease Area, but, overall, small numbers of these bats are expected in the Lease Area given its distance from shore (Bureau of Ocean Energy Management 2014). While evidence exists of bats visiting wind turbines close to shore (2.5–4.3 mi [4–7 km]) in the Baltic Sea (Ahlén et al. 2009, Rydell and Wickman 2015) and bats are demonstrated to be vulnerable to collisions (see above), little bat activity is expected in the Lease Area because of its distance from shore. Therefore, population-level impacts for migratory tree bats are expected to be “low”.

2.3.2.3 Decommissioning

While the specifics of decommissioning activities are not fully known at this time, the potential impact of decommissioning activities on bats is expected to be equal to or less than impacts from construction, as levels of vessel activity and removal of offshore structures would be comparable to activity levels during construction. The Project will use best practices available at the time to minimize potential effects. Decommissioning is generally considered beneficial for bat species as WTGs and OSSs will be removed.

2.4 Mitigation

In general, offshore exposure of bat populations has been avoided by siting the Project offshore in a Wind Energy Area designated by BOEM. To minimize or mitigate the potential for bat impacts and habitat loss, the Project will use best practices identified in the *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* (BOEM 2016). The Project will comply with FAA and USCG requirements for lighting while, to the extent practicable, using lighting technology that minimizes impacts on bat species.

Several environmental protection measures will reduce potential impacts to bat species, including but not limited to:

- Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations.
- Comply with the Northern Long-Eared Bat 4(d) rule (81 FR 1900-1922) to avoid and minimize long-term impacts on the species.
    - Note that protections under the 4(d) Rule will expire March 31, 2023 when the endangered status ruling goes into effect. New guidelines and protections to be issued by USFWS are pending. Revolution Wind will continue to coordinate with RIDEM and USFWS regarding time of year restrictions through the permitting process and will adhere to requirements imposed by these agencies.
- Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This wide spacing of WTGs will allow avian and bat species to avoid individual WTGs and minimize risk of potential collision.
- Revolution Wind will comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian and bat species.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (see Appendix D of the Project's COP).
- Revolution Wind will document any dead (or injured) bats found incidentally on vessels and structures during construction, O&M, and decommissioning and provide an annual report to BOEM and USFWS.

See section 3.11 with details regarding Revolution Wind's intention to develop and implement a post-construction monitoring plan.

2.5 Summary and Conclusions

The primary identified Project-related hazard to bats is collision with above-water offshore structures such as wind turbines and offshore substations, and these hazards are generally associated with lighting which attracts insects and pursuant bats. Lighting during the operations and maintenance phase of the Project will be limited, which should reduce insect and potential bat attraction (Stantec 2018a).

Due to the distance of the Lease Area from shore, bats are not expected to regularly forage in the Lease Area, and exposure to this area is expected to be limited to periods of migration, particularly in fall. Because cave-hibernating species generally make small migratory movements close to shore, exposure of cave-hibernating bats to the Lease Area is expected to be “minimal” to “low”. There is little evidence of use of the offshore environment by federally listed northern long-eared bats, thus, exposure for this species is expected to be “minimal”. Overall impact ratings for cave-hibernating bats range from “minimal” to “low”.

Because migratory tree bats make large migratory movements, some of which may occur over offshore environments, some bats within this group could pass through the Lease Area. Given the distance of the Lease Area from shore, and based on existing data regarding tree bat migratory behavior, only small numbers of migratory tree bats are expected to occur within the Lease Area (Bureau of Ocean Energy Management 2012). Since offshore movements of migratory tree bats are generally limited to fall migration, exposure is expected to be “low”.

Overall, the Project is expected to have “minimal” to “low” impacts on bats. The Project is expected to have “minimal” to “low” population-level impacts for any species of bats. Individual impacts to northern long-eared bats are expected to be “minimal” because there is little evidence that they occur in the offshore environment. These conclusions are consistent with those determined by a comprehensive risk assessment conducted for the adjacent South Fork Wind Farm (Stantec 2018a).

3 Part III: Birds

3.1 Overview of potential bird exposure to Project components in the Lease Area

A broad group of avian species may pass through the Lease Area and surrounding area, including migrants (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). There is high diversity of marine birds that use the Lease Area because it is located at the northern end of the Mid-Atlantic Bight, a region that overlaps northern and southern species assemblages.

The Mid-Atlantic Bight is an oceanic region that reaches from Cape Cod, MA, to Cape Hatteras, NC, and is characterized by a broad expanse of gently sloping, sandy-bottomed continental shelf. Within this region, the 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 the shallow coastal region is bathed in cool Arctic waters brought south 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 region exhibits a strong seasonal cycle in temperature, with sea surface temperatures spanning 37–86 °F (3–30 °C; Williams et al. 2015b).

Migrant terrestrial species using the Atlantic Flyway may follow the coastline during migration or choose more direct flight routes over expanses of open water. Many marine birds also make annual migrations up and down the eastern seaboard (e.g., gannets, loon, and sea ducks), taking them directly through the region in spring and fall. This results in a complex ecosystem where the community composition shifts regularly, and temporal and geographic patterns are highly variable. The region 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 and storm-petrels, visit from the Southern Hemisphere (where they breed during the austral summer). 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 region.

Three species listed under the Endangered Species Act (ESA) are present in the region: Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus rufa*), and Roseate Tern (*Sterna dougallii*). The Atlantic population of Piping Plovers nests on beaches in the region and will also migrate (spring and fall) through the area to and from breeding sites. Red Knots winter in southern states or in Central or South America and pass through the region during migration in transit to and from Arctic breeding sites. Roseate Terns also fly through the region on their way north to breeding sites in New York, New England states, and Atlantic Canada. Below, a detailed assessment of exposure, vulnerability, and risk is presented for each major taxonomic group. Federally listed species are assessed individually.

Table 3-1. Avian species recorded offshore of Rhode Island/Massachusetts in the OSAMP aerial and/or boat-based surveys, and cross-referenced with USFWS IPaC database (http://ecos.fws.gov/ipac/). Presence indicated by (•). E = Endangered. Piping Plovers and Red Knots may also pass through the Lease Area, but were not recorded in the OSAMP surveys and were not listed in the IPaC database for the Lease Area. ESA species potentially present are discuss in the text.

		OSAMP Survey		Federal Status			State (RI)
Taxonomic Group	*Species*	Aerial	Boat	IPaC	BCC[1]	ESA[2]	Status[3]
Ducks, Geese, and Swans							
Brant	*Branta bernicla*	•					
Canada Goose	*Branta canadensis*		•				
Mallard	*Anas platyrhynchos*		•				
Sea Ducks							
Black Scoter	*Melanitta americana*	•	•	•			
Common Eider	*Somateria mollissima*	•	•	•			
Long-tailed Duck	*Clangula hyemalis*		•	•			
Red-breasted Merganser	*Mergus serrator*		•	•			
Surf Scoter	*Melanitta perspicillata*	•	•	•			
White-winged Scoter	*Melanitta fusca*	•	•	•			
Grebes							
Red-necked Grebe	*Podiceps grisegena*		•				
Shorebirds							
Short-billed Dowitcher	*Limnodromus griseus*		•		•		
Semipalmated Plover	*Charadrius semipalmatus*		•		•		
Whimbrel	*Numenius phaeopus*		•				
Phalaropes							
Red Phalarope	*Phalaropus fulicarius*		•				
Red-necked Phalarope	*Phalaropus lobatus*		•				
Skuas and Jaegers							
Pomarine Jaeger	*Stercorarius pomarinus*		•	•			
South Polar Skua	*Stercorarius maccormicki*			•			
Auks							
Atlantic Puffin	*Fratercula arctica*		•	•			
Common Murre	*Uria aalge*	•		•			
Dovekie	*Alle alle*	•	•	•			
Razorbill	*Alca torda*	•	•	•			
Thick-billed Murre	*Uria lomvia*		•	•			
Small Gulls							
Bonaparte's Gull	*Chroicocephalus philadelphia*		•	•			
Medium Gulls							
Black-legged Kittiwake	*Rissa tridactyla*	•		•			
Laughing Gull	*Leucophaeus atricilla*	•					
Ring-billed Gull	*Larus delawarensis*		•	•			
Large Gulls							
Great Black-backed Gull	*Larus marinus*	•	•	•			
Herring Gull	*Larus argentatus*	•	•	•			
Medium Terns							
Common Tern	*Sterna hirundo*		•	•			
Roseate Tern	*Sterna dougallii*		•			E	SH
Loons							
Common Loon	*Gavia immer*	•	•	•			

		OSAMP Survey		Federal Status			State (RI)
Taxonomic Group	*Species*	Aerial	Boat	IPaC	BCC[1]	ESA[2]	Status[3]
Pacific Loon	*Gavia pacifica*		•				
Red-throated Loon	*Gavia stellata*	•	•	•	•		
Storm-Petrels							
Wilson's Storm-Petrel	*Oceanites oceanicus*	•	•	•			
Petrels and Shearwaters							
Cory's Shearwater	*Calonectris diomedea*	•		•			
Great Shearwater	*Ardenna gravis*	•		•	•		
Northern Fulmar	*Fulmarus glacialis*	•		•			
Sooty Shearwater	*Ardenna grisea*	•					
Manx Shearwater	*Puffinus puffinus*			•			
Gannets							
Northern Gannet	*Morus bassanus*	•	•	•			
Cormorants							
Great Cormorant	*Phalacrocorax carbo*		•				
Double-crested Cormorant	*Phalacrocorax auritus*			•			
Herons and Egrets							
Great Blue Heron	*Ardea herodias*		•				C
Raptors							
Merlin	*Falco columbarius*		•				
Passerines (perching birds, songbirds)							
Bank Swallow	*Riparia riparia*		•				
Barn Swallow	*Hirundo rustica*		•				
Blackpoll Warbler	*Setophaga striata*		•				
Chimney Swift	*Chaetura pelagica*		•				
Dark-eyed Junco	*Junco hyemalis*		•				C
Gray Catbird	*Dumetella carolinensis*		•				
Mourning Dove	*Zenaida macroura*		•				
Ruby-throated Hummingbird	*Archilochus colubris*		•				
Savannah Sparrow	*Passerculus sandwichensis*		•				
Snow Bunting	*Plectrophenax nivalis*		•				
Tree Swallow	*Tachycineta bicolor*		•				
Yellow-rumped Warbler	*Setophaga coronata*		•				

All species listed are protected by the Migratory Bird Treaty Act (MBTA)
[1]BCC = Birds of Conservation Concern 2008; birds listed for Bird Conservation Region (BCR) 30
[2]E = Endangered, T = Threatened, SC = Special Concern
[3]SH = State Historical, C = Concern

3.2 Methods: Risk, Exposure, and Vulnerability frameworks

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 phase (Bureau of Ocean Energy Management 2012, Goodale and Milman 2016). For birds, the primary impact-producing factors related to the offshore components of the Project are above water objects to be located within the Lease Area; these include vessels, lighting, wind turbines, and sub-substations (Table 3-2). Project activities below water, including but not limited to foundation and cable installation, are not expected to be a long-term hazard for birds (Bureau of Ocean Energy Management 2018) and are discussed briefly below. Low probability events, such as spills, are discussed in the body of the COP.

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

Impact-Producing Factor(s)	Potential Effect	Description	Construction & Decommissioning[1]	Operation
Visible Structures/Lighting (Vessels, lighting, wind turbines, sub-stations?	Collision	Mortality and injury caused by collision with Project structures	✓	✓
Habitat Alteration (Vessels, noise from pile-driving, wind turbines, sub-stations)	Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	✓	
Habitat Alteration (Wind turbines, sub-stations)	Displacement (Permanent)	Permanent avoidance and/or displacement from habitat		✓

[1]Effects of decommissioning are expected to be less than or equal to construction activities.

3.2.2 Overview of potential effects by construction phase

The potential direct effect of operating offshore wind energy projects on birds is mortality due to collision with visible structures (Drewitt and Langston 2006, Fox et al. 2006, Goodale and Milman 2016). The potential indirect effect of operating offshore wind energy projects on birds is habitat loss due to displacement from the wind farm (Fox and Petersen 2019), which is caused by the birds responding to habitat alteration (i.e., presence of the wind turbines). Further details by construction phase are discussed below.

Construction and Installation: Birds can be displaced by construction activities, or they may collide with construction elements (e.g., construction vessels or wind turbines being installed). Spatially, bird exposure to the Lease Area will be similar during all development phases, but exposure to construction activities is considered to be temporary. During construction, there may be temporary disturbance of sediment during cable installation, but the disturbance will be confined to a small area, and permanent loss of foraging habitat for seabirds is unlikely. In the assessment below, potential effects from construction and operation are evaluated for each taxonomic group. During construction, a short-term impact-producing factor to birds includes the lighting of construction vessels, WTGs, and construction equipment that may attract birds. However, collision risk due to attraction to lighting during nighttime construction activities is considered to be temporary (Fox et al., 2006), and can be minimized by reducing lighting to the extent practicable. For this reason, lighting is not discussed in detail as an individual hazard.

Operations and Maintenance: The potential effects of the offshore component of the Project to birds are primarily limited to the operation of the wind turbines. The lighting of wind turbines and the associated offshore substation 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, and are unlikely to have population-level impacts. Thus, lighting is not discussed in detail as an individual hazard but considered a factor that could increase collision risk.

Maintenance vessels may temporarily displace birds, but are not expected to cause adverse effects (Bureau of Ocean Energy Management 2018). In addition, the operation of the interconnection cable does not pose a particular hazard to birds (Epsilon Associates Inc. 2018), and will not be discussed in detail.

Wind energy is recognized as a major contributor to reducing greenhouse gases and mitigating the effects of climate change (Allison et al. 2019). Offshore wind farms also have the potential to provide new foraging habitat for some species of birds (e.g., sea ducks, and pursuit divers) because of the reef effect and the establishment of invertebrate communities on turbine support structures (Goodale and Milman 2016). The purpose of this section is to discuss the potential effects of the proposed wind farm on birds to support NEPA review, but potential effects should be considered within the context of the benefits the wind farm is providing.

During operation, the potential effects of offshore wind farms on birds are (1) habitat loss due to displacement, and (2) mortality due to collision (Drewitt and Langston 2006, Fox et al. 2006, Goodale and Milman 2016). The risk of potential effects occurs when vulnerable species are exposed to the hazards of an offshore wind development. 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).

The Project has proposed three operational cut-in and cut-out wind speed scenarios (Part VIII), which would lead to various reductions in the time that WTGs would be operating. These three scenarios encompass the minimum and maximum WTG characteristics as exhibited and analyzed in the COP. Avian species would be at less risk of collision when the blades are not spinning; however, collision with stationary WTG structures during periods of low visibility would still be considered a risk.

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; 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 how the exposure and vulnerability assessments were combined to assess potential effects.

3.2.3 Risk Framework

The potential direct and indirect effects associated with the operational phase of the Project were evaluated qualitatively using a risk assessment framework. The framework used a weight-of-evidence approach and combined evaluations of both exposure and behavioral vulnerability within the context of the European literature to establish potential risk (Figure 3-1).

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 (i.e., the Lease Area) rather than to a specific number of turbines. There are many species- and site-specific factors that contribute to the collision and displacement risk. 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 further apart. Thus, a fewer number of larger turbines may pose a lower risk than a larger number of smaller turbines (Johnston et al. 2014). Individual risk was described for listed species, and population risk was described for non-listed species.

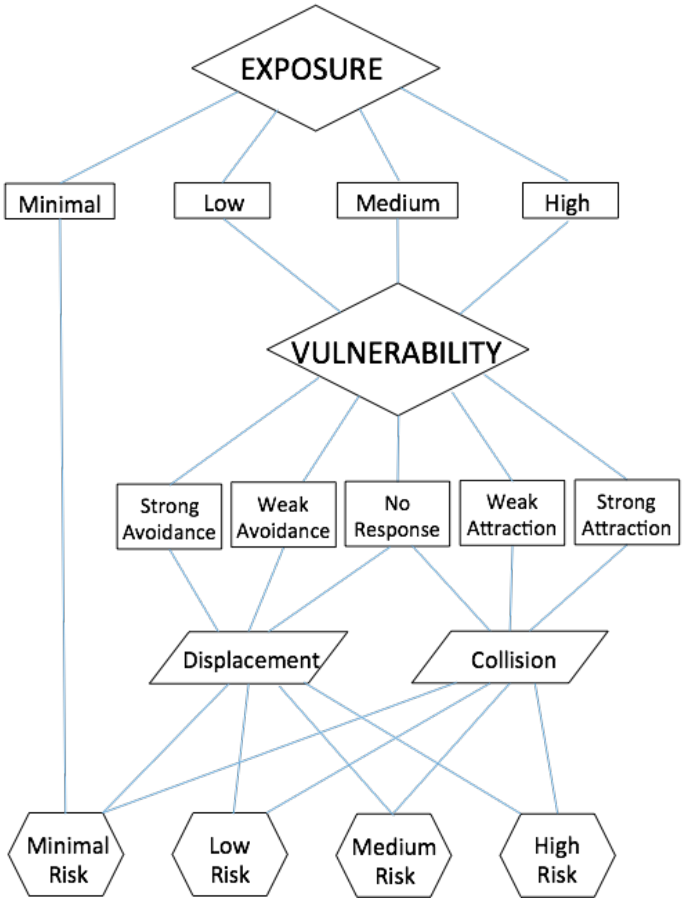

Figure 3-1: Risk assessment framework. First exposure was assessed, second vulnerability was assessed, and then, using a weight of evidence approach, the risk was evaluated.

Exposure was evaluated based on aerial surveys conducted in Rhode Island and Massachusetts waters, individual tracking data for species of special interest, and regional distribution models (Winship et al. 2018), while behavioral vulnerability was evaluated based on boat-based survey flight height data and literature (Furness et al. 2013, Wade et al. 2016). The assessment included the entire Lease Area (as of March 2020) and was inclusive of the proposed South Fork Wind Farm. Initially, risk was assigned using the following risk categories:

- Minimal: Minimal ranking in exposure and/or vulnerability.
- Low: Low ranking in exposure and low-high vulnerability.
- Medium: Medium/medium, medium/high or high/medium ranking in exposure and vulnerability, respectively.
- High: High/high ranking in exposure and vulnerability, respectively.

Final risk categories (Table 3-3) were assigned with consideration to other factors, such as broad population trends or general habitat use. Vulnerability rankings (Section 3.2.5)—specifically, collision vulnerability (CV), displacement vulnerability (DV), and population vulnerability (PV)—are all used to make the final evaluation on the population- level risk (Table 3-3). First the CV and

DV categories are combined with the exposure assessment to develop a preliminary risk determination. Then, rather than multiplying the CV and DV by the PV score, as is done in some vulnerability assessments (Furness et al. 2013), we used the PV score to adjust the risk score up or down based upon 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., low-medium), an adjustment down would eliminate the high end of the range and an adjustment up would eliminate the low end of the range. This approach limits the influence of PV in the risk assessment to account for the broad uncertainty in our general understanding of population dynamics. A detailed description of data sets used in the assessment, and the exposure assessment methods are detailed, below, as are the vulnerability scoring methods.

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					

3.2.4 Exposure Framework

Exposure has both horizontal and vertical components. 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. 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 species exposure, methods used to assign an exposure metric, methods to aggregate scores to year and taxonomic group, and interpretation of exposure scores.

3.2.4.1 Exposure Assessment Data Sources and Coverage

To assess the proportion of marine bird populations exposed to the Lease Area, two primary data sources were used to evaluate local and regional marine bird use: (1) the Rhode Island Ocean Special Area Management Plan (OSAMP) aerial surveys, and (2) version 2 of the Marine-life Data and Analysis Team (MDAT) marine bird relative density and distribution models. The OSAMP surveys provide local coverage of 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. Note that OSAMP data are used in the MDAT modeling methodology so the information sources are not independent of each other. Each of these primary sources is described in more detail below, along with additional data sources that 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.

3.2.4.1.1 Rhode Island Ocean Special Area Management Plan (OSAMP) Surveys

The Rhode Island Ocean Special Area Management Plan (OSAMP) established a framework that engaged all major stakeholders, such as government, citizens, civic and environmental organizations, resource users, and the private sector, in transparent decision-making for marine-based economic development. The OSAMP study area included approximately 1,467 square miles (3,800 km^2) including areas of the Block Island Sound, Rhode Island Sound, and the Atlantic continental shelf. Use of these waters by coastal and marine birds is heaviest during winter months, peaking in early-March to mid-April as birds prepare for and begin their spring migrations. In general, coastal waters of less than 20 m in depth are important foraging habitat for diving ducks in winter, and nearshore shallow waters are important foraging habitat for locally breeding terns during summer months. Passerines utilize the air space during migration periods, and Block Island is an important stopover and resting spot for many species. Several methods were used to quantify the distributions and abundances of birds in the study area:

- *land-based surveys* – six 1–2 hour seawatches (≤ 3 km from shore) were carried out per month at 11 survey stations along coastal mainland Rhode Island from January 2009 to mid-February 2010 (*n*=796);
- *boat-based surveys* – (**a**) systematic line transect surveys were carried out in offshore waters approximately once a month from February to May, 2009 (*n*=4) on two parallel transect grids south and east of Block Island, (**b**) systematic line transect surveys were carried out approximately four times per month from June 2009 until March 2010 on eight sawtooth transects distributed around the study area (*n*=54), and (**c**) systematic line transect surveys were carried out in a sawtoooth pattern in nearshore waters in the northwest corner of the study area during 10 August-3 September 2009 (*n*=8) to assess the distribution and abundance of Roseate Terns in the area (Figure 3-2); and
- *aerial surveys* – a series of 24 strip transects, 3 km apart, covered the entire study area. Surveys were flown from December 2009 to August 2010 (29 survey days) and from October 2010 to July 2012 (41 survey days; Figure 3-2). On each survey day, they flew 8 transects and covered the total of 24 transects over three survey days. They alternated by flying every third transect line across, which allowed them to cover the entire area each day while still including a denser pattern of survey transects in their overall design. Surveys were conducted 1-3 times per month.

Boat-based surveys followed a standard line transect method (modified from Camphuysen et al. 2004) with observers stationed on the upper deck of a 90 ft (27.5 m) vessel. The vessel traveled as a steady 10 knots (18.5 km/h), and observers used distance sampling (i.e., estimating the distance and angle to each bird observed). Flight heights were estimated for all individuals or flocks observed flying during all land-based surveys (*n*=250,992) and offshore and nearshore boat-based surveys (*n*=8,927), with estimates categorized in a series of five discrete bins (<10 m, 10-25 m, 26-125 m, 126-200 m, >200 m).

During land-based, boat-based, and aerial surveys, a total of 121 species was recorded, including many migrant land birds. The overall pattern from these studies indicates higher species diversity and densities in the shallow, nearshore waters of the study area year-round. Overall, a very small number of Roseate Terns was observed offshore in these surveys (*n*=8), with greater numbers observed inshore from land-based surveys (*n*=125) and in nearshore waters in boat-based surveys (*n*=29).

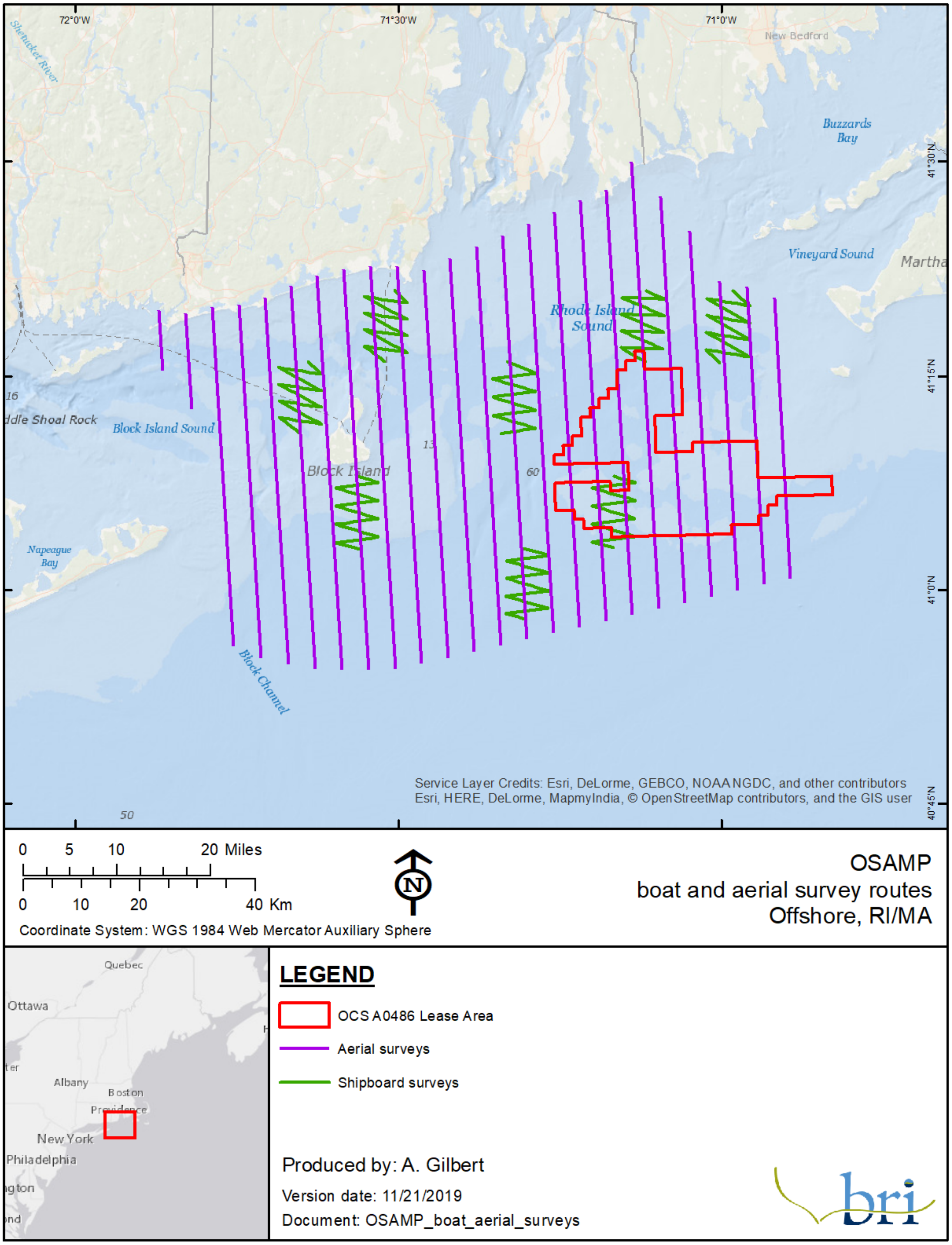

Figure 3-2: Aerial and boat-based surveys conducted in the Rhode Island Ocean Special Area Management Plan (OSAMP) study area during 2009 and 2010.

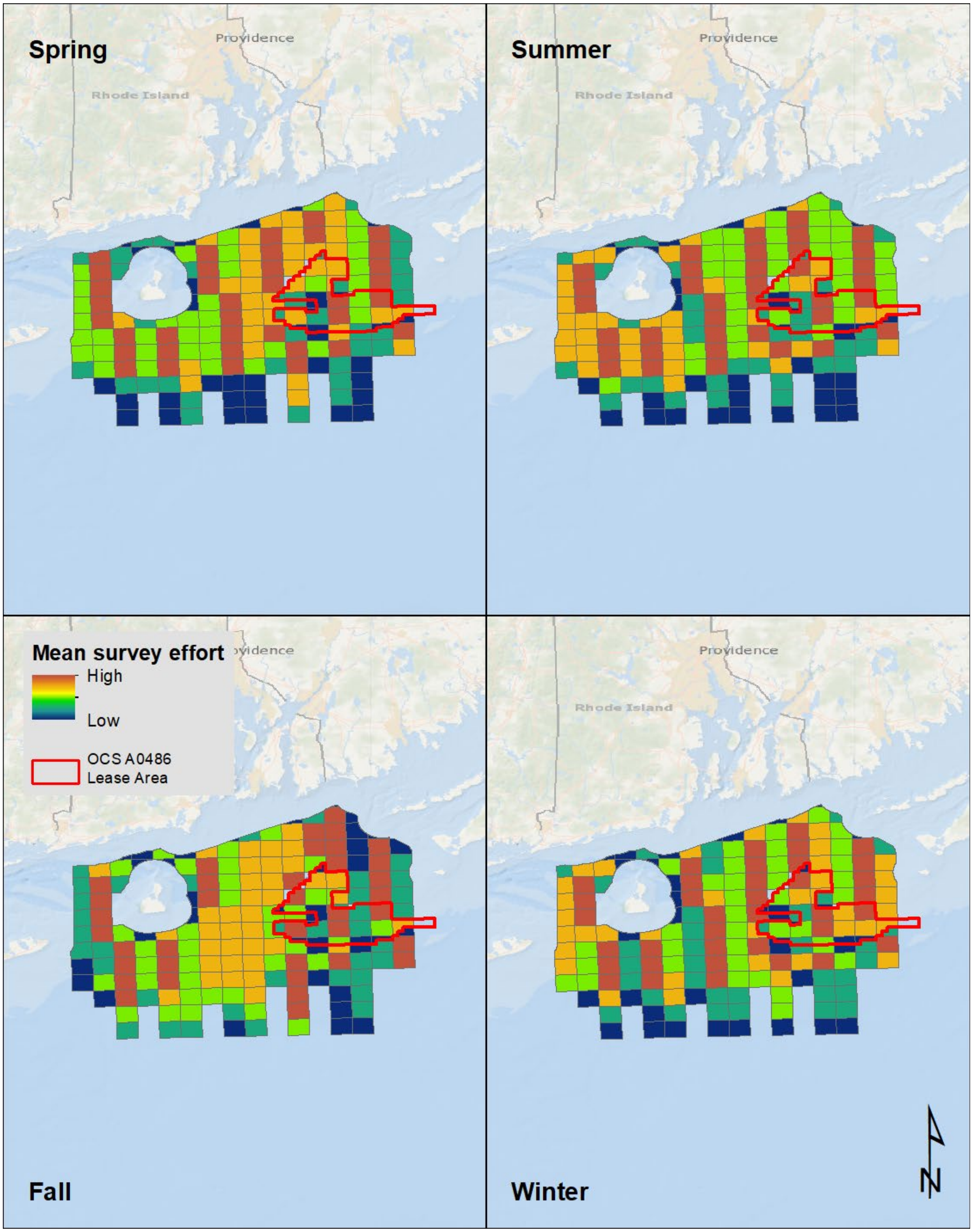

Figure 3-3: Overall OSAMP aerial survey effort by season. While effort varied by OCS lease block and season, the entire study area, including almost all of the Lease Area, was thoroughly surveyed each season.

3.2.4.1.2 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 abundance. Updates to these models (Version 2) are available directly from Duke University's Marine Geospatial Ecology Lab MDAT model web page (http://seamap.env.duke.edu/models/mdat/). The MDAT analysis integrated survey data (1978–2016) from the Northwest Atlantic Seabird Catalog (managed by NOAA) and the Eastern Canada Seabirds at Sea database (managed by Environment and Climate Change Canada) with a range of environmental variables to produce long-term average annual and seasonal models (Figure 3-4). These models were developed to support marine spatial planning in the northeast by the Northeast Regional Planning Body but are also available to support other planning efforts. Version 2 relative abundance and distribution models were produced for 47 avian species using U.S. Atlantic waters from Florida to Maine, and thus provide an excellent regional context for local relative densities estimated from OSAMP surveys.

The MDAT and OSAMP information sources each have strengths and weaknesses. The OSAMP survey 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 surrounding areas. 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 boat surveys also produced "unidentified" observations (e.g., "unknown large gull" or "unknown small tern") which prove difficult for evaluating species-specific exposures.

The MDAT models, in contrast, are based on data collected at much larger geographic and temporal scales. These data were also collected using a range of survey methods and include the OSAMP data. 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 survey data from decades of surveys and long-term climatological averages of dynamic covariates, and given changing climate conditions, 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.

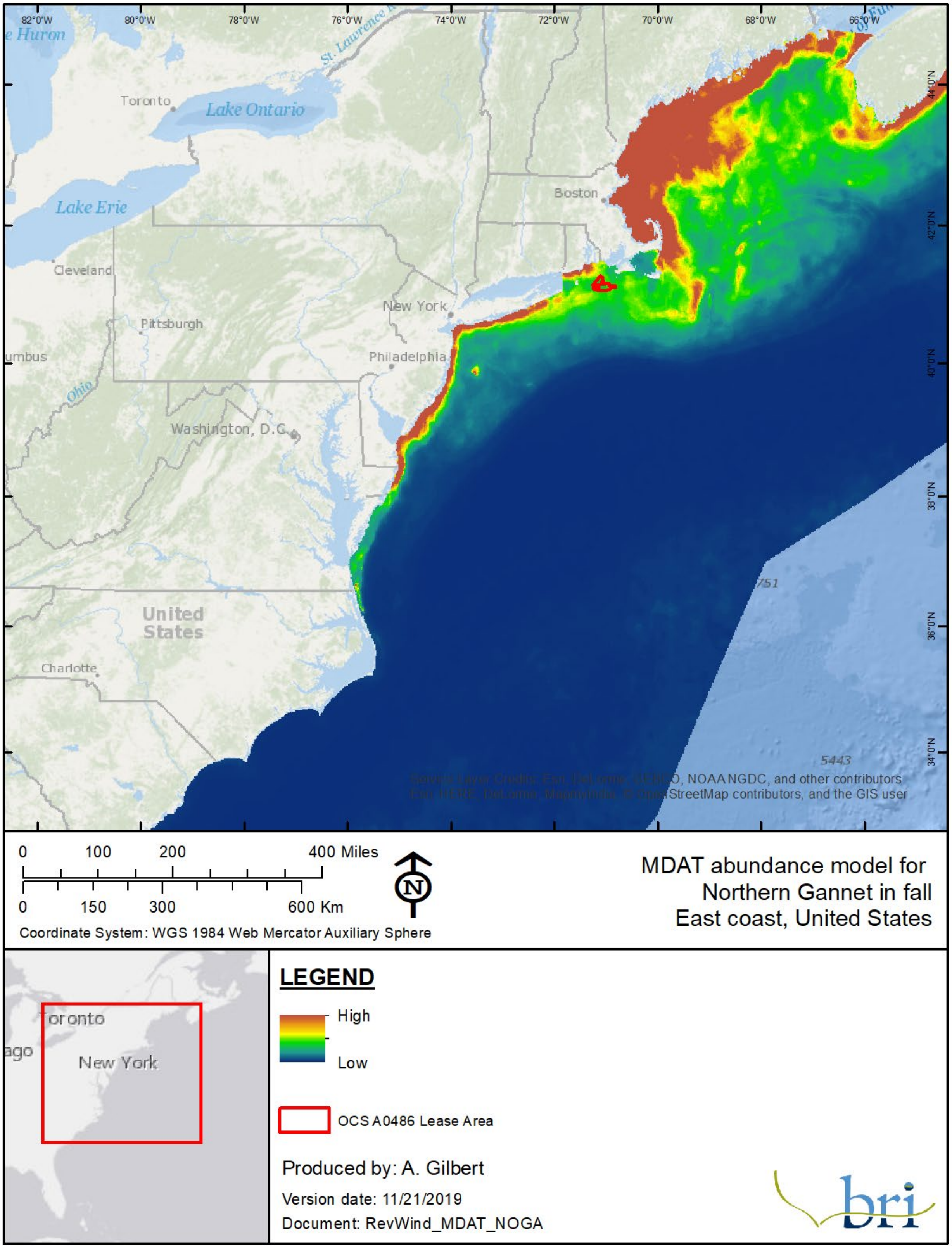

Figure 3-4: Example MDAT abundance model for Northern Gannet in fall.

3.2.4.1.3 Secondary Data Sources

3.2.4.1.3.1 *Northwest Atlantic Seabird Catalog*

The Northwest Atlantic Seabird Catalog is the comprehensive database for the majority of offshore and coastal seabird surveys conducted in the Atlantic waters of the U.S. from Maine to Florida. The Seabird Catalog database contains records from 1938-2017, having more than 180 datasets and >700,000 observation records along with associated effort information (Kaycee Coleman, Database Manager, *personal communication*). Until recently, the database was managed by the U.S. Fish and Wildlife Service (USFWS), in the Division of Migratory Birds. The database is currently being managed by the National Oceanic and Atmospheric Administration (NOAA. All data received were mapped to determine the occurrence of rare species within the Lease Area, as well as adjacent areas to the north and south.

3.2.4.1.3.2 *Diving Bird Tracking Studies*

A satellite telemetry tracking study on the Atlantic coast 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 (Spiegel et al. 2017). These species – 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 390 individuals were tracked using satellite transmitters over the course of five years (2012–2016), including some scoters and Long-tailed Ducks tagged as part of the Atlantic and Great Lakes Sea Duck Migration Study by Sea Duck Joint Venture (SDJV) partners[3]. Results provide a better understanding of how these diving birds use offshore areas of the Atlantic Outer Continental Shelf and beyond.

3.2.4.1.3.3 *Sea Duck Tracking Studies*

The Atlantic and Great Lakes Sea Duck Migration Study, a multi-partner collaboration, was initiated by the SDJV in 2009 with the goals of (1) fully describing full annual cycle migration patterns for four species of sea ducks (Long-tailed Duck [*Clangula hyemalis*], Surf Scoter, Black Scoter [*Melanitta americana*], and White-winged Scoter [*M. fusca*]), (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 United States and Canada by various project partners including Biodiversity Research Institute, Canadian Wildlife Service, USGS Patuxent Wildlife Research Center, University of Rhode Island, Rhode

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

Island Department of Environmental Management, USFWS, SDJV, and the University of Montreal. These collective studies have led to increased understanding of annual cycle dynamics of sea ducks, as well as potential interactions with and impacts from offshore wind energy development (Loring et al. 2014, SDJV 2015, Meattey et al. 2018, 2019).

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 on the Atlantic coast, 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).

3.2.4.1.3.4 *Migrant Raptor Studies*

To facilitate research efforts on migrant raptors (i.e., migration routes, stopover sites, space use relative to Wind Energy Areas, wintering/summer range, origins, contaminant exposure), Biodiversity Research Institute 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). These collective efforts have resulted in the deployment of satellite transmitters on 38 Peregrine Falcons (35 hatch year and 3 adults) and 16 Merlins (13 hatch year and 3 adults). Satellite-tagged Peregrines and Merlins 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[4] where these data are stored and processed.

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

Since 2013, BOEM and 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 sentry stations (Loring et al. 2017). Having proved the methods successful, the study was expanded to 16 automated stations in 2014, and, in 2015, they began tagging Piping Plovers (*Charadrius melodus*) and Roseate Terns (*Sterna dougallii*; Loring et al. 2019). They continue to tag and track these species and have expanded the automated station array south to include areas of New York, New Jersey, Delaware, and Virginia.

3.2.4.2 Exposure Mapping

Maps were developed to visually display local and regional context for exposure assessments. A three-part map was created for each species-season combination that includes MDAT and/or

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

OSAMP data (see Part VI). Any species-season combination which did not at least have either MDAT model or OSAMP (i.e., blank maps) were left out of the final map set.

The first map panel (A) presents the OSAMP as proportions of total effort-corrected counts. For each OCS Lease Block, the proportion of all effort-corrected counts (total counts per kilometer of survey distance) was calculated in the surveyed area that was located in that Lease Block (across all surveys in a given calendar season). This method was useful as it scaled all density data from 0-1 to standardize data visualizations between species. Exposure was ranked from low to high for each species based on weighted quantiles calculated for the OCS Lease Block proportion values. Quantiles were weighted by the densities 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 5 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 OSAMP, while Panel C shows the density output over the entire northwest Atlantic. Density data are scaled in a similar way to the OSAMP, 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 species densities and to strengthen the analysis. Additionally, while the color scale for the MDAT data is approximately matched to that used for the OSAMP, 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 species.

3.2.4.3 Exposure Assessment Metrics

To assess bird exposure at the local (i.e., Massachusetts/Rhode Island wind energy areas) 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 species. Using the MDAT data, masked to remove zero-effort predicted cells, the predicted seasonal density surface for a given species was aggregated into a series of rectangles that were approximately the same size as the Lease Area, and calculated the mean density estimate of each rectangle. This process compiled a dataset of density estimates across the entire surveyed range of the species 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 species 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 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 species-season combination using the OSAMP aerial data. The mean relative density for the Lease Area (a collection of 24 partial or full OCS Lease Blocks) was calculated. To compare the Lease Area to other locations, the nearest 23 lease blocks to each lease block surveyed in each season (winter, *n*=186; spring, *n*=186; summer, *n*=186; and fall, *n*=186) was identified and the relative density of each Lease Area-sized block was calculated. Thus, a dataset of relative densities for all possible Lease Area-sized blocks was compiled within the OSAMP study and this data set was used to assign scores to all species-season combinations, based on the same quartile categories described for the MDAT models, above. Because the avian surveys made every effort to survey all species, if a score for a species-season combination was not available for the OSAMP (local assessment), then the local assessment score was assigned a 0 since no animals were sighted for that species season combination.

3.2.4.4 Species Exposure Scoring

To determine the relative exposure for a given species and season in the Lease Area compared to all other areas, the MDAT quartile score and OSAMP 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 account for both the local and regional importance of the Lease Area to a given species during a given season. However, if a species-season combination was not available for the MDAT regional assessment, then the score from the local assessment (OSAMP study) was accepted as the best available information for that species-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, species-season combinations labeled as 'Minimal' had low densities at both the local and regional scales. 'Low' exposure was assessed for species with below-average densities at local and regional 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 species-season combinations where density was high for one scale and low for another. 'High' exposure is 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 species and season. The listed scores represent the exposure scores from the local OSAMP data (left) and the regional MDAT (right).

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. OR Lease Area local density is between the 50th and 75th percentiles and regional density is below the 25th percentile, or vice versa.	1, 1 2, 0
Medium	Lease Area local or regional density is between the 50th and 75th percentiles. OR Lease Area local density is between the 50th and 75th percentiles and regional density between the 25th and 50th percentiles, or vice versa. OR Lease Area local density is greater than the 75th percentile and regional density is below the 25th percentile, or vice versa. 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).	2, 2 2, 1 3, 0 3, 1
High	Lease Area densities at both local and regional scales are above the 75th percentile. OR Local densities are greater than the 75th percentile and regional densities are between the 50th and 75th percentiles, or vice versa.	3, 3 3, 2

3.2.4.5 Aggregating Scores to Year and Taxonomic Group

The seasonal scores were aggregated into annual scores for each species and taxonomic group identified in Table 3-1. The overall seasonal score was used in this process, which ranged from 0–3 for each season with a score of 0 for Minimal and a score of 3 for High. All species were grouped into the appropriate taxonomic groups (e.g., Herring Gull in 'Gulls, Skuas, and Jaegers'; Black Scoter in 'Sea Ducks'; etc.). To understand the total exposure across the annual cycle for each species, all the seasonal scores were summed to obtain an annual score, which could range from 0–12 (Figure 3-5). These annual scores could be mapped to exposure categories of Minimal (scores of 0–2), Low (3–5), Medium (6–8), and High (9–12). The annual rating for a species does not indicate potential seasonal variation in exposure between seasons, but rather represents the integrated risk relative to season distribution of the species across the entire annual cycle. Annual scores were summarized by species and taxonomic group to compare relative risk (Figure 3-5).

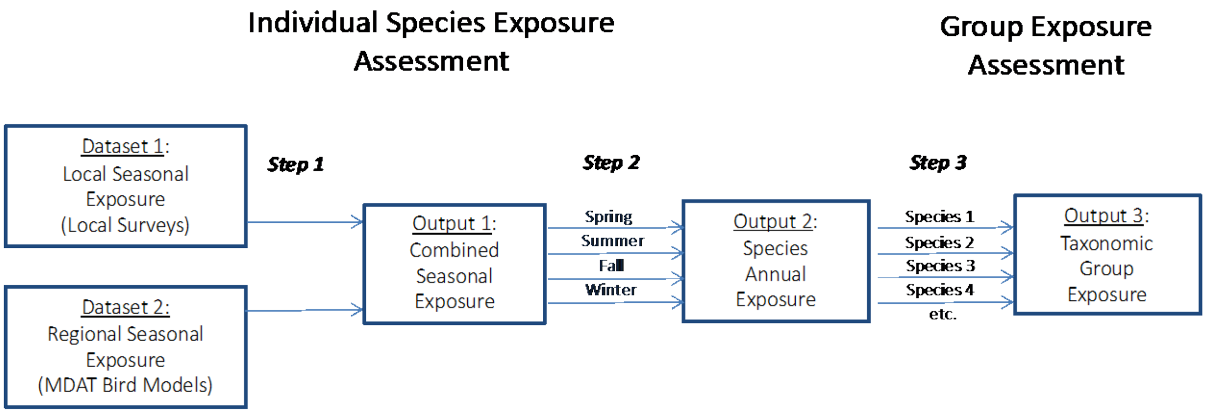

Figure 3-5: Diagram of the exposure analysis flow from local and regional exposure analyses to final taxonomic group exposure values. Local (OSAMP surveys) and regional (MDAT bird models) exposure assessments were combined in Step 1 to calculate seasonal exposure scores. Seasonal exposure scores were then added in Step 2 to determine the total annual exposure score for each species. Finally, in Step 3, a taxonomic group exposure score was estimated from all species in the group.

To describe the range of annual exposure for each taxonomic group, the minimum value was used for each season and the maximum value across each species for all the species in the group. These ranges can be quite large (e.g., exposure for the species in the 'Shearwaters, Petrels, and Storm-Petrels' group range from Minimal to High, based on the various species' expected densities in the Lease Area and resulting estimated exposure). These group ranges can also be quite small (for example, both tern species are considered to have low exposure). These ranges indicate the variance in exposure category across the species within each taxonomic grouping.

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 OSAMP data. Uncommon species with few detections in the Lease Area may be somewhat over-rated for exposure using this method, while common species with relatively few detections in the Lease Area may be effectively under-rated in terms of total exposure to the Project. Density estimates per square kilometer are presented to provide context for the exposure scores.

3.2.4.6 Interpreting Exposure Scores

The final exposure scores for each species and season, as well as the aggregated scores (e.g., the annual scores for each species and taxonomic group), should be interpreted as a measure of the relative importance of the Lease Area for a species/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 taxon.

A High exposure score indicates that the observed and predicted densities of the taxon in the Lease Area were high relative to densities of that taxon in other surveyed areas. Conversely, a Low or Minimal exposure score means that the taxon was predicted to occur at much 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 species in the Lease Area. In fact, common species 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 higher. This quantitative annual exposure score was then considered with additional species-specific information, along with expert opinion, to place each species group within a final exposure category (described below in section 3.2.4.7).

3.2.4.7 Exposure Categories

Final qualitative exposure determinations were developed using the quantitative assessment of exposure (described above), other locally available data, existing literature, and species accounts. Final exposure level categories used in this assessment are described in Table 3-5.

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

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

3.2.5 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 (Willmott et al. 2013, Furness et al. 2013, Wade et al. 2016, Kelsey et al. 2018, Fliessbach et al. 2019). 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 groups, 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.

3.2.5.1 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 in (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 (Willmott et al. 2013, Kelsey et al. 2018, Fliessbach et al. 2019), 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 End and/or Thr
	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%
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

3.2.5.2 *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 (Willmott et al. 2013, Furness et al. 2013, Kelsey et al. 2018). 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.

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

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 methods have 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. 2014). Three additional boat-based datasets were excluded because there was low confidence in the data (collect by citizen science efforts and not QA/QCed) or estimated flight heights only included part of the air space below 300 m.

  Many of the boat-based datasets provided flight heights as categorical ranges for which the mid value of the range in meters was 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 300 meters 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-meter 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 3.5.0.[5] 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	Color in figures	MW	Lower blade tip height	Upper blade tip height
Minimum RSZ	Green	8–10	28.5 m	197 m
Maximum RSZ	Gold	12	46	266 m

- 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 (Garthe and Hüppop 2004, Furness et al. 2013, Bradbury et al. 2014, Adams et al. 2016, Wade 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. and Kelsey et al). 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 were all conducted in Europe; the studies were conducted at wind farms with turbines much smaller than are proposed for the

[5] R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL: https://www.R-project.org/

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 scores were calculated from the OSAMP 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.

3.2.5.3 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.

$$DV = MAd + HF \quad \textit{Equation 3}$$

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, 2018; Vanermen et al. 2015, Skov et al. 2018), and indexes (Garthe and Hüppop 2004, Furness et al. 2013, Bradbury et al. 2014, Adams et al. 2016, Wade et al. 2016, Kelsey et al. 2018). 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 Outer Continental Shelf.

3.2.5.4 Final Risk Determination

The CV, DV, and PV calculations are all used to make a final evaluation on population- level risk (Table 3-3). 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. 2013), the PV score is used to adjust the risk score up or down based upon 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., low-medium), 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.

3.2.6 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 Project area and the region (i.e., exposure); 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. OSAMP 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 (Willmott et al. 2013, Kelsey et al. 2018), 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 (Table 3-9) 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.

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 Summary: Exposure, Vulnerability, and Risk for Birds at the Revolution Wind Project

This avian assessment focused on the potential effects of the offshore Project components within the Lease Area during construction, operational, and decommissioning phases. Overall, the MDAT models indicate avian abundance is greater closer to shore than in the Lease Area (Figure 3-6).

Spatially, bird exposure to the Lease Area will be similar during both phases. However, exposure to all construction activities is considered to be temporary. Birds are expected to have the same basic behavioral vulnerability to both phases (i.e., interacting with or being displaced by construction vessels or operating wind turbines) and, thus, bird vulnerability was not assessed by specific construction phase. The potential effects of the offshore submarine export cable are not considered a hazard to bird populations and were not assessed.

Avian flight heights were important in the assessment of behavioral vulnerability. Flight heights used in the assessment were gathered from the OSAMP boat-based surveys (local) and the datasets in the Northwest Atlantic Seabird Catalog (regional).

The assessment, below, includes the following for each species group: a description of the spatiotemporal context of exposure, exposure assessment, 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.

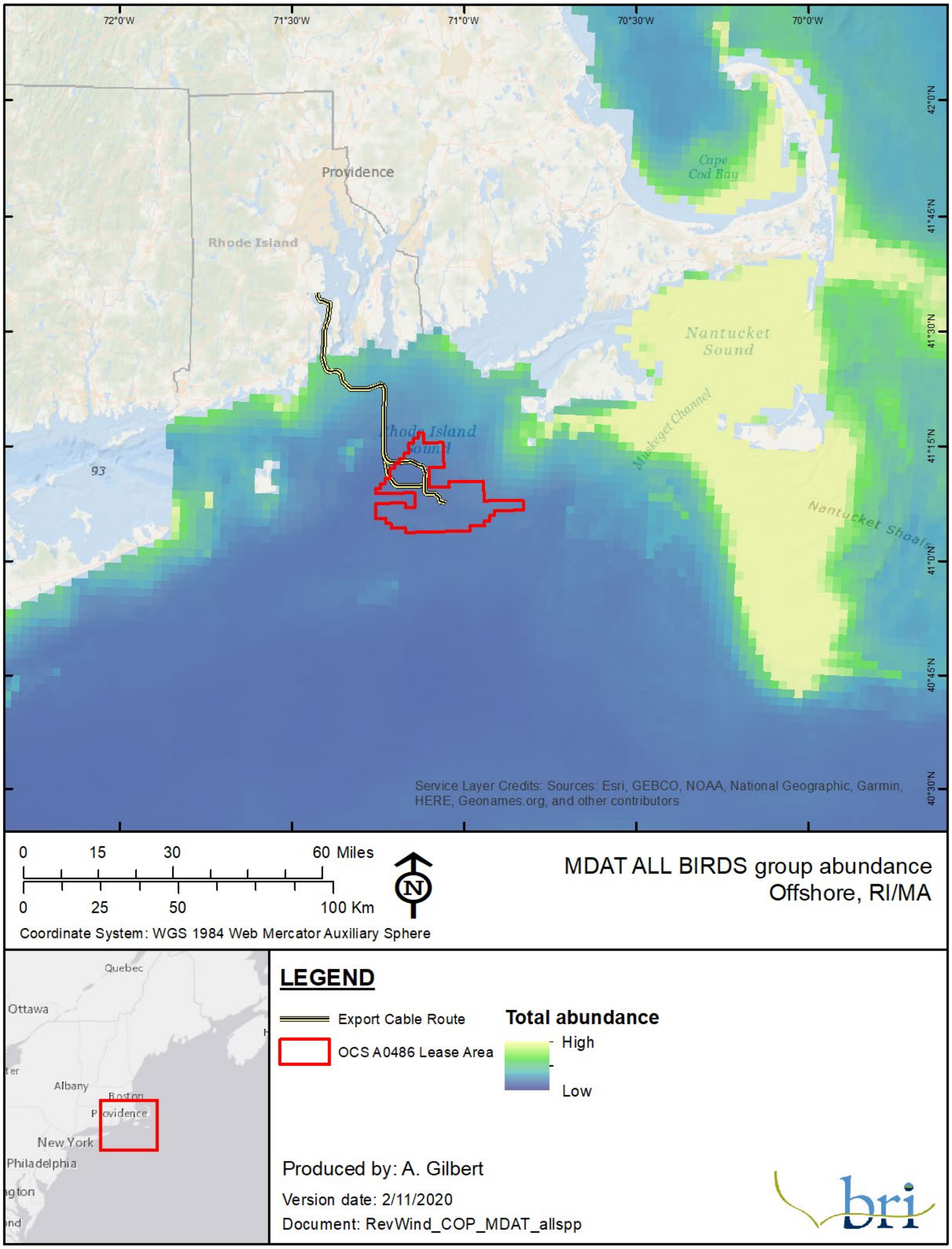

Figure 3-6: Bird abundance estimates (all species) from the MDAT models.

3.4 Shorebirds

3.4.1 Spatiotemporal Context

Shorebirds are coastal breeders and foragers that generally avoid straying out over deep waters during breeding. Few shorebird species breed locally on the U.S. Atlantic coast, however. 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. 2000, Tracy et al. 2002). Very little is known regarding the migratory movements of these species, although they are known to travel well offshore. Two shorebird species, Piping Plover and Red Knot, are federally protected under the ESA – and are addressed in detail below. Shorebirds of conservation concern identified in the USFWS IPaC database and those that are listed in Rhode Island or Massachusetts are found in Table 3-10.

Table 3-10: Shorebirds of conservation concern in Rhode Island and Massachusetts, and their federal status (E = Endangered; T = Threatened; SC = Special Concern; BCC = Birds of Conservation Concern), identified in the IPaC database for the offshore Project area.

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

3.4.2 Exposure Assessment

Exposure was assessed using species accounts and OSAMP survey data. Exposure to construction and operation is considered to be “minimal” because shorebirds have limited spatial and temporal exposure and, there were few shorebirds observed offshore during all seasons (Figure 3-7). Due to the minimal exposure, a vulnerability and risk assessment was not conducted for non-ESA shorebird species.

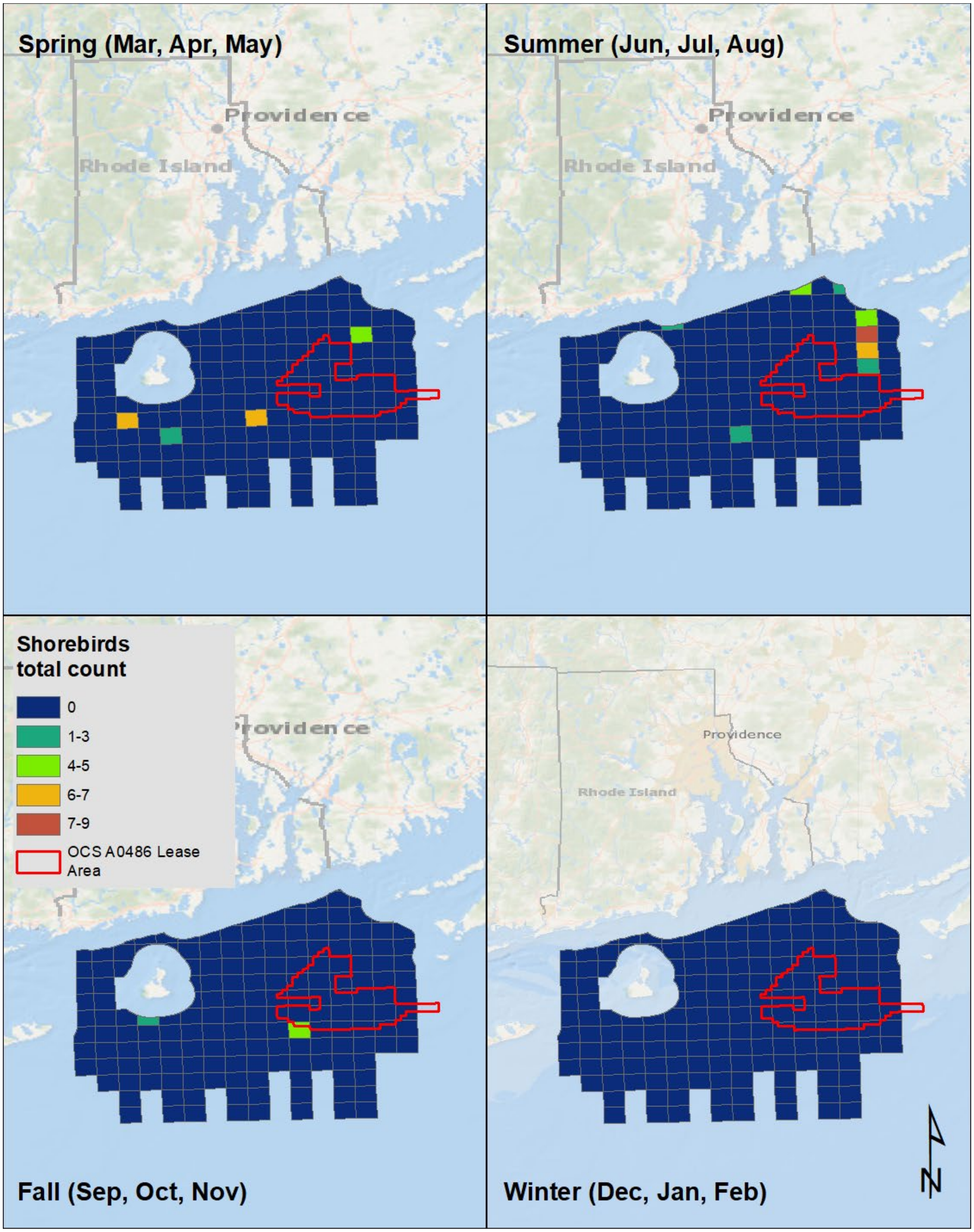

Figure 3-7: Shorebirds observed, by season, during the OSAMP surveys. There were low densities of all species, among the species observed were Whimbrel, Semipalmated Plover, and Short-billed Dowitcher.

3.4.3 Endangered Shorebird Species

3.4.3.1 Piping Plover

3.4.3.1.1 Spatiotemporal context

The Piping Plover (*Charadrius melodus*) is a small shorebird that nests on beaches and wetlands along the Atlantic coast of North America, around the Great Lakes, and in the Midwestern plains (Elliott-Smith and Haig 2004). The species winters in the coastal southeastern U.S. and Caribbean (Elliott-Smith and Haig 2004, U.S. Fish and Wildlife Service 2009, Bureau of Ocean Energy Management 2014). Due to a number of threats, the Atlantic subspecies (*C. m. melodus*) is listed as threatened under the ESA (https://www.fws.gov/northeast/pipingplover/), and is heavily managed on the breeding grounds to promote population recovery (Elliott-Smith and Haig 2004). 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 breed in Rhode Island and are present during spring and fall migratory periods (Rhode Island Department of Environmental Management 2015). They breed above the high tide line along the coast, primarily on sand beaches (U.S. Fish and Wildlife Service 2018a). Non-migratory movements in May–August appear to be exclusively coastal (Burger et al. 2011), and flight heights during this period are generally well below the 66 ft (20 m) and occur in the immediate vicinity of the coastline (Burger et al. 2011).

Piping Plovers were traditionally thought to migrate along the Atlantic coast, but recent evidence suggests that, like other shorebirds, they either make nonstop long-distance migratory flights (Normandeau Associates Inc. 2011), or offshore migratory “hops” between coastal areas (Loring et al. 2017). Recent nanotag tracking indicates that at least some individuals of this species likely traverse the Lease Area during migratory movements (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, 2019).

3.4.3.1.2 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 spring and fall migration. A recent nanotag study tracked migrating Piping Plovers captured in Massachusetts (*n*=75) and Rhode Island (*n*=75: Loring et al. 2019). The study found that five tracked birds (all tagged in Massachusetts) likely passed through the northern Rhode Island/Massachusetts Lease Area, and would be exposed to the Project; a probability density analysis conducted with the data indicates higher use of the area to the west of Martha’s Vineyard (Figure 3-8). The exposure estimates are considered a minimum estimate because of lost tags and incomplete coverage of the offshore environment by land-based receivers (Loring et al. 2019). However, because movements are estimated from point transmissions, direct linear paths between points do not necessarily represent true flight paths taken by individuals. Overall, there is no habitat for Piping Plovers in the Lease Area, and the expected exposure to individuals of this species is “low” to “medium”.

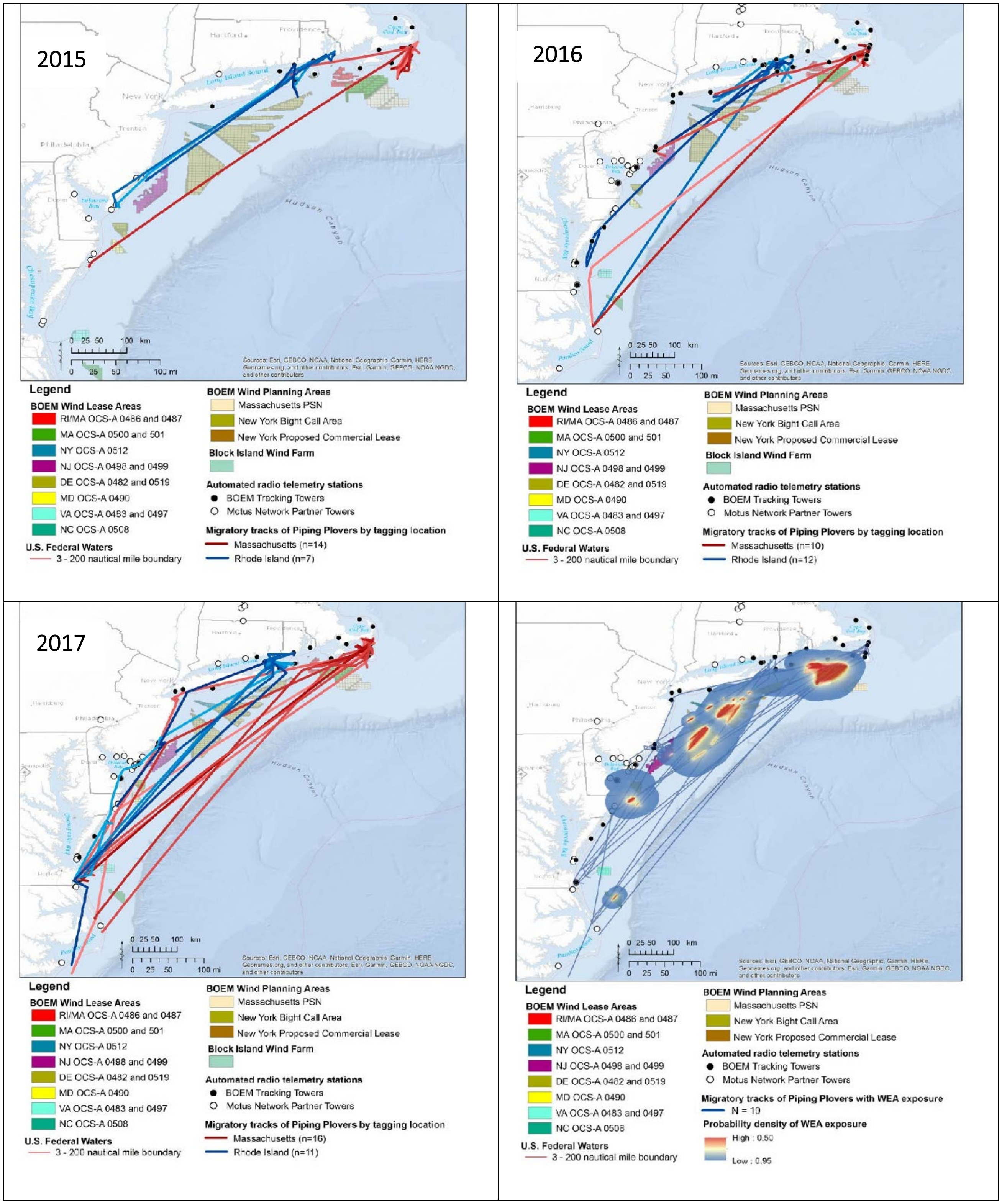

Figure 3-8: Modeled migratory track by year of Piping Plovers with nanotags and composite probability density across Wind Energy Areas for all years of the study (from Loring et al. 2019a).

3.4.3.1.3 Relative Behavioral Vulnerability Assessment

The migratory flight height of Piping Plovers tagged with nanotags was generally above the RSZ (820 ft; 250 m), with 15.2% of birds flying between 25-250 m (82 – 820 ft) in Wind Energy Areas (Loring et al. 2019). Offshore radar studies have recorded shorebirds flying at 3,000–6,500 ft (1,000–2,000 m; Richardson 1976, Williams and Williams 1990 *in* Loring et al. 2019a), while nearshore radar studies have recorded lower flight heights of 330 ft (100 m; Dirksen et al. 2000 *in* Loring et al. 2019). Flight heights can vary with weather; during times of poor visibility, the birds may fly lower (Dirksen et al. 2000 *in* Loring et al. 2019). Since Piping Plovers 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. Thus, Piping Plovers have “minimal” to “low” vulnerability to collision with construction equipment.

Piping Plovers are not considered to be vulnerable to displacement because their feeding habitat is strictly coastal (Burger et al. 2011). Therefore, 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 is unlikely to be significantly affected by offshore Project activities, including boat traffic, unless that boat traffic occurs very near beaches or intertidal feeding areas. See Table 3-11.

Table 3-11: Summary of Piping Plover vulnerability.

Effect	Description	Evidence from literature	
		Construction	Operation
Collision	Mortality and injury caused by collision with Project structures	Minimal–Low	Minimal–Low
Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	Minimal	Minimal
Displacement (Permanent)	Permanent avoidance and/or displacement from habitat	Minimal	Minimal

3.4.3.1.4 Risk

Because exposure of Piping Plovers will be limited to migration, they have low vulnerability to collision, and there is no evidence of vulnerability to displacement, individual- level impacts during construction and operation are expected to be “minimal” to “low”. While these birds are listed at the state and federal levels, they received a “medium” population vulnerability score because they have a low (1) rank in adult survival. Therefore, the final risk score was not adjusted. This finding is supported by the results of a collision risk model carried out by BOEM for Piping Plovers potentially passing through the proposed nearby Vineyard Wind Offshore Wind Energy Project (a proposed 80-100 WTG project located approximately 16 mi [14 nm] to the southeast) that estimated the annual number of fatalities as zero and that any extra energy expenditure resulting from the avoidance of an offshore wind farm by Piping Plovers would be insignificant (Bureau of Ocean Energy Management 2019).

3.4.3.2 Red Knot

3.4.3.2.1 Spatiotemporal context

The Red Knot (*Calidris canutus*) is a medium-sized shorebird with one of the longest migrations in the world, undertaking non-stop flights of up to 5,000 mi (8,000 km; Baker et al. 2013). The Atlantic flyway subspecies (*C. c. rufa*) is listed as threatened under the ESA, primarily because this population decreased by approximately 70% from 1981 to 2012, to less than 30,000 individuals (Burger et al. 2011, Baker et al. 2013)[6]. 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. 2013). 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. 2013).

The Red Knot is present in Rhode Island only during migratory periods (Bureau of Ocean Energy Management 2014). The fall migration period is July-October. 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. 2013, Bureau of Ocean Energy Management 2014). Of the birds that winter on the southeast U.S. coast and/or the Caribbean (considered short-distance migrants), a small proportion are predicted to 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 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).

3.4.3.2.2 Exposure Assessment

Exposure for Red Knots was assessed using species accounts and individual tracking data. Red Knot exposure to the Project is limited to migration. Flight heights during migration are thought to be well above the RSZ for long-distance migrants, but there is potential for exposure to

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

collision for shorter-distance migrants that can traverse the Wind Energy Area within the RSZ, particularly during the fall (Loring et al. 2018). In a recent telemetry study, five birds tagged in Massachusetts (*n* = 99) were detected as potentially crossing the Rhode Island/Massachusetts Lease Area (Figure 3-9). Migration flights are generally undertaken at night, but in good weather conditions, perhaps lessening any risk of collision (Loring et al. 2018) because in fair weather the birds are likely to be flying well above the WTGs. Overall, there is no habitat for the species in the Lease Area, and the expected exposure to individuals of this species is "low” to “medium”.

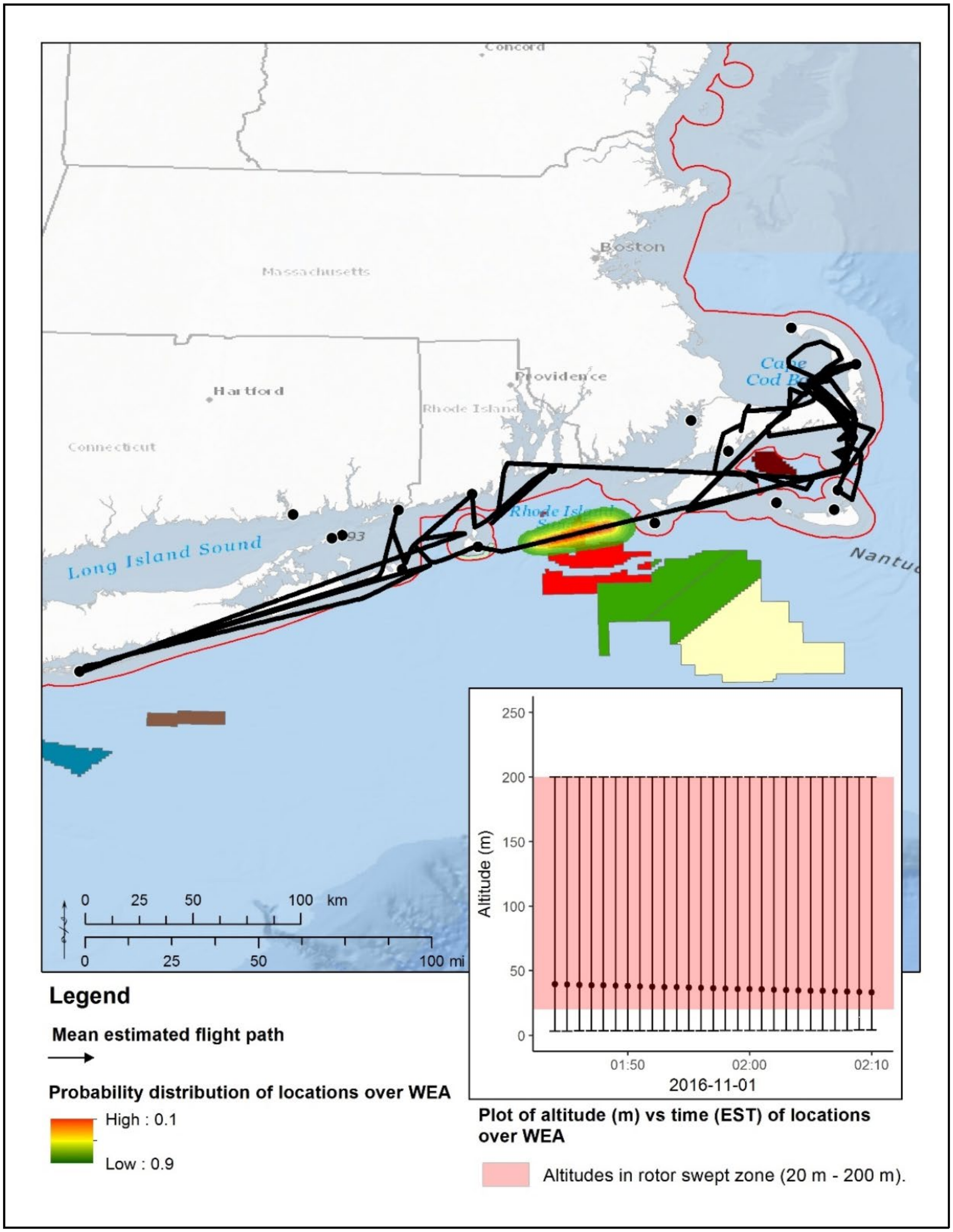

Figure 3-9: An example of the estimated flight path of a Red Knot tracked with nanotags that passed through the Lease Area. Probability bands illustrate spatial error around locations during potential exposure to the Lease Area (from Loring et al. 2018b).

3.4.3.2.3 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), but Red Knots likely adjust their altitude to take advantage of local weather conditions, including flying at lower altitudes in headwinds (Baker et al. 2013), or during periods of poor weather and high winds (Burger et al. 2011). 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. Thus, Red Knots have "low" vulnerability to collision with construction equipment or turbines (Table 3-12).

Red Knots are not considered to be vulnerable to displacement because their feeding habitat is strictly coastal (Burger et al. 2011). 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 is unlikely to be significantly affected by Project activities, including boat traffic, unless that boat traffic occurs very near beaches or stopover feeding areas.

Table 3-12: Summary of Red Knot vulnerability.

Effect	Description	Evidence from literature	
		Construction	Operation
Collision	Mortality and injury caused by collision with Project structures	Low	Low
Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	Minimal	Minimal
Displacement (Permanent)	Permanent avoidance and/or displacement from habitat	Minimal	Minimal

3.4.3.2.4 Risk

Given that Red Knot exposure will be limited to migration and that these birds have minimal–low vulnerability to both 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 rank (2) in adult survival and a medium CCS max score. Therefore, the final risk score was not adjusted. This finding is supported by the results of a collision risk model carried out by BOEM for Red Knots potentially passing through the proposed nearby Vineyard Wind Offshore Wind Energy Project (a proposed 80–100 WTG project located approximately 16 mi [14 nm] to the southeast) that estimated the annual number of fatalities as zero and that any extra energy expenditure resulting from the avoidance of an offshore wind farm by Red Knots would be insignificant (Bureau of Ocean Energy Management 2019).

3.5 Wading Birds

3.5.1 Spatiotemporal Context

Most long-legged wading birds (such as herons and egrets, etc.) 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. They are capable of crossing large areas of ocean and may traverse the Lease Area during spring and fall migration periods. The IPaC database did not indicate any wading birds in the Lease Area or adjacent waters.

3.5.2 Exposure Assessment

Exposure was assessed using species accounts and OSAMP survey data. Exposure to offshore construction and operation is considered to be "minimal" (Table 3-13) because wading birds spend a majority of the year in freshwater aquatic systems and near-shore marine systems, and there is little use of Lease Area by wading birds. There were few observations of species within this group during all seasons and none were observed in the Lease Area (Figure 3-10). Due to the assessment of "minimal" exposure, a vulnerability and risk assessment was not conducted.

Table 3-13: Number of species in each exposure category in each season for the heron and egrets group.

Taxonomic Group	Season	Minimal	Low	Medium	High
Heron and Egrets	Winter	1	·	·	·
	Spring	1	·	·	·
	Summer	1	·	·	·
	Fall	1	·	·	·

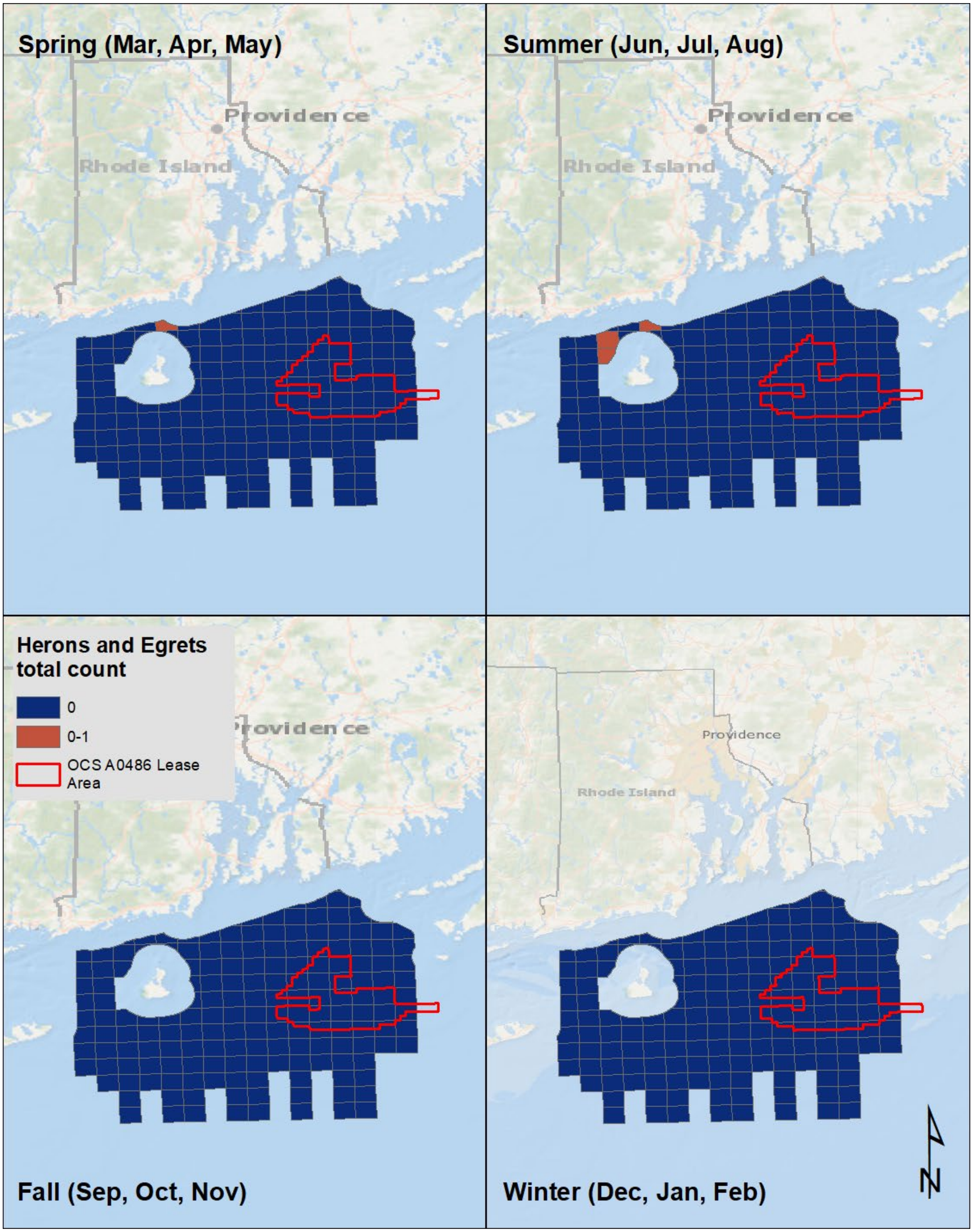

Figure 3-10: Herons and egrets observed, by season, during the OSAMP surveys. Only a small number of Great Blue Heron and Great Egret were observed offshore, and none were observed in the Lease Area.

3.6 Raptors

3.6.1 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 is 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, eagles, *Buteo* hawks, and large *Accipiter* hawks (i.e., Northern Goshawks) are rarely observed offshore (DeSorbo et al. 2012, 2018c). Sharp-shinned Hawks, Cooper's Hawks, Northern Harriers, American Kestrels, and Ospreys have all been observed at offshore islands regularly during migration, but generally in low numbers (DeSorbo et al. 2012, 2018c). Of the common owl species, the larger species (Barred Owl and Great-horned Owl) are generally considered to avoid the offshore environment. Northern Saw-whet Owls 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 (Rasmussen et al. 2008). Long-eared Owls also migrate along the coast and winter in the mid-Atlantic (Marks et al. 1994).

Among raptors, falcons are the most likely to be encountered in offshore settings (Cochran 1985, DeSorbo et al. 2012, 2018c). Merlins are the most abundant diurnal raptor observed at offshore islands during fall migration (DeSorbo et al. 2012, 2018c). Peregrine Falcons fly hundreds of miles/kilometers offshore during migration, and have been observed on vessels and oil drilling platforms considerable distances from shore (Voous 1961, McGrady et al. 2006, Johnson et al. 2011a, 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 (DeSorbo et al. 2015, 2018c); meanwhile breeding adults from New Hampshire either used inland migration routes or were non-migratory (DeSorbo et al. 2018b). While the IPaC database did not indicate any raptors in the Lease Area or adjacent waters, other data resources, such as satellite telemetry data, suggest falcons may pass through the Lease Area during migration (Figure 3-11). Bald Eagles are federally protected under the Bald and Golden Eagle Protection Act and are addressed separately in detail below.

3.6.2 Exposure Assessment

Exposure was assessed using species accounts, OSAMP survey data, and individual tracking data. Raptor exposure to the Lease Area is expected to be limited to falcons. The OSAMP surveys had no records of falcons within the Lease Area. However, individual tracking data indicates falcons fly in the vicinity of the Lease Area during migration (Figure 3-11). For these reasons, flacons are considered to have "low" exposure to Lease Area. Falcons may be attracted to turbines as offshore perching and hunting sites, which may increase temporal exposure during migration.

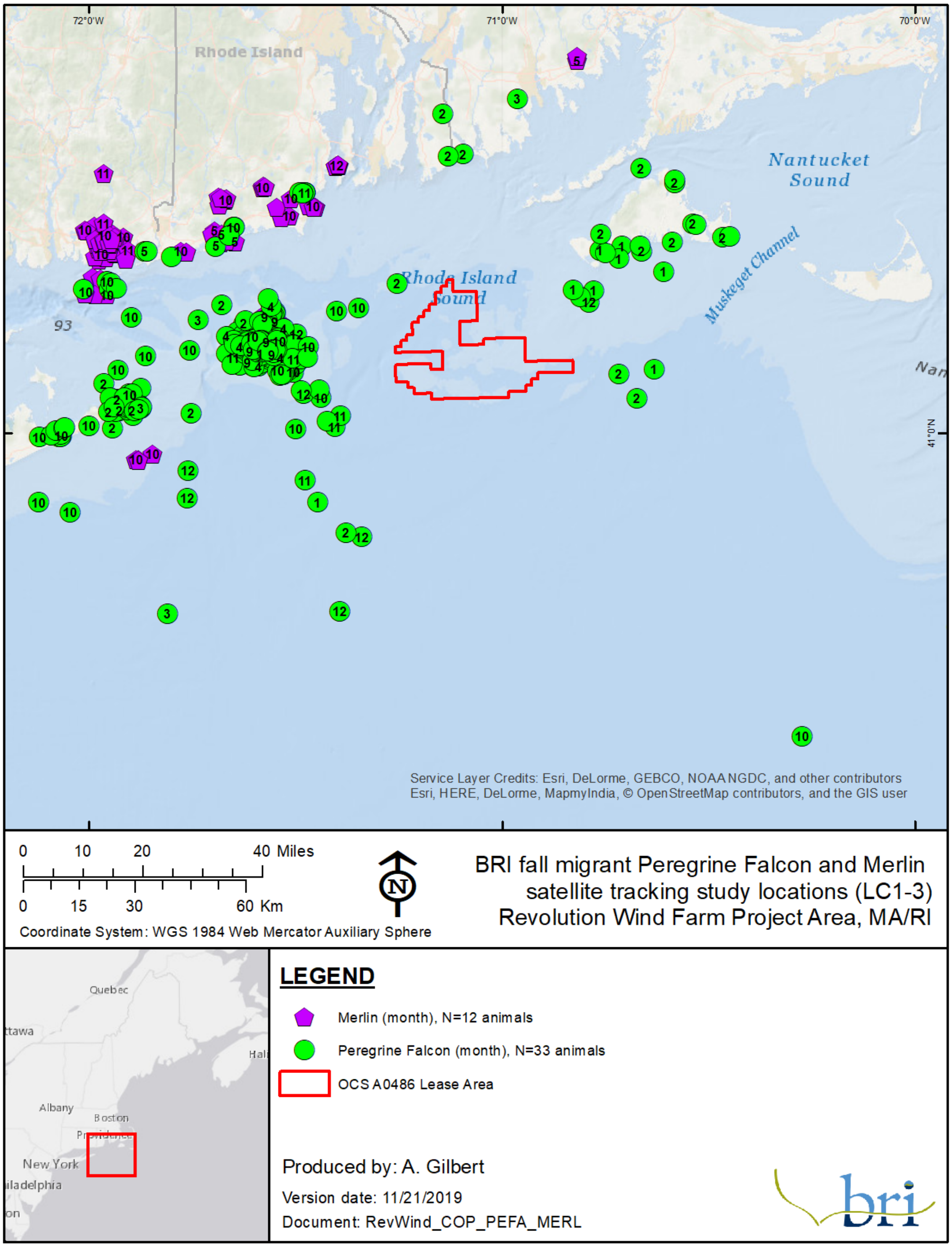

Figure 3-11. Location estimates from satellite transmitters instrumented to Peregrine Falcons and Merlins tracked from three raptor research stations along the Atlantic coast, 2010–2018. Research stations include Block Island, Rhode Island (The Block Island Raptor Research Station; Peregrines: n=3 adult females, n=18 hatching year females, n=17 hatching year peregrines. Merlins: 3 adult females, and 13 hatching year females; DeSorbo et al. 2018c), Monhegan Island, Maine (n=2 HY female Peregrine Falcons) and Cutler, Maine (n=1 adult female Merlin). The number shown in points represents the month in which the location estimate was fixed.

3.6.3 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). Peregrine Falcons and Kestrels have been observed landing on the platform deck of offshore wind turbines (Hill et al. 2014, Skov et al. 2016); however, Peregrine Falcon mortalities have not been documented at European offshore wind developments such as the monitoring effort at the Thanet Wind Farm (Skov et al. 2018). 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 (Meek et al. 1993, Hötker et al. 2006, 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 to their urban nest site in Massachusetts (T. French, MassWildlife, pers. comm.). Carcasses were not detected in post-construction mortality studies at several terrestrial projects in the U.S. (West Virginia and California) and New Zealand with falcon activity (Hein et al. 2013, Bull et al. 2013, DiGaudio and Geupel 2014). In terrestrial habitats providing foraging and nesting opportunities not present offshore, 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 (12.4 mi [20 km] from the coast) indicate macro (i.e., avoiding entire wind farm) 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 kestrels 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” (Table 3-14), 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 phase.

3.6.4 Risk Analysis

Risk of potential impacts to non-falcon raptor populations is considered “minimal” due to minimal rates of exposure. Population- level impacts to falcon species is considered “low” because falcons have low exposure and low to medium vulnerability. 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.

Table 3-14: Summary of raptor vulnerability.

Effect	Description	Evidence from literature	
		Construction & Decommissioning[1]	Operation
Collision	Mortality and injury caused by collision with Project structures	Low–Medium	Low–Medium
Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	Minimal–Low	Minimal–Low
Displacement (Permanent)	Permanent avoidance and/or displacement from habitat	Minimal–Low	Minimal–Low

[1]Effects of decommissioning are expected to be less than or equal to construction activities.

3.7 Eagles protected under the Bald and Golden Eagle Protection Act (BGEPA)

3.7.1 Spatiotemporal Context

Eagles are federally protected under the BGEPA. The Bald Eagle (*Haliaeetus leucocephalus*) is broadly distributed across North America. This species 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 2000).

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 heavily utilize forested regions (Katzner et al. 2012). Golden Eagles commonly winter in the southern Appalachians and are regularly observed in Mid-Atlantic States, 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 develops poorly over the open ocean, during long-distance movements.

Bald Eagles are present year-round in Massachusetts and Rhode Island and have been slowly increasing in numbers over the last 30 years or so. They are rarely observed in offshore surveys (Williams et al. 2015; all observations <3.7 mi [6 km] from shore), which supports the notion that Bald Eagles do not venture far from land.

3.7.2 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, they tend not to fly over large waterbodies, and features that might potentially attract them offshore are absent in the vicinity. The Northwest Atlantic Seabird Catalog database includes few Bald Eagle observations, none of which are in or near the Lease Area.

3.7.3 Relative Behavioral Vulnerability Assessment

Although there is little research on eagle interactions with offshore developments, eagles are expected to have “minimal” vulnerability to collision and displacement because they do not tend to be actively foraging or flying through the offshore environment. Neither species present in the northeastern U.S. is expected to forage over the Lease Area or use the area during migration.

3.7.4 Risk

Since exposure is expected to be minimal for both eagle species, the individual-level impacts during construction and operation are expected to be “minimal”.

3.8 Songbirds

3.8.1 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 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).

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 (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 small 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 indicate any songbirds in the Lease Area or adjacent waters, evidence from the literature and from the OSAMP dataset indicates some songbirds do migrate offshore of Massachusetts and Rhode Island.

3.8.2 Exposure Assessment

Exposure of songbirds to Project components within the Lease Area was assessed using species accounts, OSAMP survey data, and literature. Exposure during Project 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. Some passerines were encountered in the Lease Area during migration periods, but in low numbers (Figure 3-12). Overall, the exposure of these species will be limited to migration, and actual exposure is likely low.

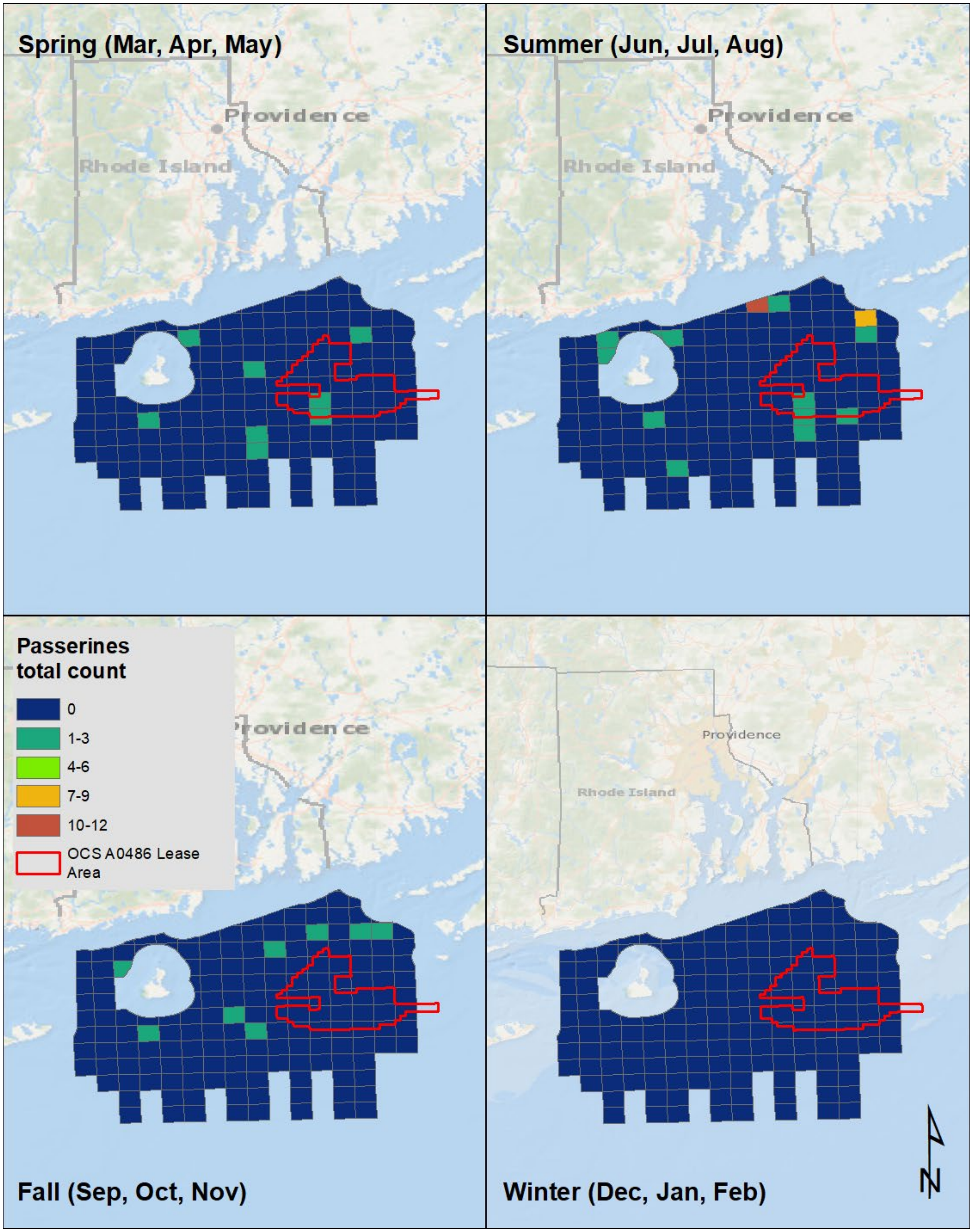

Figure 3-12: Songbirds (passerines) observed, by season, during the OSAMP surveys. While there were low densities of all species, among the species observed, swallows, swifts, warblers, and sparrows were the most common species observed.

3.8.3 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 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 avian fatality rates at onshore wind farms range from 3–5 birds per MW per year (American Wind Wildlife Institute 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). Mortality is likely to be stochastic and infrequent. Like other terrestrial species, since use of the offshore environment is limited to migration any avoidance behavior is not going to cause the bird to be displacement from important habitat.

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” (Table 3-15).

Table 3-15: Summary of songbird vulnerability.

Effect	Description	Evidence from literature	
		Construction & Decommissioning[1]	Operation
Collision	Mortality and injury caused by collision with Project structures	Low–Medium	Low–Medium
Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	Minimal	Minimal
Displacement (Permanent)	Permanent avoidance and/or displacement from habitat	Minimal	Minimal

[1]Effects of decommissioning are expected to be less than or equal to construction activities.

3.8.4 Risk Analysis

This analysis suggests that the potential population-level impacts to songbirds are "minimal" to "low" because, while songbirds 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).

3.9 Coastal Waterbirds

3.9.1 Spatiotemporal Context

Coastal waterbirds use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. In this group, aquatic 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). 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 Section 3.10 Marine Birds, below. The IPaC database did not indicate any coastal waterbirds in the Lease Area or adjacent waters.

3.9.2 Exposure Assessment

Exposure of coastal waterbirds to Project components within the Lease Area was assessed using species accounts, OSAMP survey data, and literature. Exposure is considered to be "minimal" (Table 3-16) because coastal waterfowl spend a majority of the year in freshwater aquatic systems and near-shore marine systems, and there is little use of the Lease Area during any season (Figure 3-13). Due to the minimal exposure, a vulnerability and risk assessment was not conducted.

Table 3-16. Number of species in each exposure category in each season for the ducks, geese, and swans group.

Taxonomic Group	Season	Minimal	Low	Medium	High
Ducks, Geese, and Swans	Winter	1	·	·	·
	Spring	1	·	·	·
	Summer	1	·	·	·

	Fall	1	·	·	·

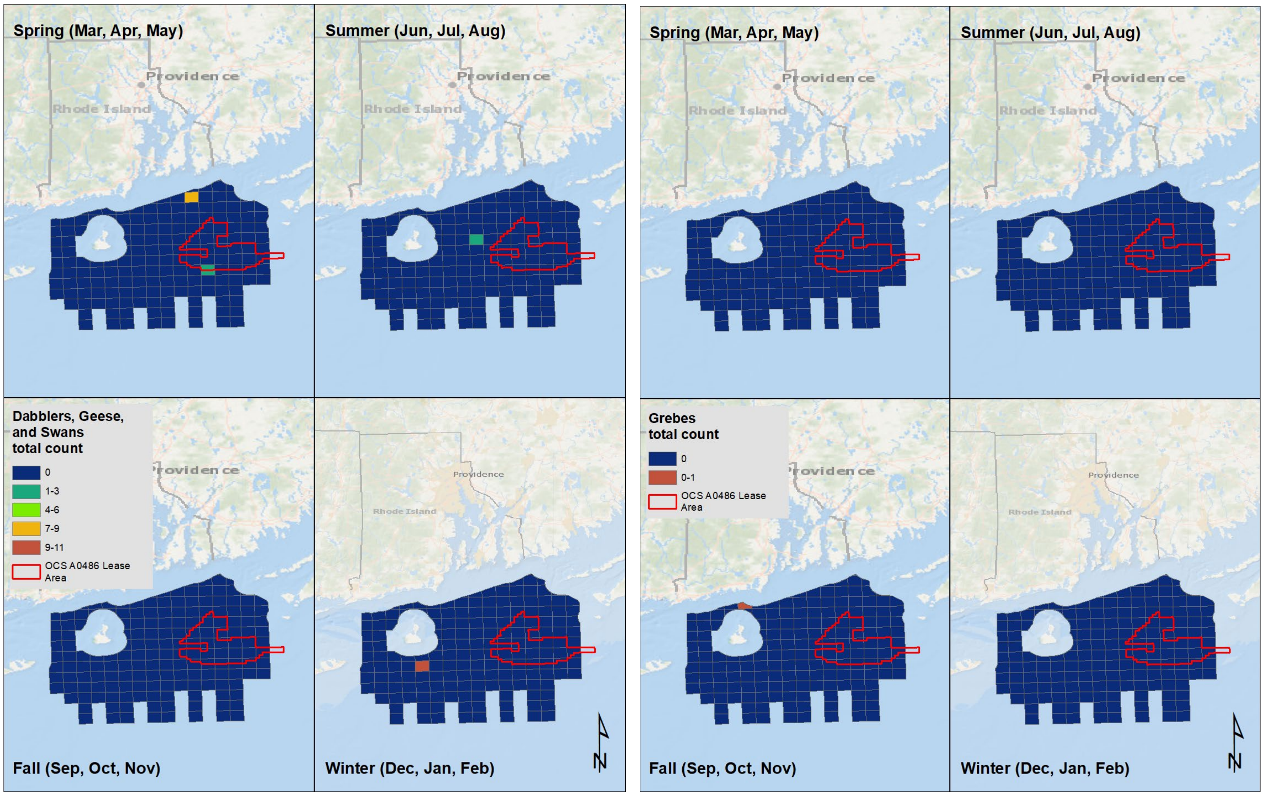

Figure 3-13: Coastal ducks, geese, and swans (left) and grebes (right) observed, by season, during the OSAMP surveys. There were low densities of all species observed and included Brant, Canada Goose, and Mallard.

3.10 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 and terns, and auks. Overall, the Lease Area is in an area identified as having a relatively low marine bird conservation ranking, and wind farms installed in the Lease area are not expected to substantially reduce overall marine bird distributions (Winiarski et al. 2014). The IPaC database indicated that few marine birds of conservation concern may be present in the Lease Area and adjacent waters (Table 3-17). Other data resources, however, indicate that Roseate Terns (an ESA listed species) may pass through the Lease Area during migration; this species is discussed in detail in the tern section. In the following sections, the assessments for major taxonomic groups of marine birds are reviewed, including discussion of their exposure (summarized in Table 3-18), their densities inside and outside of the Lease Area (summarized in Table 3-19), and their vulnerability (summarized in

Table 3-20). Part V of this assessment provides the species-specific densities by season as a supplement (see Table V-1) and the vulnerability scores for each species (see Table V-2).

Table 3-17: Marine birds of conservation concern identified in the IPaC database: their state and federal status (E = Endangered; T = Threatened; SC = Special Concern; BCC = Bird of Conservation Concern).

Common Name	Scientific Name	RI Status	MA Status	Federal Status
Common Loon	*Gavia immer*	.	SC	.
Red-throated Loon	*Gavia stellata*	.	.	BCC
Common Tern	*Sterna hirundo*	.	SC	.

Table 3-18: Annual exposure scores for each marine bird species in each taxonomic grouping.

Taxonomic Grouping	Species	Annual Species Exposure Score[1]
Sea Ducks	Black Scoter	1
	Common Eider	2
	Long-tailed Duck	1
	Red-breasted Merganser	1
	Surf Scoter	3
	White-winged Scoter	6
Auks	Common Murre	6
	Dovekie	0
	Razorbill	5
Small Gulls	Bonaparte's Gull	1
Medium Gulls	Black-legged Kittiwake	4
	Laughing Gull	0
	Ring-billed Gull	1
Large Gulls	Great Black-backed Gull	3
	Herring Gull	4
Medium Terns	Common Tern	3
Loons	Common Loon	4
	Red-throated Loon	2
Storm-Petrels	Wilson's Storm-Petrel	1
Shearwaters and Petrels	Cory's Shearwater	4
	Great Shearwater	2
	Manx Shearwater	1
	Northern Fulmar	1
	Sooty Shearwater	2
Gannets	Northern Gannet	1
Cormorants	Double-crested Cormorant	2
	Great Cormorant	0

[1]Minimal = 0–2, Low = 3–5, Medium = 6–8, and High = 9–12.

Table 3-19: Effort corrected counts (count/km of survey transect) within the OCS-A-0486 Lease Area and the OSAMP aerial survey area within the Atlantic Outer Continental Shelf.

Taxonomic Grouping	Species	Average counts/km in the Lease Area	Average counts/km in the OSAMP aerial survey area
Sea Ducks	Black Scoter	0	0.071
	Common Eider	0.001	0.038
	Long-tailed Duck	0.002	0.002
	Red-breasted Merganser	0	0
	Surf Scoter	0.006	0.009
	White-winged Scoter	0.012	0.012
	Unidentified Scoter	0.122	0.43
Skuas and Jaegers	Unidentified Jaeger	0	0
Auks	Common Murre	0.039	0.028
	Dovekie	0.007	0.016
	Razorbill	0.011	0.024
	Unidentified Auk	0.212	0.194
	Unidentified Murre	0.006	0.002
Small Gulls	Bonaparte's Gull	0.001	0.001
Medium Gulls	Black-legged Kittiwake	0.022	0.046
	Laughing Gull	0.001	0.002
	Ring-billed Gull	0	0
Large Gulls	Great Black-backed Gull	0.037	0.061
	Herring Gull	0.038	0.209
All Gulls	Unidentified Gull	0.016	1.005
Medium Terns	Common Tern	0	0.003
All Terns	Unidentified Tern	0.003	0.009
Loons	Common Loon	0.054	0.105
	Red-throated Loon	0.007	0.01
	Unidentified Loon	0.004	0.002
Storm-Petrels	Wilson's Storm-Petrel	0.033	0.053
Shearwaters and Petrels	Cory's Shearwater	0.02	0.021
	Great Shearwater	0.007	0.007
	Manx Shearwater	0	0
	Northern Fulmar	0.004	0.007
	Sooty Shearwater	0.002	0.001
	Unidentified Petrel	0	0
	Unidentified Shearwater	0.015	0.017
Gannets	Northern Gannet	0.106	0.351
Cormorants	Double-crested Cormorant	0	0.001
	Great Cormorant	0	0
	Unidentified Cormorant	0	0

Table 3-20: Summary of vulnerability scores. In the taxonomic group discussions below, vulnerability scores for each species are detailed and ranges are added for some species based upon the literature.

Taxonomic Group	Population Vulnerability	Collision Vulnerability		Displacement Vulnerability
		Minimum RSZ	Maximum RSZ	
Sea Ducks	Low	Low	Low	High
Phalaropes	Low	Low	Low	Medium
Auks	Low	Minimal	Minimal	High
Large Gulls	Low	Medium	Low	Medium
Medium Gulls	Low	Medium	Low	Medium
Small Gulls	Low	Low	Low	Medium
Medium Terns	High*	Low	Low	High
Loons	Medium	Low	Low	High
Shearwaters and Petrels	Medium	Low	Low	Medium
Storm-Petrels	Low	Low	Low	Medium
Gannet	Low	Low	Low	Medium
Cormorants	Minimal	Medium	Medium	Low

*Population vulnerability for Common Tern was medium, and Roseate Tern was high, which averaged to the high category. See text for further details.

3.10.1 Loons

3.10.1.1 Spatiotemporal Context

Common Loons and Red-throated Loons are both known to use the Atlantic Outer Continental Shelf in winter, including areas in coastal Rhode Island. Analysis of satellite-tracked Red-throated Loons, captured and tagged on the Atlantic coast, found their winter distributions to be largely inshore, although they did overlap with the Lease Area somewhat during their migration periods, particularly in spring (Gray et al. 2016). Wintering Common Loons generally show a broader and more dispersed distribution offshore in winter than Red-throated Loons (Williams et al. 2015a).

3.10.1.2 Exposure Assessment

Exposure of common loons to Project components within the Lease Area was assessed using species accounts, tracking data, OSAMP survey data, and MDAT models. Exposure to Project components during construction and operation is considered to be “low” to “medium” because loons may pass through the Lease Area during spring and fall migration, and Common Loons may use the area during the winter (Table 3-21). Both Red-throated Loons and Common Loons had considerably lower average counts/km within the Lease Area than the OSAMP aerial survey area (Table 3-19). In addition, tracking data indicate that Red-Throated Loons largely pass through the area only during spring migration (Figure 3-14).

Table 3-21: Number of loon species in each exposure category by season.

Taxonomic Group	Season	Minimal	Low	Medium	High
Loons	Winter	1	1	·	·
	Spring	·	2	·	1
	Summer	1	1	1	·
	Fall	·	2	1	·

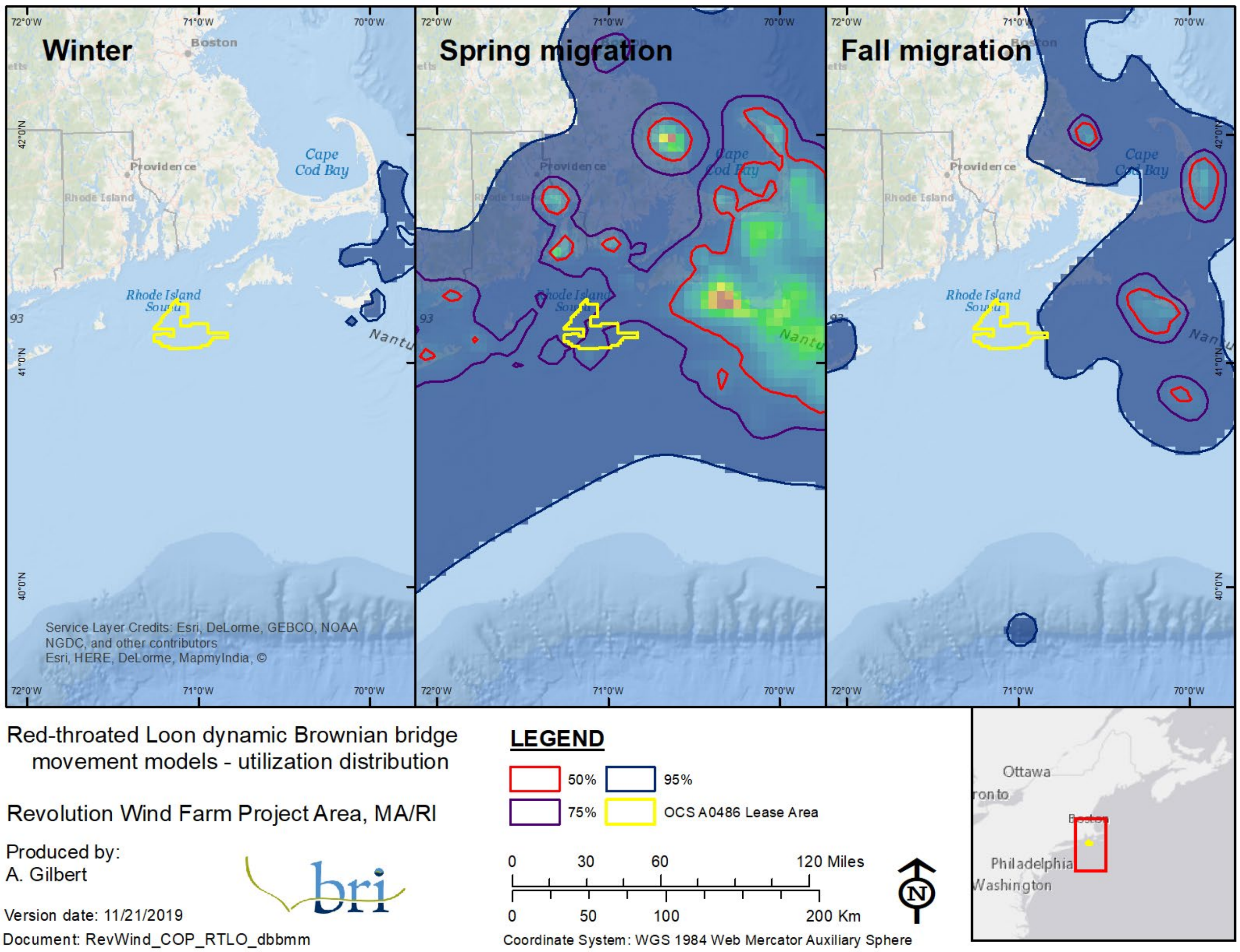

Figure 3-14: Dynamic Brownian bridge movement models for Red-throated Loons (*n*=46, 46, 31 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the birds stay close to shore or shallow shoals in the winter and during fall migration but may pass through the Lease Area during spring migration.

3.10.1.3 Relative Behavioral Vulnerability Assessment

Loons are consistently identified as being vulnerable to displacement (Garthe and Hüppop 2004, Furness et al. 2013, MMO 2018). 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). However, there is some evidence that Red-throated Loons may return to wind farm areas after construction has been completed (APEM 2016). Common Loons are expected to have a similar avoidance response.

Based upon the above evidence, the risk to loons is limited to displacement from wind developments during construction and operation. From the literature, displacement vulnerability is considered to be "high" for loons during all phases because they are known to display a strong avoidance to offshore wind developments; the displacement score (DV) was "high" for both species (Table 3-22).

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 (3–18% depending on species and turbine option; Figure 3-15) if they do not avoid the wind farm. For these reasons, loons received a "low" collision risk score. Based upon the literature, a lower range is added to collision vulnerability.

Table 3-22: Summary of loon vulnerability. CV = collision vulnerability; DV = displacement vulnerability; PV = population vulnerability. Based upon the literature, collision vulnerability was adjusted to include a lower range limit (green).

Taxonomic Group	Species	Collision Vulnerability (CV)		DV	PV
		Minimum RSZ	Maximum RSZ		
Loons	Common Loon	Minimal–Low (0.33)	Minimal–Low (0.33)	High (0.8)	Medium (0.6)
	Red-throated Loon	Minimal–Low (0.37)	Minimal (0.23)	High (0.9)	Low (0.47)

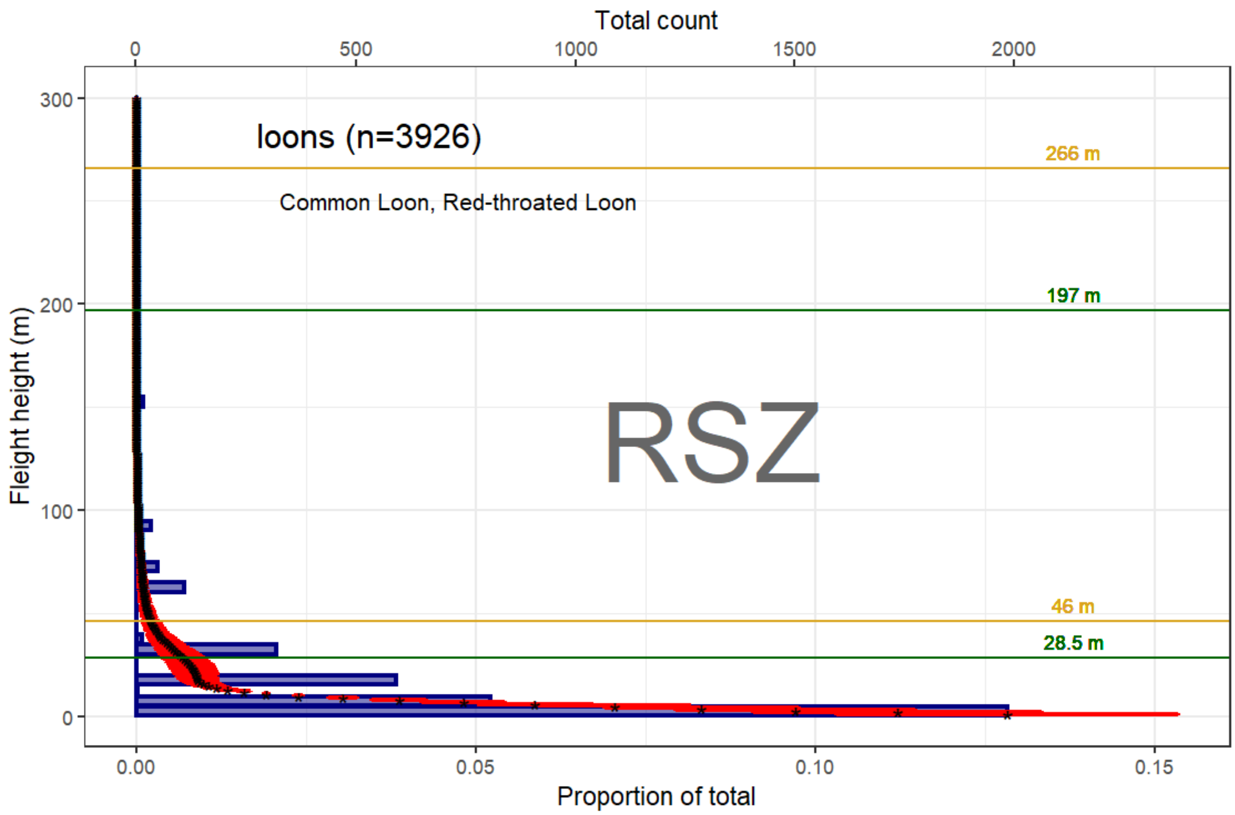

Figure 3-15: Flight heights of loons (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

3.10.1.4 Risk Analysis

This analysis suggests that the risk of the potential impacts to loon populations is "minimum" to "medium" because, overall, these birds have low to medium exposure, both spatially and temporally, and a high vulnerability to displacement due to strong avoidance. However, there is uncertainty about how displacement will affect individual fitness (e.g., will it increase 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. Based on recently modeled build-out scenarios, loons are considered to have a higher likelihood of cumulative habitat loss than other species groups (Goodale et al. 2019). Habitat loss due to displacement from the Project is unlikely to impact population trends because of the relatively small size of the Lease Area in relation to available foraging habitat. Since the loons had a low to medium population vulnerability score, the final risk score was not adjusted.

3.10.2 Sea Ducks

3.10.2.1 Spatiotemporal Context

The sea ducks include Common Eiders, scoters, and Long-tailed Ducks, all of which are northern or Arctic breeders that use the Atlantic Outer Continental Shelf heavily in winter, including areas in coastal Rhode Island. 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. Models of sea ducks tracked with satellite transmitters indicate that the birds may be exposed to the Lease Area during the winter, as well as during fall and spring migration, but that the Lease Area was not within the 50% core use areas (Figure 3-16 to Figure 3-19).

3.10.2.2 Exposure Assessment

Exposure was assessed using species accounts, tracking data, OSAMP survey data, and MDAT models. Exposure is considered to be "minimal" to "medium" because the sea duck annual exposure score was generally minimal to low with one high score for White-winged Scoter in the spring (Table 3-23), the average counts/km of sea ducks within the Lease Area were generally lower or similar to that in the OSAMP aerial survey area (Table 3-19), and the literature indicates that sea duck exposure will be primarily limited to migration or travel between wintering sites.

Table 3-23: Number of species in each exposure category by season for sea ducks.

Taxonomic Group	Season	Minimal	Low	Medium	High
Sea Ducks	Winter	4	2		·
	Spring	4	1	·	1
	Summer	6	·	·	·
	Fall	2	4	·	·

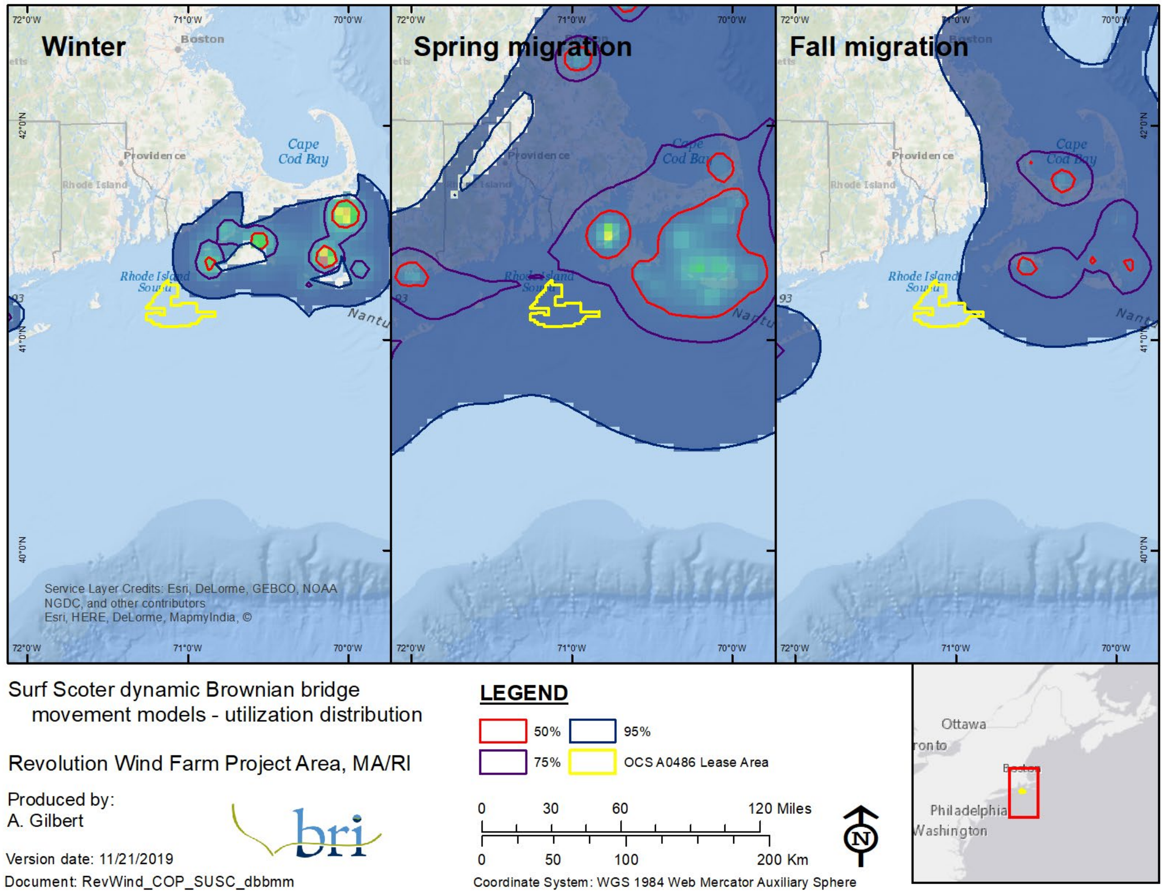

Figure 3-16: Dynamic Brownian bridge movement models for Surf Scoter (*n*=78, 87, 83 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the birds stay close to shore in the winter and during fall migration but may pass through the Lease Area during spring migration. Data provided by BOEM: see section 3.2.4.1.3.2 (p.47).

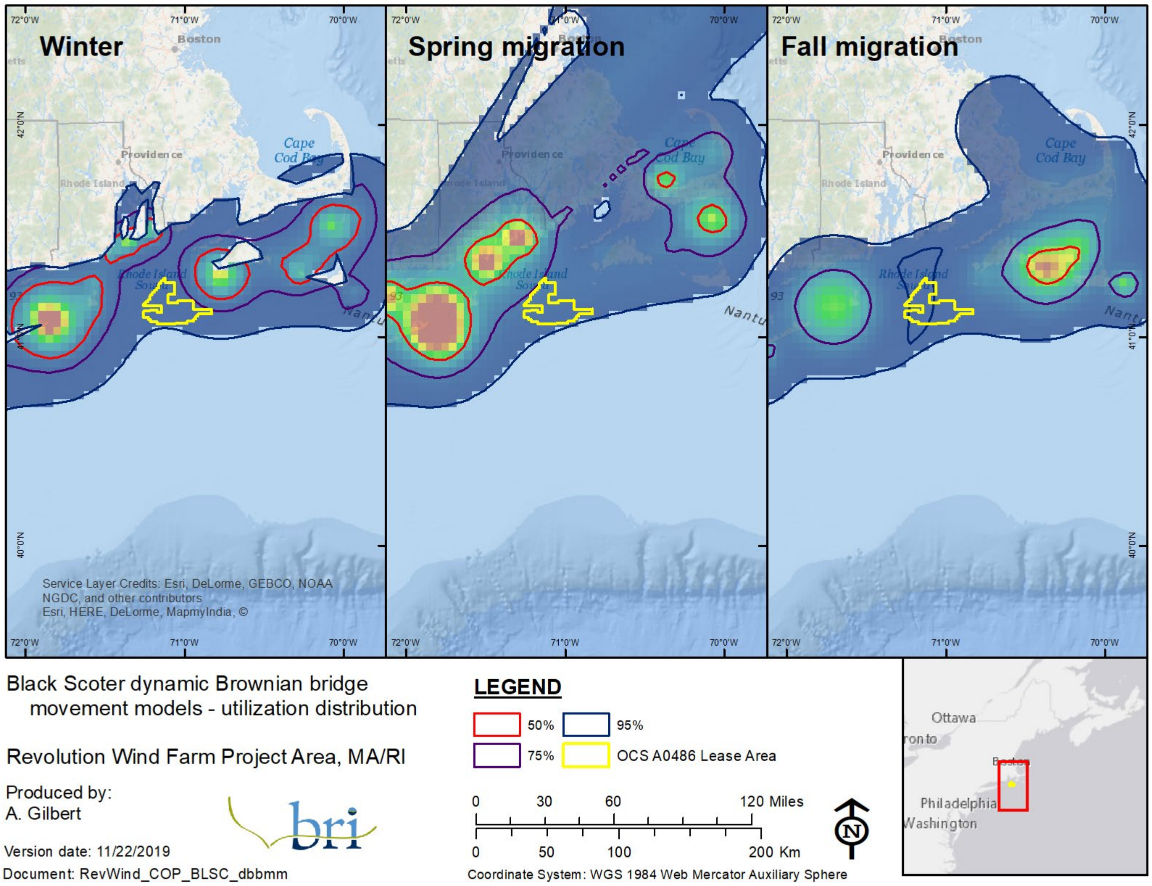

Figure 3-17: Dynamic Brownian bridge movement models for Black Scoter (*n*=61, 76, 80 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the birds stay closer to shore in the winter and during migration but may pass through the Lease Area. Data provided by multiple sea duck researchers: see section 3.2.4.1.3.3 (p.47).

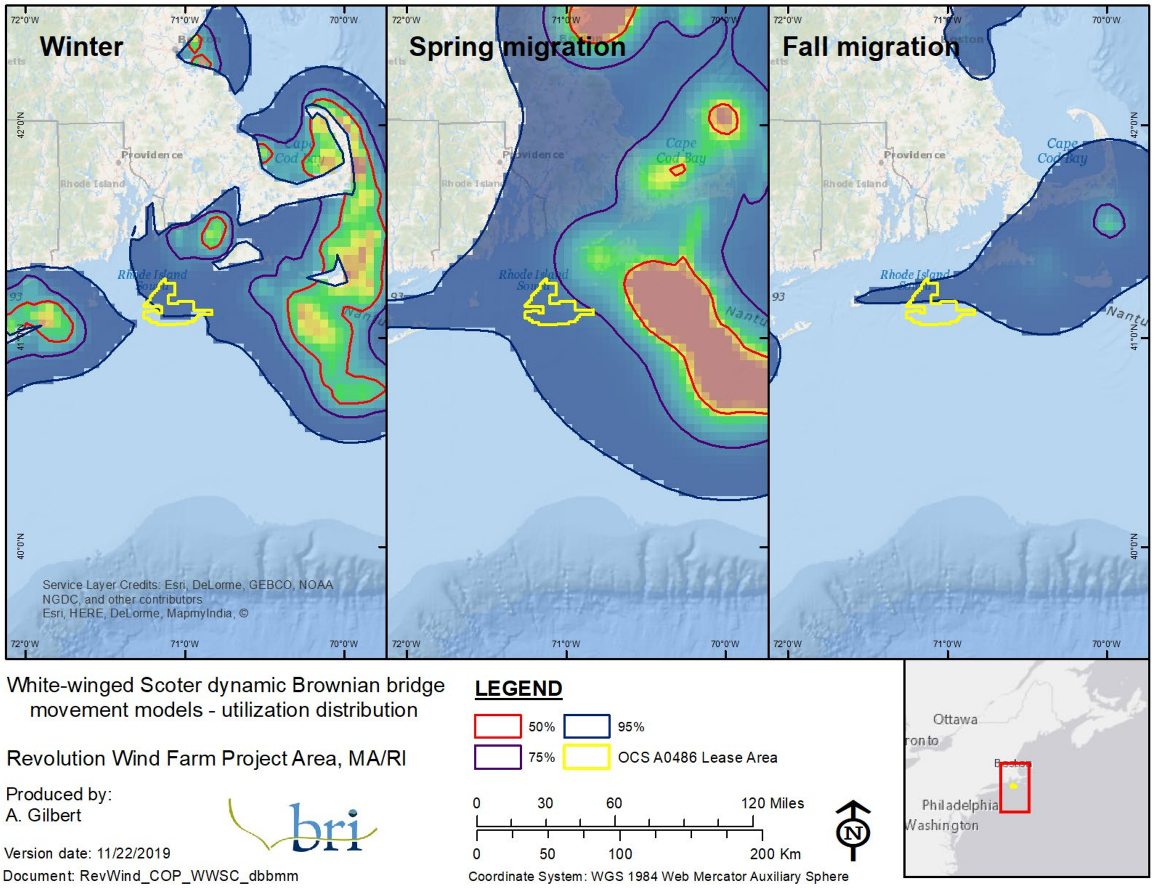

Figure 3-18: Dynamic Brownian bridge movement models for White-winged Scoter (*n*=66, 45, 62 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the birds stay close to shore or use the shoals well west of the Lease Area. Data provided by multiple sea duck researchers: see section 3.2.4.1.3.3 (p.47).

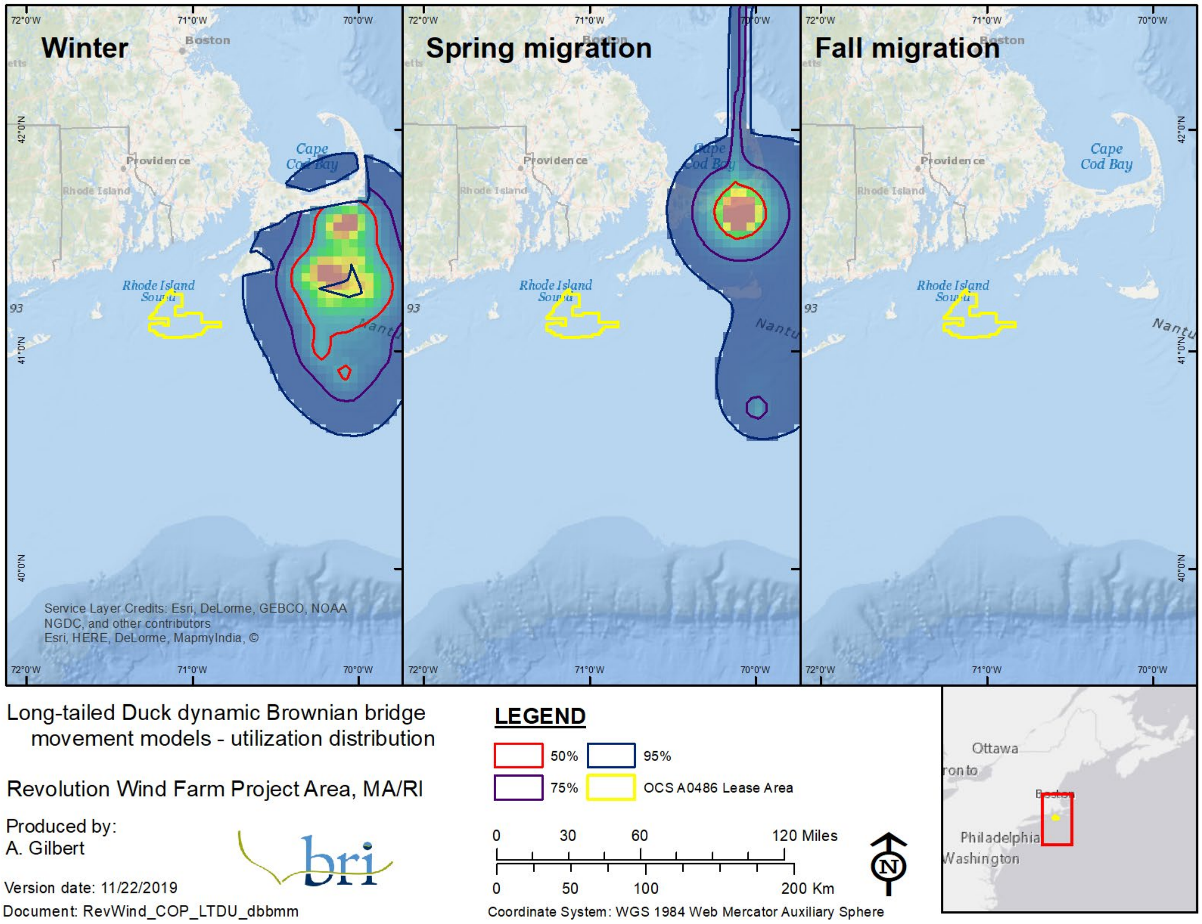

Figure 3-19: Dynamic Brownian bridge movement models for Long-tailed Duck (*n*=49, 60, 37 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the birds generally stay close to the shoals well west of the Lease Area. Data provided by multiple sea duck researchers: see section 3.2.4.1.3.3 (p.47).

3.10.2.3 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 (0–3% within the RSZ depending on species [excluding Red-breasted Merganser] and turbine option; Figure 3-20). Avoidance behavior has been documented for Black Scoter, Common Eider (Desholm and Kahlert 2005, Larsen and Guillemette 2007), and Greater Scaup (Dirksen and van der Winden 1998 *in* Langston 2013). Preliminary post-construction surveys at the Block Island Wind Farm reported lower densities of ducks inside the turbine area than outside (Stantec 2018d). 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); 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 upon the above evidence, the risk to sea ducks is primarily limited to 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” (Table 3-24). However, since there is evidence of birds returning to wind farms once they become operational, vulnerability to permanent displacement will vary by species; for this reason, a lower range has been added to displacement vulnerability. Since sea ducks generally fly below the RSZ and have strong avoidance behavior, collision vulnerability was “minimal” to “low” with the exception of Red-breasted Merganser that received a score of “medium” for turbine option 1 (Figure 3-20). Red-breasted Merganser was not included in the vulnerability range in the final table because they were not observed in the Lease Area.

Table 3-24: Summary of sea duck vulnerability. CV = collision vulnerability; DV = displacement vulnerability; PV = population vulnerability. Based upon the literature, displacement vulnerability was adjusted to include a lower range limit (green) to account for macro-avoidance rates potentially decreasing with time.

Taxonomic Group	Species	Collision Vulnerability (CV)		DV	PV
		Minimum RSZ	Maximum RSZ		
Sea Ducks	Black Scoter	Low (0.33)	Low (0.33)	Medium–High (0.9)	Low (0.4)
	Common Eider	Low (0.27)	Low (0.27)	Medium–High (0.9)	Low (0.47)
	Long-tailed Duck	Low (0.4)	Low (0.4)	Medium–High (0.9)	Low (0.27)
	Red-breasted Merganser	Medium (0.53)	Low (0.4)	Low–Medium (0.5)	Low (0.27)
	Surf Scoter	Low (0.33)	Low (0.33)	Medium–High (0.9)	Medium (0.53)
	White-winged Scoter	Low (0.4)	Low (0.4)	Medium–High (0.8)	Medium (0.53)

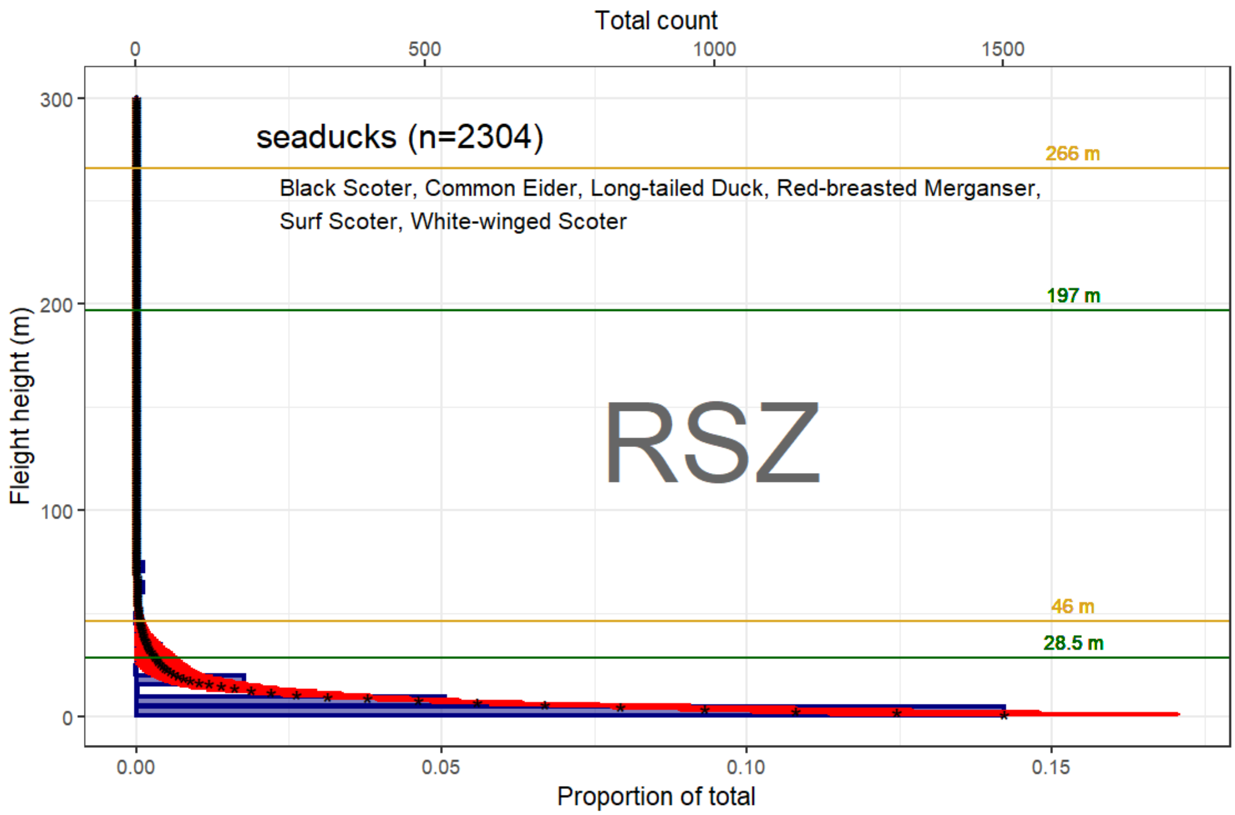

Figure 3-20: Flight heights of sea ducks (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

3.10.2.4 Risk Analysis

This analysis suggests that the risk of potential impacts to sea duck populations is “minimal” to “medium” because, overall, these birds have minimal to medium exposure, both spatially and temporally, and medium to high vulnerability to permanent displacement due to avoidance behaviors. Based on recently modeled build-out scenarios, loons are considered to have a higher likelihood of cumulative habitat loss than other species groups (Goodale et al. 2019). Habitat loss due to displacement from the Project, however, is unlikely to impact population trends because of the relatively small size of the Lease Area in relation to available foraging habitat. Since the sea ducks had a “low–medium” population vulnerability score, the final risk score was not adjusted.

3.10.3 Petrels, Shearwaters, and Storm-Petrels

3.10.3.1 Spatiotemporal Context

Petrels, shearwaters, and storm-petrels that occur in the region mostly breed in the southern hemisphere and visit the northern hemisphere during the austral winter (boreal summer) in vast numbers. These species use the U.S. Atlantic Outer Continental Shelf region, including areas offshore of Rhode Island, so heavily that they greatly outnumber the locally breeding species and year-round resident marine birds at this time of year (Nisbet et al. 2013). Several of these species (e.g., Cory's Shearwater, Wilson's Storm-Petrel) are found in high densities across the broader region, concentrating beyond the outer continental shelf and the Gulf of Maine as shown in the MDAT avian abundance models (Winship et al. 2018).

3.10.3.2 Exposure Assessment

Exposure was assessed using species accounts, OSAMP survey data, and MDAT models. Overall, exposure is considered to be "minimal" to "low" because, while the petrel group is commonly observed throughout the region during the summer months, they are typically found much further offshore than the Lease Area (see maps in Part IV). The annual exposure score for this group is "minimal" to "low" (Table 3-25).

Table 3-25: Number of species in each exposure category by season for petrels, shearwaters, and storm-petrels.

Taxonomic Group	Season	Minimal	Low	Medium	High
Petrels, Shearwaters, and Storm-Petrels	Winter	6	·	·	·
	Spring	5	·1	·	·
	Summer	2	3	1	·
	Fall	5	1	·	·

3.10.3.3 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 extremely limited exposure, if any, to the RSZ (0% within the RSZ; Figure 3-21 and Figure 3-22). Species within this group forage on vertically migrating 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. However, there is little data on avian behavior in the marine environment during such periods, as surveys are limited to good weather during daylight hours. Studies that exist indicate that light-induced mass mortality events are primarily a land-based, juvenile issue, involving fledging birds leaving their colonies at night (Le Corre et al. 2002, Rodríguez et al. 2014, 2015, 2017). Response to intermittent LED lights, likely to be used at offshore wind farms, is largely unknown at this point, but unlikely to have population-level effects. The collision vulnerability (CV) score is "minimal" 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 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) identified that there was "very high" uncertainty on displacement vulnerability for these species. Based upon the evidence in the literate, and identified uncertainty, a lower range has been added.

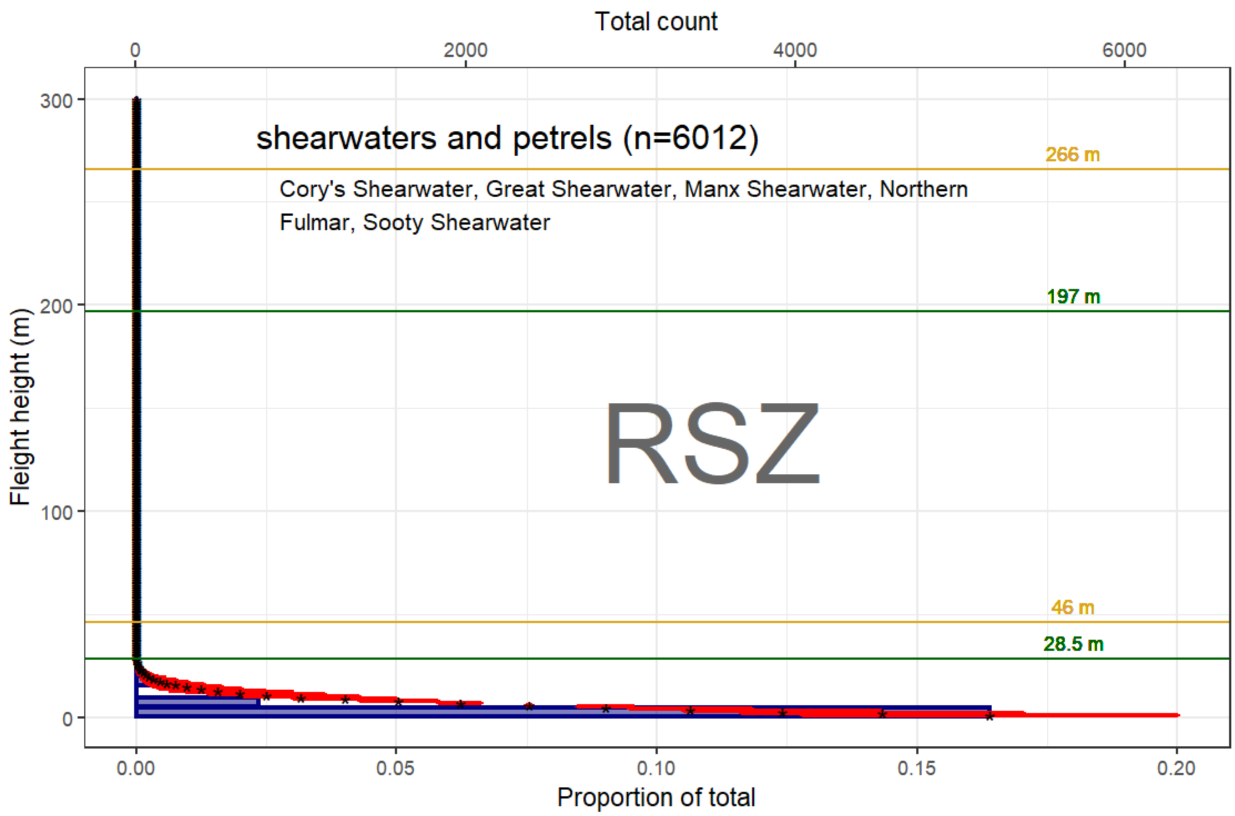

Figure 3-21: Flight heights of shearwaters and petrels (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

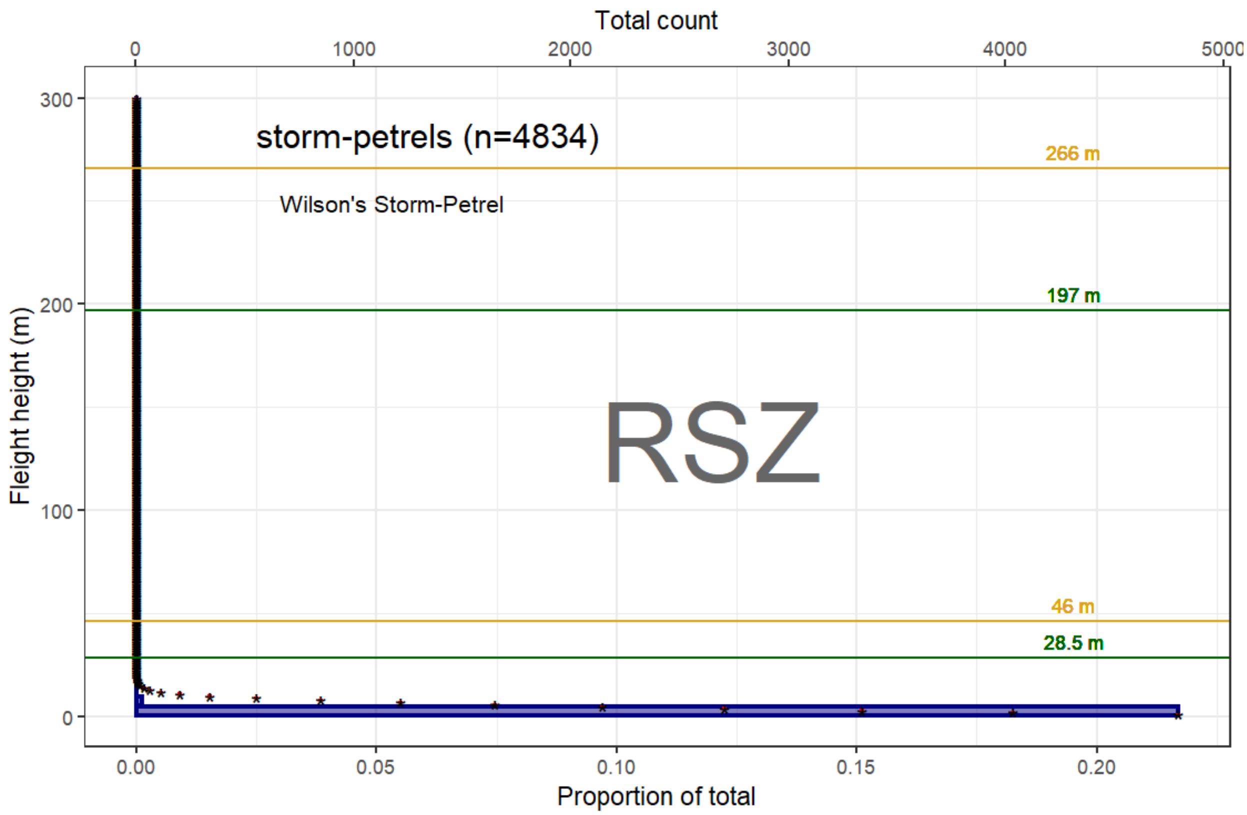

Figure 3-22: Flight heights of storm- petrels (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

Table 3-26: Summary of petrel, shearwater, and storm-petrel vulnerability. CV = collision vulnerability; DV = displacement vulnerability; PV = population vulnerability. Based upon the literature, displacement vulnerability was adjusted to include a lower range limit (green).

Taxonomic Group	Species	Collision Vulnerability (CV)		DV	PV
		Minimum RSZ	Maximum RSZ		
Petrels and Shearwaters	Cory's Shearwater	Low (0.37)	Low (0.37)	Low–Medium (0.6)	Medium (0.6)
	Great Shearwater	Low (0.33)	Low (0.33)	Low–Medium (0.6)	Medium (0.67)
	Manx Shearwater	Low (0.4)	Low (0.4)	Low–Medium (0.6)	Medium (0.53)
	Northern Fulmar	Low (0.43)	Low (0.43)	Low–Medium (0.6)	Low (0.47)
	Sooty Shearwater	Low (0.37)	Low (0.37)	Low–Medium (0.6)	Medium (0.53)
Storm-Petrels	Wilson's Storm-Petrel	Low (0.43)	Low (0.43)	Low–Medium (0.6)	Low (0.4)

3.10.3.4 Risk Analysis

This analysis suggests that the risk of potential impacts to the petrel group populations is "minimal" to "low" because, overall, these birds have minimal to low spatial exposure and low to medium vulnerability to collision and displacement. Since the petrel group had a low–medium population vulnerability score, the final risk score was not adjusted.

3.10.4 Candidate Petrel Species

3.10.4.1 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 (Jan-Jun), Black-capped Petrels travel long distances to forage over deep waters (~650–6500 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), (Jodice et al. 2015), but are rarely seen in offshore waters off of Rhode Island.

The small, declining global population, likely less than 2,000 breeding pairs, has been listed as *Endangered* on the IUCN Red List since 1994 (BirdLife International 2018) and is currently proposed for federal listing as *Threatened* in the U.S. (U.S. Fish and Wildlife Service 2018b) due to its heavy use of the Gulf Stream within U.S. waters (U.S. Fish and Wildlife Service 2018c) 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, and the effects of climate change on the biology of the species and its prey are largely unknown (Goetz et al. 2012). Furthermore, 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 2018b).

3.10.4.1.1 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 US only as a result of tropical storms (Lee 2000). The Northwest Atlantic Seabird Catalog contains approximately 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, suggests possibly greater use of shelf waters than previously known, especially in the South Atlantic Bight (Jodice et al. 2015). The closest sightings (to the Project's Lease Area) are from northern New York waters, where five observations were reported in 2016 (see Figure 3-32). Recent tracking of Black-capped Petrels with satellite transmitters confirms that the birds are primarily using areas beyond the shelf break (Atlantic Seabirds 2019; Figure 3-23). In their Biological Assessment for the proposed Vineyard Wind Farm, BOEM concluded that, given the lack of overlap of their distribution with wind farm activities, there would be no effect on Black-capped Petrels (Bureau of Ocean Energy Management 2019).

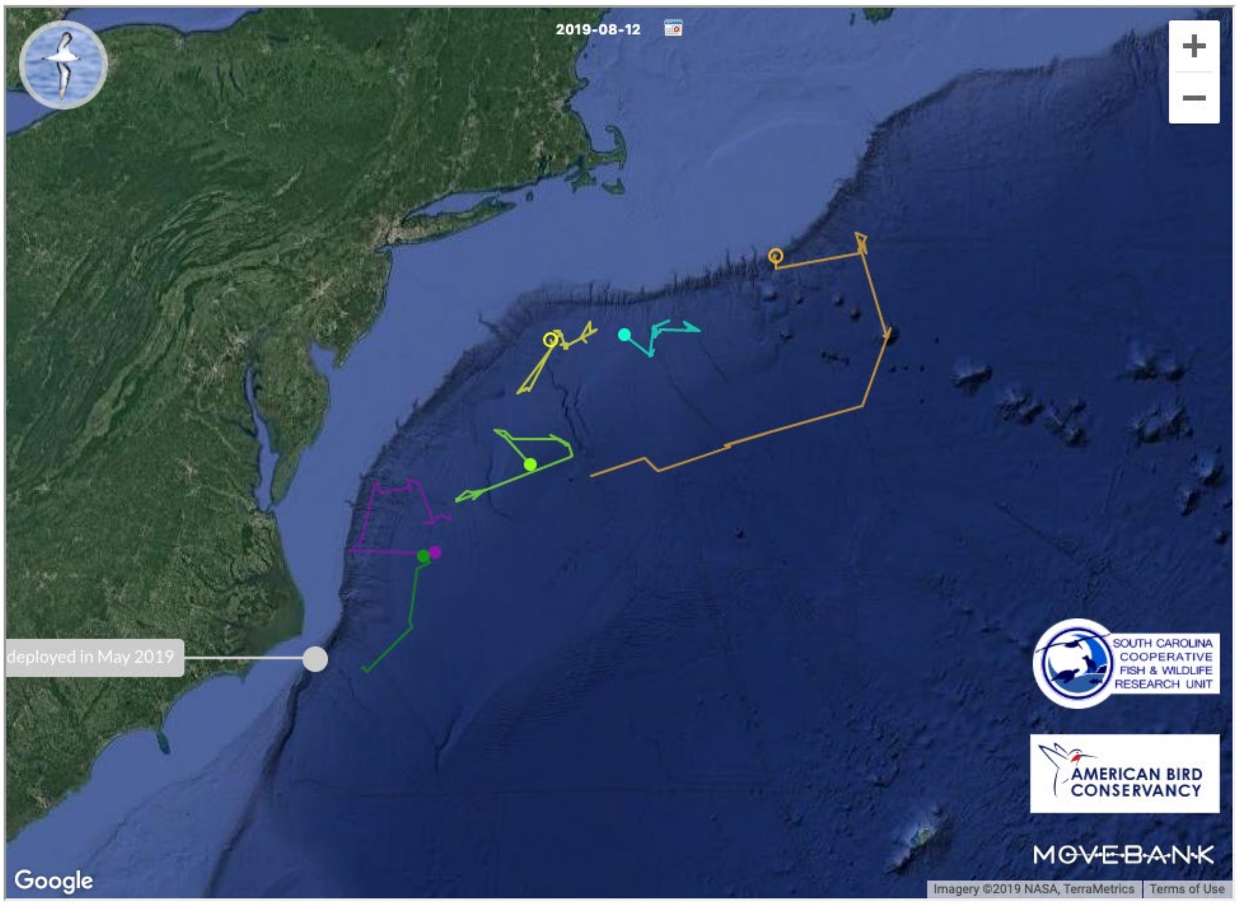

Figure 3-23: Track lines of Black-capped Petrels tagged with satellite transmitters (Atlantic Seabirds 2019).

3.10.4.1.2 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, but the vulnerability range for the other petrel species used as a proxy.

3.10.4.2 Risk Analysis

This analysis suggests that the risk of potential impacts to Black-capped Petrels is "minimal" because, overall, these birds have minimal spatial and temporal exposure. Since Black-capped petrels are not state listed, and they had a medium population vulnerability score, the final risk score was not adjusted.

3.10.5 Gannets and Cormorants

Gannets and cormorants are addressed separately below, due to the potential vulnerability of Northern Gannets highlighted in European studies.

3.10.5.1 Gannets

3.10.5.1.1 Spatiotemporal Context

Northern Gannets (*Morus bassanus*) use the U.S. Atlantic Outer Continental Shelf during winter and migration, including nearshore and offshore areas off of Rhode Island. They breed in southeastern Canada and winter south along the Atlantic coast to the Gulf of Mexico. Based on analysis of satellite-tracked Northern Gannets captured and tagged on the Atlantic coast, these birds show a preference for shallow, productive waters and are mostly found inshore of the Atlantic Wind Energy Areas in winter (Stenhouse et al. 2017). Northern Gannets are opportunistic foragers that are capable of long-distance oceanic movements, and they generally migrate on a broad front; these characteristics may increase their exposure to offshore wind facilities, compared with species that are truly restricted to inshore habitats (Stenhouse et al. 2017).

3.10.5.1.2 Exposure Assessment

Exposure of Northern Gannets to Project components within the Lease Area was assessed using species accounts, tracking data, OSAMP survey data, and MDAT models. Exposure is considered to be "minimal" to "low" for gannets because the annual exposure score was "minimal" (Table 3-27) and average counts/km of Northern Gannets within the Lease Area was substantially lower than the entire OSAMP aerial survey area (Table 3-19). However, individual tracking data indicates that the Lease Area falls within the core use area for these birds during the spring, and touches on it in the fall (Figure 3-24).

Table 3-27: Exposure scoring by season for Northern Gannets.

Taxonomic Group	Season	Minimal	Low	Medium	High
Gannet	Winter	1	·	·	·
	Spring	·	1	·	·
	Summer	1	·	·	·
	Fall	1	·	·	·

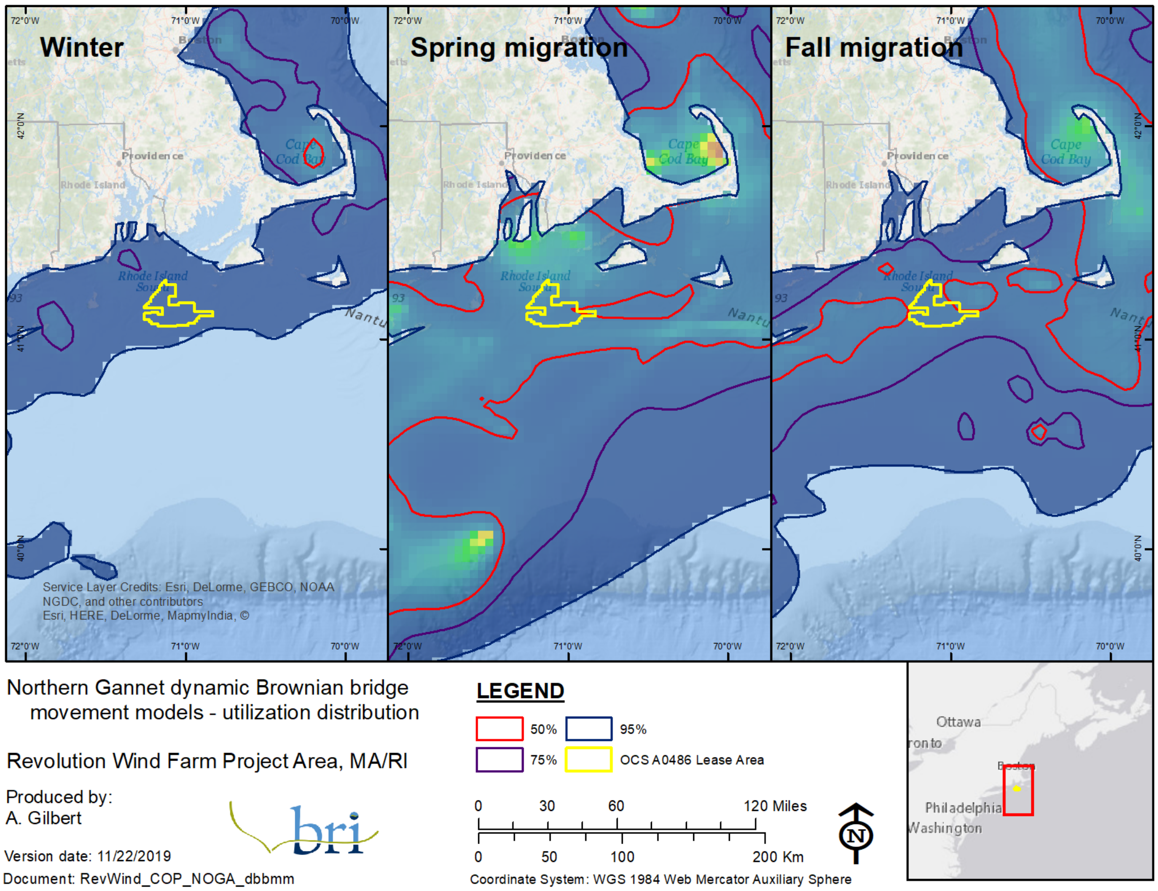

Figure 3-24: Dynamic Brownian bridge movement models for Northern Gannets (*n*=34, 35, 36 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the Lease Area is used by gannets during the winter, spring, and fall.

3.10.5.1.3 Relative Behavioral Vulnerability Assessment

Northern Gannets are identified as being vulnerable to both displacement and collision. Northern Gannets are considered to be vulnerable to displacement from habitat because studies indicate that 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 by gannets

(Garthe et al. 2017) and avoidance rates are estimated to be 64–84% (macro) and 99.1% (total; Krijgsveld et al. 2011, Cook et al. 2012, Vanermen et al. 2015, Skov et al. 2018). However, there is little information suggesting avoidance behavior leads to permanent displacement. Since gannets feed on highly mobile surface-fish and follow their prey throughout the outer continental shelf (Mowbray 2002), avoidance of the Lease Area is unlikely to lead to habitat loss. When gannets enter a wind development they may also be vulnerable to collision because they have the potential to fly within the RSZ (Furness et al. 2013, Garthe et al. 2014, Cleasby et al. 2015). When gannets enter an offshore wind development they 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. 2014). Flight height data from the Northwest Atlantic Seabird Catalog shows the birds flying within the RSZ 6–15% of the time, depending upon the turbine option (Figure 3-25).

Based upon the above evidence, the risk of offshore developments to Northern Gannets is collision and displacement. The collision vulnerability (CV) score was “low” for all turbine options. Vulnerability to displacement is “medium” because Northern Gannets are known to avoid offshore wind developments (Table 3-28).

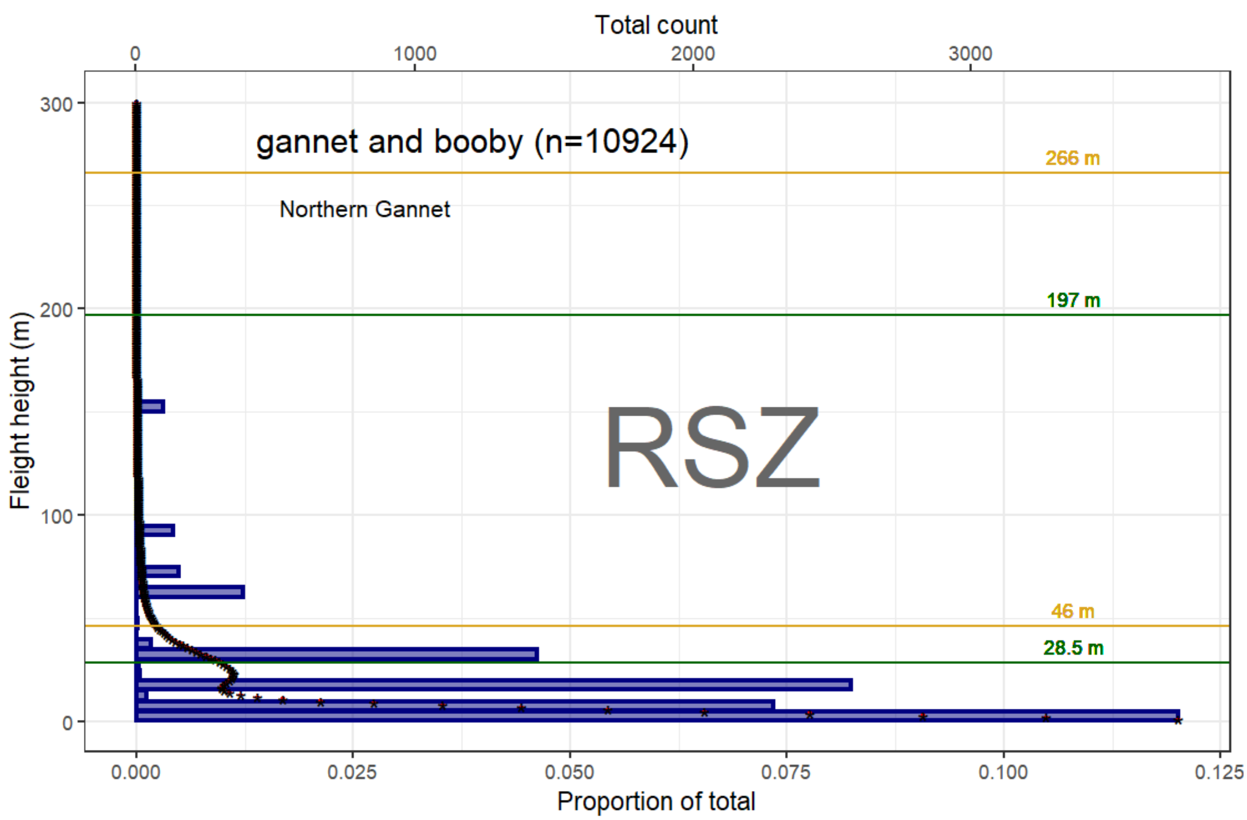

Figure 3-25: Flight heights of Northern Gannets (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

Table 3-28: Summary of Northern Gannet vulnerability. CV = collision vulnerability; DV = displacement vulnerability; PV = population vulnerability.

Species	Collision Vulnerability (CV)		DV	PV
	Minimum RSZ	Maximum RSZ		
Northern Gannet	Low (0.4)	Low (0.4)	Medium (0.6)	Low (0.47)

3.10.5.1.4 Risk Analysis

This analysis suggests that the risk of potential impacts to the Northern Gannet population is “minimal” to “low” because, overall, these birds have minimal to low exposure, both spatially and temporally, low vulnerability to collision, and medium vulnerability to displacement. However, there is uncertainty about how displacement will affect individual fitness (e.g., will it increase energy expenditure due to avoidance). 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. Since the Northern Gannet had a low population vulnerability score, the final risk score was not adjusted.

3.10.5.2 Cormorants

3.10.5.2.1 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. 2000). Double-crested Cormorants tend to forage and roost close to shore. The regional MDAT abundance models show that cormorants are concentrated closer to shore and not commonly encountered offshore. This aligns with the literature, which indicates these birds rarely use the offshore environment (Dorr et al. 2014).

3.10.5.2.2 Exposure Assessment

Exposure was assessed using species accounts, OSAMP survey data, and MDAT models. Exposure is considered to be “minimal” to “low” for cormorants based upon the exposure score (Table 3-29), and few to no cormorants were observed within the Lease Area during the OSAMP surveys (Table 3-19).

Table 3-29: Number of species in each exposure category by season for cormorants.

Taxonomic Group	Season	Minimal	Low	Medium	High
Cormorants	Winter	2	·	·	·
	Spring	2	·	·	·
	Summer	1	1	·	·
	Fall	1	1	·	·

3.10.5.2.3 Relative Behavioral Vulnerability Assessment

Cormorants have been documented to be attracted to wind turbines (Krijgsveld et al. 2011, Lindeboom et al. 2011), often fly through the RSZ (18–31% within the RSZ depending on turbine option; Figure 3-26), rank in the middle of collision vulnerability assessments (Furness et al. 2013), and received a high collision vulnerability score (Table 3-30). Based upon the evidence, the risk to cormorants is from collision, as there is little evidence to suggest they will be displaced by offshore wind farms. Vulnerability to collision is "medium" because, while there is evidence that cormorants may be vulnerable to collision, there have been no observations of collision for this group (Table 3-30).

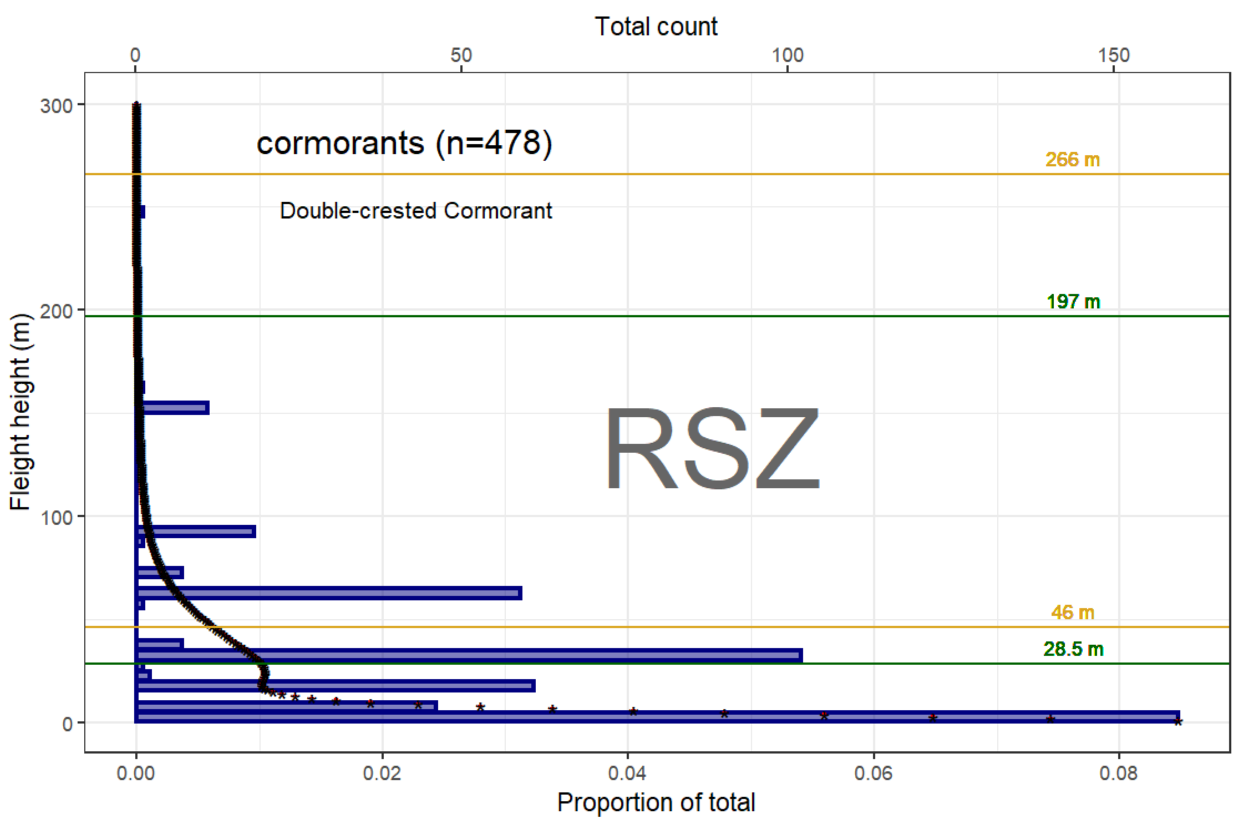

Figure 3-26: Flight heights of cormorants (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

Table 3-30: Summary of Double-crested Cormorant vulnerability. CV = collision vulnerability; DV = displacement vulnerability; PV = population vulnerability.

Species	Collision Vulnerability (CV)		DV	PV
	Minimum RSZ	Maximum RSZ		
Double-crested Cormorant	Medium (0.73)	Medium (0.6)	Low (0.4)	Minimal (0.13)

3.10.5.2.4 Risk Analysis

This analysis suggests that the risk of potential impacts to cormorants is “minimal” to “low” because, overall, these birds have minimal to low exposure, both spatially and temporally. However, since the Double-crested Cormorant had a minimal population vulnerability score, the final risk score was adjusted down to a final “minimal” score.

3.10.6 Gulls, Skuas, and Jaegers

3.10.6.1 Spatiotemporal Context

There are 12 species of gulls, skuas, and jaegers that could be exposed to the Project’s Lease Area, but only six species in this group were positively identified in the OSAMP surveys. No skuas or jaegers were observed within the Lease Area, likely because these species prefer pelagic waters far from shore. The regional MDAT abundance models show that birds within this group have a wide distribution ranging from near shore (gulls) to offshore (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).

3.10.6.2 Exposure Assessment

Exposure was assessed using species accounts, OSAMP survey data, and MDAT models. Exposure ratings for gulls are assigned at “minimal” to “medium” (Table 3-31). The average counts/km for gull species within the Lease Area were mostly lower than those in the OSAMP survey area (Table 3-19).

Table 3-31: Number of species in each exposure category by season for small, medium, large, and all gulls.

Taxonomic Group	Season	Minimal	Low	Medium	High
Small gulls	Winter	1	·	·	·
	Spring	1	·	·	·
	Summer	1	·	·	·
	Fall	·	1	·	·
Medium gulls	Winter	3	·	·	·
	Spring	2	1	·	·
	Summer	2	1	·	·

Taxonomic Group	Season	Minimal	Low	Medium	High
	Fall	2	·	1	·
Large gulls	Winter	·	2	·	·
	Spring	·	2	·	·
	Summer	·	2	·	·
	Fall	1	1	·	·
All gulls	Winter	4	2		
	Spring	3	3		
	Summer	3	3		
	Fall	3	2	1	

3.10.6.3 Relative Behavioral Vulnerability Assessment

Gulls are considered to be vulnerable to collision but not displacement. 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). Gulls ranks at the top of collision vulnerability assessments because they can fly within the RSZ (Johnston et al. 2014), have been document to be attracted to turbines (Vanermen et al. 2015), and individual birds have been documented to collide with turbines (Skov et al. 2018). Tetra Tech conducted a beached-bird survey at Block Island Wind before construction, during construction, and post-construction for the from June 2015 to July 2017, and in 2019: there was not an increase in carcasses found post-construction as compared to baseline monitoring, and 2017 had the lowest bird carcass per search rate observed during the beached-bird survey period (Tetra Tech 2017). The flight heights for this group in the Northwest Atlantic Seabird Catalog indicated that they can fly within the RSZ (gulls = 0–22%, skuas and jaegers = 3–8% of the time depending on species and turbine option; Figure 3-27, Figure 3-28, Figure 3-29). 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 the wind farm, but will preferentially fly between turbines, suggesting meso-avoidance that would reduce overall collision risk (Thaxter et al. 2018). The collision vulnerability (CV) scores were “low” to “medium” for all species except Laughing Gull, which received a “low” score for two options; the displacement vulnerability score was “low” to “medium (Table 3-32).

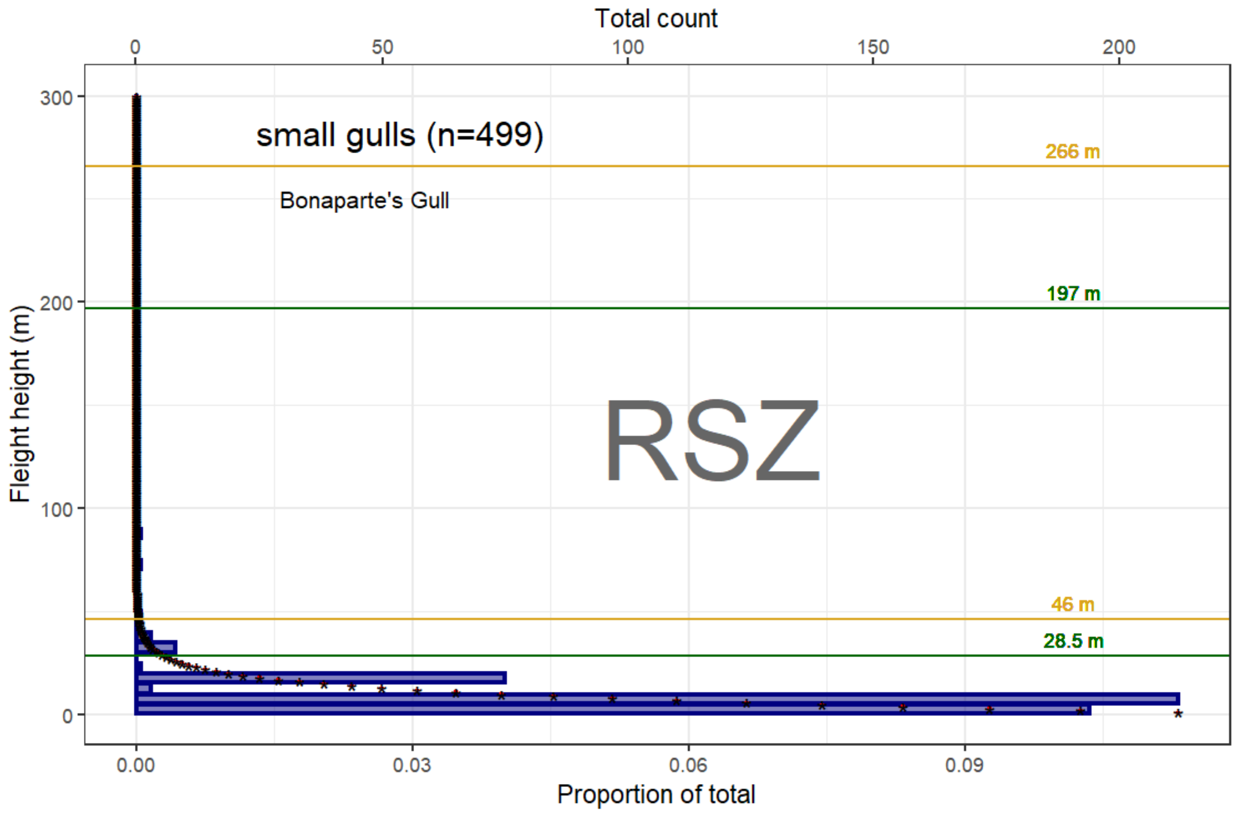

Figure 3-27: Flight heights of small gulls (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

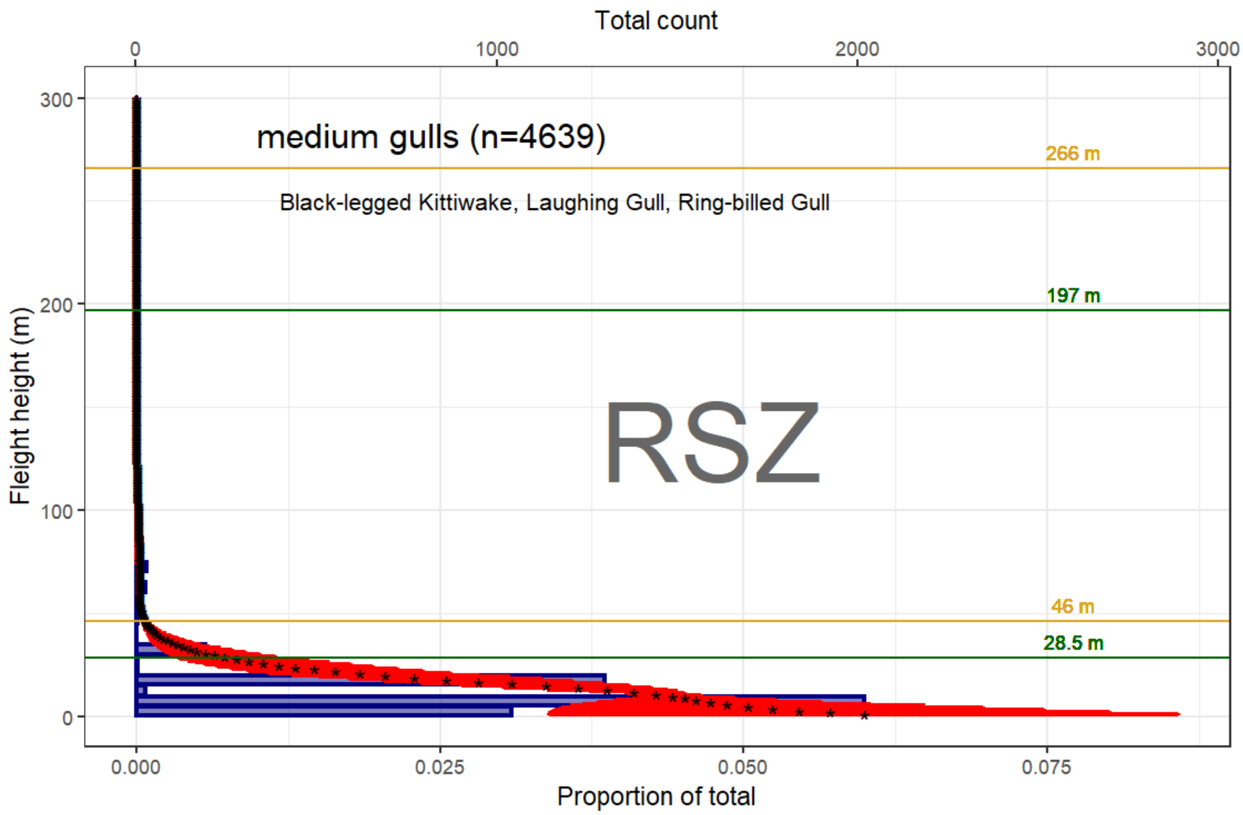

Figure 3-28: Flight heights of medium gulls (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

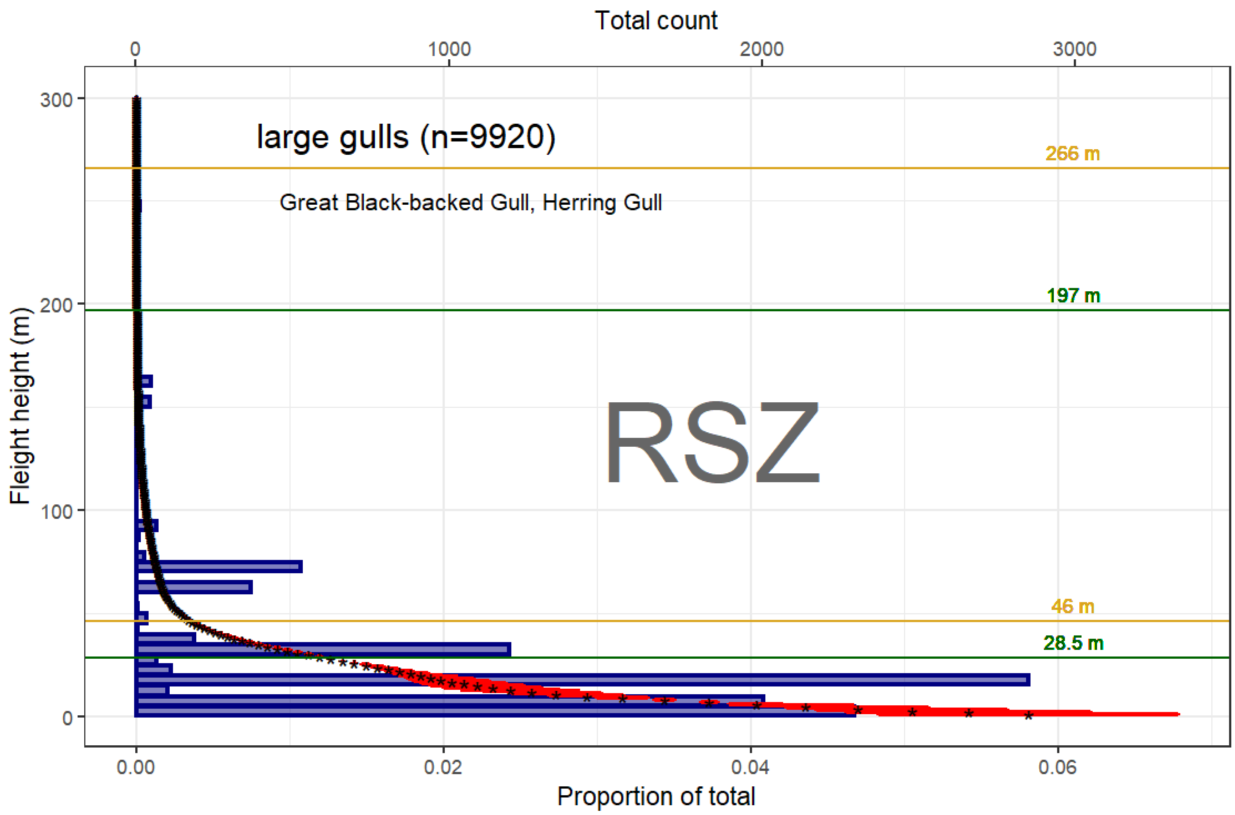

Figure 3-29: Flight heights of large gulls (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

Table 3-32: Summary of gull vulnerability. CV = collision vulnerability; DV = displacement vulnerability; PV = population vulnerability.

Taxonomic Group	Species	Collision Vulnerability (CV)		DV	PV
		Minimum RSZ	Maximum RSZ		
Small gulls	Bonaparte's Gull	Low (0.4)	Low (0.4)	Medium (0.5)	Low (0.33)
Medium gulls	Black-legged Kittiwake	Medium (0.6)	Low (0.47)	Medium (0.6)	Low (0.33)
	Laughing Gull	Low (0.47)	Low (0.47)	Medium (0.5)	Low (0.4)
	Ring-billed Gull	Medium (0.67)	Medium (0.53)	Low (0.4)	Low (0.33)
Large gulls	Herring Gull	Medium (0.63)	Medium (0.5)	Medium (0.5)	Medium (0.53)
	Great Black-backed Gull	Medium (0.57)	Low (0.43)	Medium (0.7)	Minimal (0.2)

3.10.6.4 Risk Analysis

This analysis suggests that risk of potential impacts to gull populations is "minimal" to "medium". Overall these birds have minimal to medium exposure and low to medium vulnerability to collision. However, population-level impacts are unlikely because most gull groups received a minimal to low exposure score; medium exposure is limited to the fall; recent research suggest that they may exhibit meso-avoidance; and resident gull populations are robust and generally show high reproductive success (Good 1998, Pollet et al. 2012, Burger 2015, Nisbet et al. 2017). Since the gulls had a minimal to medium population vulnerability score, the final risk score was not adjusted. Great-black Backed Gulls did have a minimal population vulnerability score, so the final risk level for this species is reduced to "minimal".

3.10.7 Terns

3.10.7.1 Spatiotemporal Context

Four tern species (Arctic Tern, Common Tern, Roseate Tern, and Least Tern) are present during the spring, summer, and fall in Rhode Island, although only low numbers of Common Terns and Unidentified terns were observed during the OSAMP surveys. All of these species are listed at the state and/or federal level (Table 3-33). Terns generally restrict themselves to coastal waters during breeding, although they may pass through the Lease Area on their migratory journeys. Roseate Terns are federally listed as well as state listed and are addressed in detail below.

Table 3-33: Conservation status of tern species in state and federal listings. E = Endangered, T = Threatened, SC = Special Concern.

Species	Federal status	RI status	MA status
Arctic Tern	SC	.	SC
Common Tern	.	.	SC
Roseate Tern	E	E	E
Least Tern	SC	T	SC

3.10.7.2 Exposure Assessment

Exposure was assessed using species accounts, OSAMP survey data, and MDAT models. A recent study used nanotags to track Common Terns tagged in New York and Massachusetts. 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, 22 of the tracked birds (*n*=257) were estimated to pass through the northern portion of the Rhode Island/Massachusetts Lease Area (Loring et al. 2019). Exposure is considered to be "low" to "medium" because, while tern exposure score was low (Table 3-34) and the average counts within the Lease Area were lower than the OSAMP survey area (Table 3-19), the northern portion of the Lease Area has been identified in the nanotag study as having a higher probability density of exposure (Figure 3-30).

Table 3-34: Number of species in each exposure category by season for terns.

Taxonomic Group	Season	Minimal	Low	Medium	High
Medium terns	Winter	1	·	·	·
	Spring	·	1	·	·
	Summer	·	1	·	·
	Fall	·	1	·	·

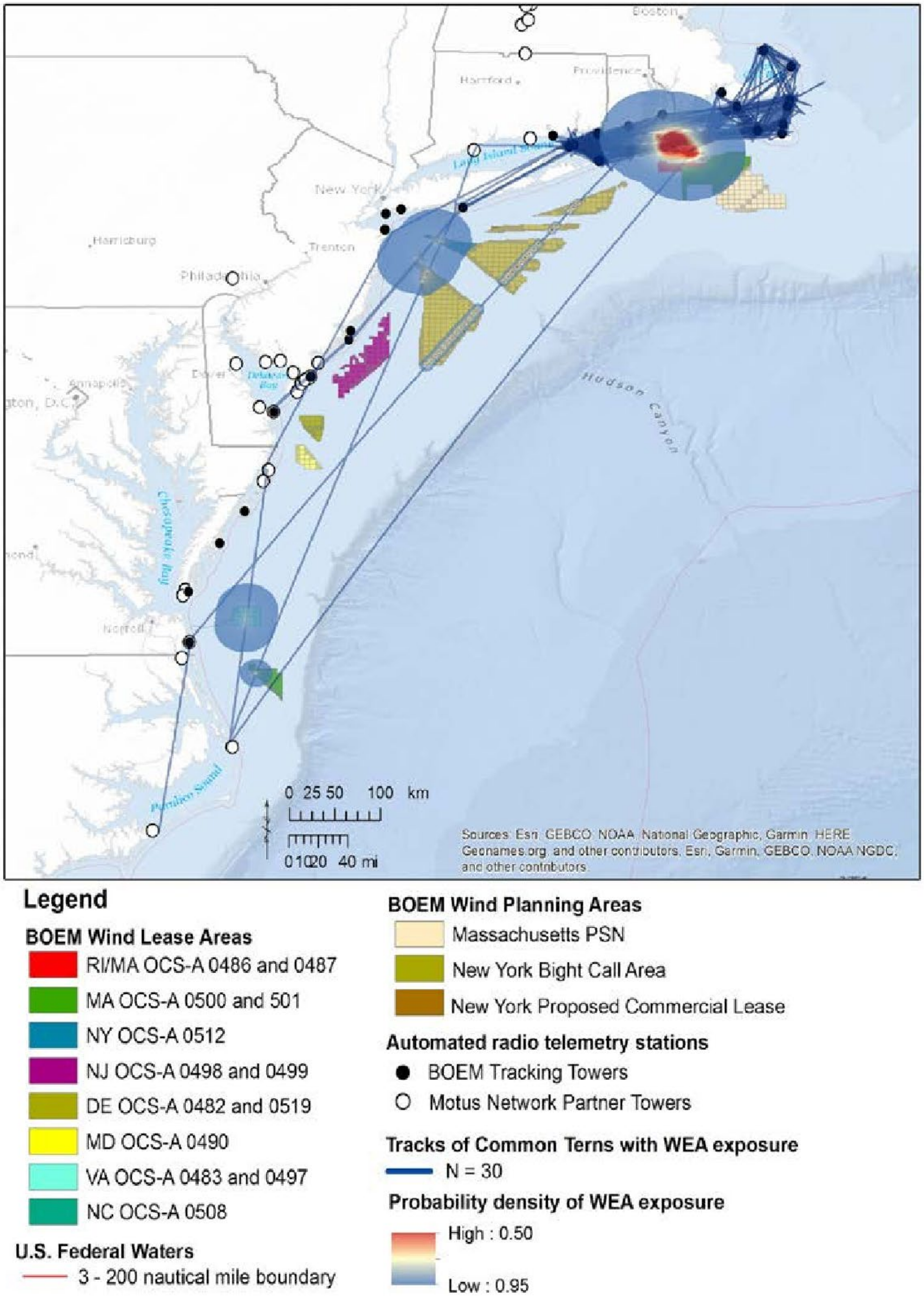

Figure 3-30: Track densities of Commons Terns (*n*=30) tracked with nanotags from Great Gull Island during the breeding and post-breeding period from 2015–2017 (from Loring et al. 2019a). The estimated tracks of 22 birds passed through the Lease Area.

3.10.7.3 Relative Behavioral Vulnerability Assessment

Terns rank in the middle of collision vulnerability assessments (Garthe and Hüppop 2004, Furness et al. 2013) and fly 2.8–12.7% between the heights of 66–492 ft (20–150 m). Common Tern flight heights recorded in the Northwest Atlantic Seabird Catalog indicate terns fly within the RSZ 0–1% of the time in the smaller turbine option only (Figure 3-31). 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 higher altitudes, 3,000–10,000 ft (1,000–3,000 m; Loring et al. 2019a). The probability of tern mortality due to collision is predicted to decline as the distance of wind turbines from the colony increases (Cranmer et al. 2017). 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 up to ~98 ft (30 m) from nests (Burger et al. 2011). Terns may also be vulnerable to displacement since they have been identified to have a 30–69.5% macro-avoidance rate (Cook et al. 2012). Common Terns and Roseate Terns have been demonstrated to avoid the airspace around a 660 kW turbine (rotor-tip height: 240 ft [73 m]; Massachusetts Maritime Academy in the U.S.) when the turbine was rotating and usually avoided the RSZ (Vlietstra 2007).

The assigned collision vulnerability (CV) score for terns is “low”; the displacement score is “high”. Common 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 because Willmott et al. (2013) categorized tern avoidance as greater than 40%. A lower range was added to the DV score because terns received a “low” disturbance score according to Wade et al. (2016); are determined to have a 30% macro avoidance of turbines at Egmond aan Zee (Cook et al. 2012); have high uncertainty scores; and displacement in terns has not been well studied (Table 3-35).

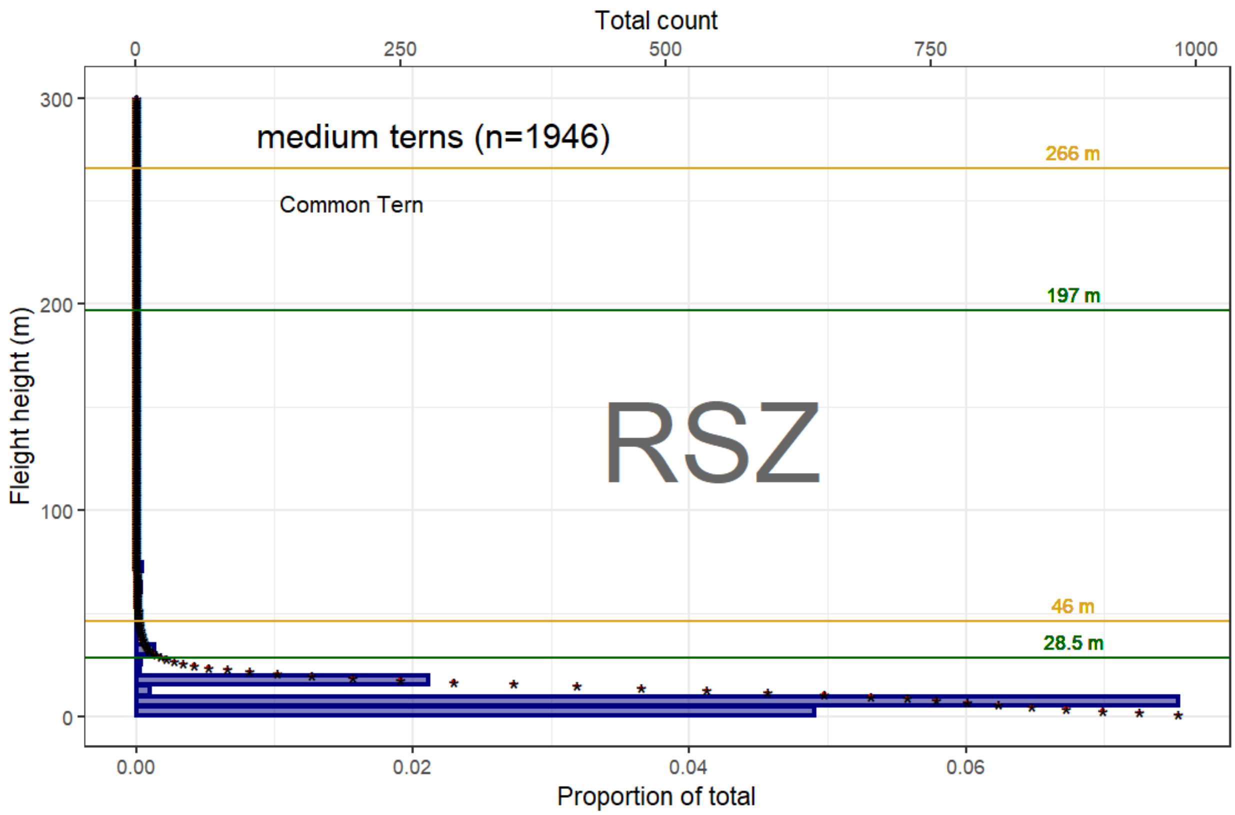

Figure 3-31: Flight heights of medium terns (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8–10 MW turbine (dark green), and a 12 MW turbine (gold).

Table 3-35: Summary of tern vulnerability. CV = collision vulnerability; DV = displacement vulnerability; PV = population vulnerability.

Taxonomic Group	Species	Collision Vulnerability (CV)		DV	PV
		Minimum RSZ	Maximum RSZ		
Medium terns	Common Tern	Low (0.33)	Low (0.33)	Medium–High (0.8)	Medium (0.67)

3.10.7.4 Risk Analysis

This analysis suggests that the risk of potential effects to Common Tern populations from collisions is “low” and that risk of effects from displacement is “low” to “medium”. However, there is uncertainty about how displacement will affect individual fitness (e.g., will it increase energy expenditure due to avoidance). 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. Since Common Terns had a medium population vulnerability score, the final risk score was not adjusted.

3.10.7.5 Endangered Tern Species

3.10.7.5.1 Roseate Tern

3.10.7.5.2 Spatiotemporal Context

The Roseate Tern (*Sterna dougallii*) is a small seabird that breeds colonially on coastal islands. The northwest Atlantic Ocean population has been federally listed as Endangered under the ESA since 1987. This population breeds in the northeastern United States and Atlantic Canada, and winters in South America, primarily eastern Brazil (U.S. Fish and Wildlife Service 2010, Nisbet et al. 2014). Declines have been largely attributed to low productivity, partially related to predators and habitat loss and degradation, though adult survival is also 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; (Nisbet et al. 2014, Loring et al. 2017).

Roseate Terns generally migrate along the Atlantic coast and arrive at their northwest Atlantic breeding colonies in late April to late May, with nesting occurring between roughly mid-May and late July. During breeding, Roseate Terns generally stay within about 6 mi (~10 km) of the colony, though they may travel 19–31 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 approximately late July to mid-September (U.S. Fish and Wildlife Service 2010). Foraging activity during the staging period is known to occur up to 10 mi (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 well offshore (Nisbet 1984, U.S. Fish and Wildlife Service 2010, Burger et al. 2011, Mostello et al. 2014, Nisbet et al. 2014). A recent nanotag tracking study (Loring et al. 2019) indicates that eight (of 90 total) tracked Roseate Terns passed through the northern portion of the Lease Area (Figure 3-33).

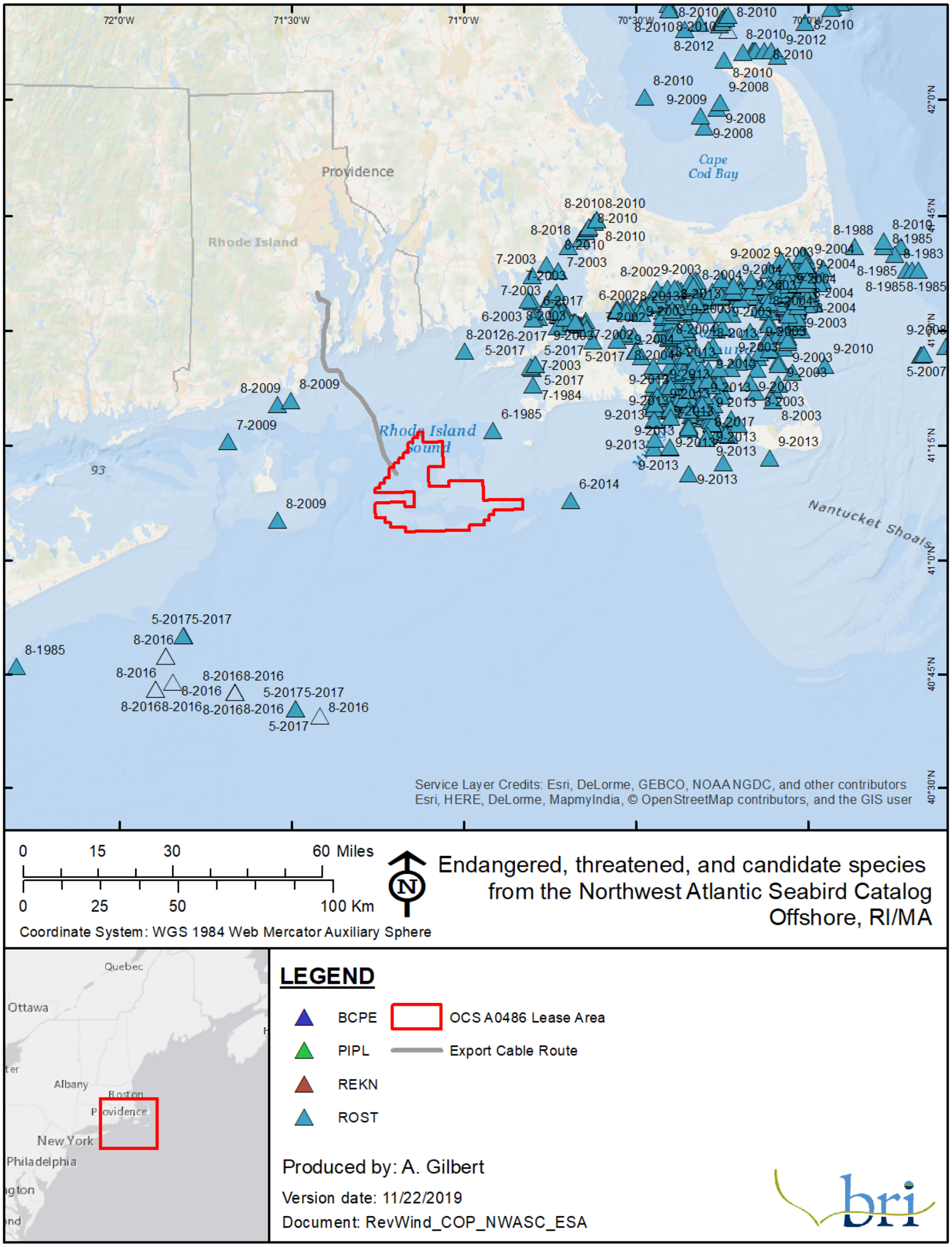

Figure 3-32: Locations of observations of Roseate Terns and other listed or candidate avian species from the Northwest Atlantic Seabird Catalog. BCPE = Black-capped Petrel, PIPL = Piping Plover, REKN = Red Knot, ROST = Roseate Tern.

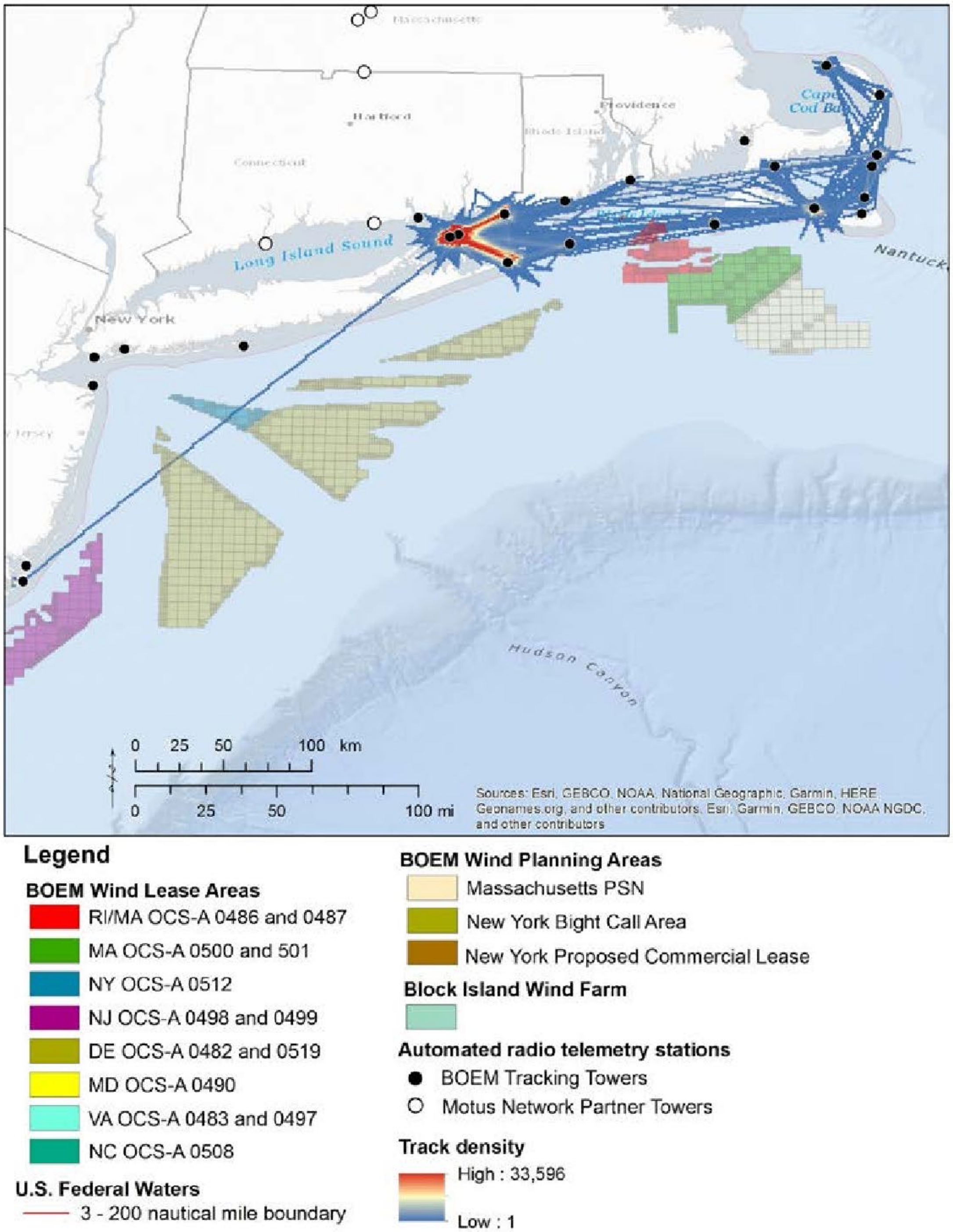

Figure 3-33: Track densities of Roseate Terns (n=90) tracked with nanotags from Great Gull Island during the breeding and post-breeding period from 2015-2017 (from Loring et al. 2019a). The estimated tracks of 8 birds passed through the Lease Area.

3.10.7.5.3 Exposure Assessment

Exposure was assessed using species accounts, tracking studies, OSAMP survey data, and MDAT models. Roseate Terns have not been confirmed in the Lease Area (Figure 3-32) and an analysis of unknown tern observations in the Northwest Atlantic Seabird Catalog from within the OSAMP study area and the Lease Area indicate few, if any, of the unknowns were likely Roseate Tern[7]. A recent study used nanotags to track Roseate Terns tagged in Massachusetts. 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, eight of the tracked birds (*n*=145) were estimates to pass through the northern portions of the Lease Area (Loring et al. 2019). Thus, they display limited spatial and temporal exposure, and the expected exposure of Roseate Terns is "minimal" to "low".

3.10.7.5.4 Relative Behavioral Vulnerability Assessment

Compared to other marine birds, terns rank in the middle of collision vulnerability assessments (Furness et al. 2013); they fly less than 13 % of between 66–492 ft (20–150 m; Cook et al. 2012), and avoid rotating 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 onshore turbine in Buzzard's Bay, Massachusetts found no tern mortalities, though Common Terns regularly flew within 50 m of the turbine. Terns may detect turbine blades during operation, both visually and acoustically, and avoided flying between turbine rotors while they were in motion (Vlietstra 2007, Minerals Management Service 2008).

Tern flight height during foraging is typically low, and European studies of related tern species at much smaller turbines (than those being considered for the Project) have suggested that approximately 4–10 % of birds may fly at rotor height (66–492 ft; 20–150 m) 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). Common Terns are known to migrate over land at considerable heights (3,000–10,000 ft; 1,000–3,000 m), though strong headwinds cause a change in migration strategy, with birds flying along coastlines and near sea level (Alerstam 1985). The altitude at which Roseate Terns migrate 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.

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[7] To determine if unknown tern observations in the Northwest Atlantic Seabird Catalog were potentially Roseate Terns, the following analysis was conducted:
Step 1: All available tern data from the Northwest Atlantic Seabird Catalog database were cut down to the OSAMP study area.
Step 2: The proportion of Roseate Terns to all identified terns was calculated (0.034).
Step 3: The proportion from step 2 was applied to the count of 272 unidentified terns in the OSAMP area and 4 in the Lease Area, assuming the same proportions of terns in unknown data apply.
Result: This returns an estimate of 9.2 additional Roseate Tern that could have occurred in the OSAMP study area and 0.14 in the Lease Area.

2004, Minerals Management Service 2008). A recent nanotag study estimated that terns primarily flew below a hypothetical RSZ of 82 ft (25 m) and that Roseate Terns flying offshore only occasionally flew within the lower portion of the RSZ (federal waters, 6.4 %; Wind Energy Areas, 0%; Loring et al. 2019a). Furthermore, in their Biological Assessment for the proposed Vineyard Wind Farm, BOEM concluded that Roseate Tern mortality from collision would be zero and that the likelihood of collision fatalities would be "insignificant and discountable" (Bureau of Ocean Energy Management 2019).

There were too few Roseate Tern observations in the Northwest Atlantic Seabird Catalog to estimate flight heights. 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 meters; Perkins et al. 2004).

Since there is little data on Roseate Tern flight height and proportion of time flying, Common Tern was used as a surrogate. Common Tern received a CV score of "low" for all turbine options; and a DV score of "medium" to "high" (Table 3-35). In addition, Wade et al. (2016) determined for Roseate Tern "very high" and "high" uncertainty for flight heights and displacement. Roseate Tern collision vulnerability may even be lower than these scores, because modeled nanotag data indicated terns generally fly below the RSZ and potentially avoid rotating turbines (Figure 3-34).

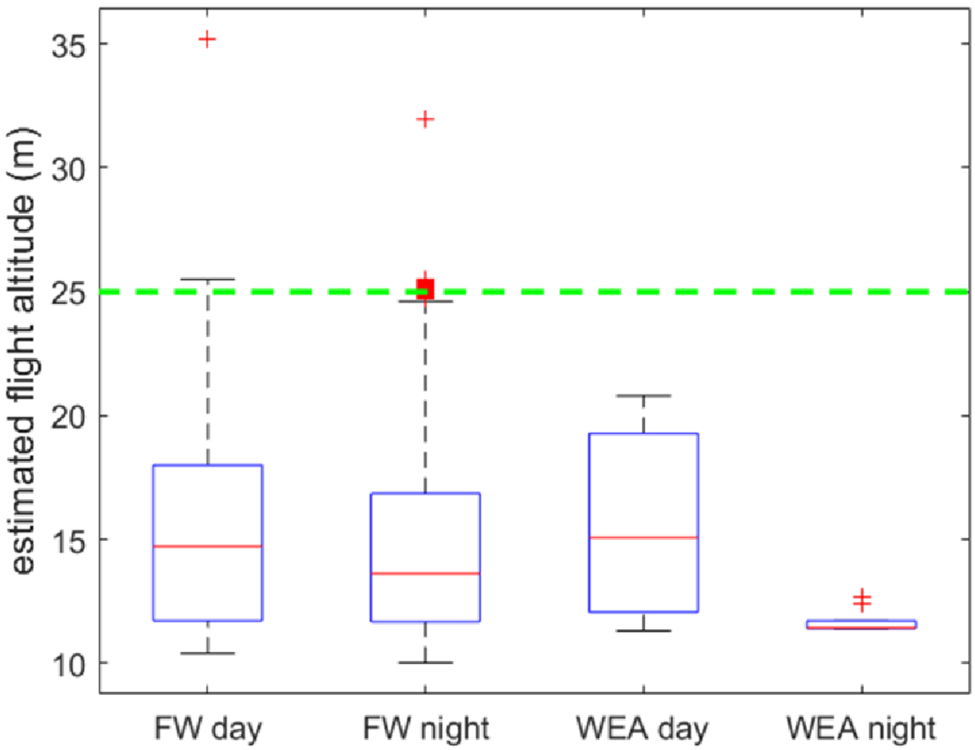

Figure 3-34. Model estimated flight altitude ranges (m) of Roseate Terns during exposure to Federal Waters (FW) and Wind Energy Areas (WEAs) during day and night (from Loring et al. 2019). The green dashed line represents the lower limit of a hypothetical RSZ (25 m), which is considerably lower than the lower option proposed for the Lease Area.

3.10.7.5.5 Risk

This analysis suggests that the risk of potential impacts to individual Roseate Terns is “minimal” to “low”, because these birds have minimal to low exposure, both spatially and temporally, and low vulnerability to collision. However, since Roseate Terns have a high population vulnerability score, the final risk score was adjusted to “low”. This finding is supported by the results of a collision risk model carried out by BOEM for Roseate Terns potentially passing through the proposed nearby Vineyard Wind Offshore Wind Energy Project (a proposed 80-100 WTG project located approximately 16 mi [14 nm] to the southeast) that estimated the annual number of fatalities as zero and that any extra energy expenditure resulting from the avoidance of an offshore wind farm by Roseate Terns would be insignificant (Bureau of Ocean Energy Management 2019).

3.10.8 Auks

3.10.8.1 Spatiotemporal Context

The auk species present on the Atlantic coast are generally northern or Arctic-breeders that winter along the U.S. Atlantic Outer Continental Shelf, including offshore waters off of Rhode Island. 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 further south than usual. The MDAT abundance models show that auks are concentrated offshore and south of Nova Scotia (see maps in Part VI).

3.10.8.2 Exposure Assessment

Exposure was assessed using species accounts, OSAMP survey data, and MDAT models. Exposure for auks is considered to be "minimal" to "medium" based upon the exposure score (Table 3-36).

Table 3-36: Number of species in each exposure category by season for auks.

Taxonomic Group	Season	Minimal	Low	Medium	High
Auks	Winter	1	1	1	·
	Spring	1	1	1	·
	Summer	3	·	·	·
	Fall	2	1	·	·

3.10.8.3 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, Dierschke et al. 2016, Wade et al. 2016). Studies in Europe have documented varying levels of displacement with rates ranging from no apparent displacement to 70% (Ørsted 2018). Auks have a 45–68% macro-avoidance rate and a 99.2% total avoidance rate (Cook et al. 2012). At considerably smaller turbines (than those being considered for 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 indicates extremely limited exposure, if any, to the RSZ (0% of the time within the RSZ; Figure 3-35). The collision vulnerability (CV) for all turbine options and species of auks is rated as "minimal"; displacement vulnerability (DV) ranges from "medium" to "high" depending on the species (Table 3-37).

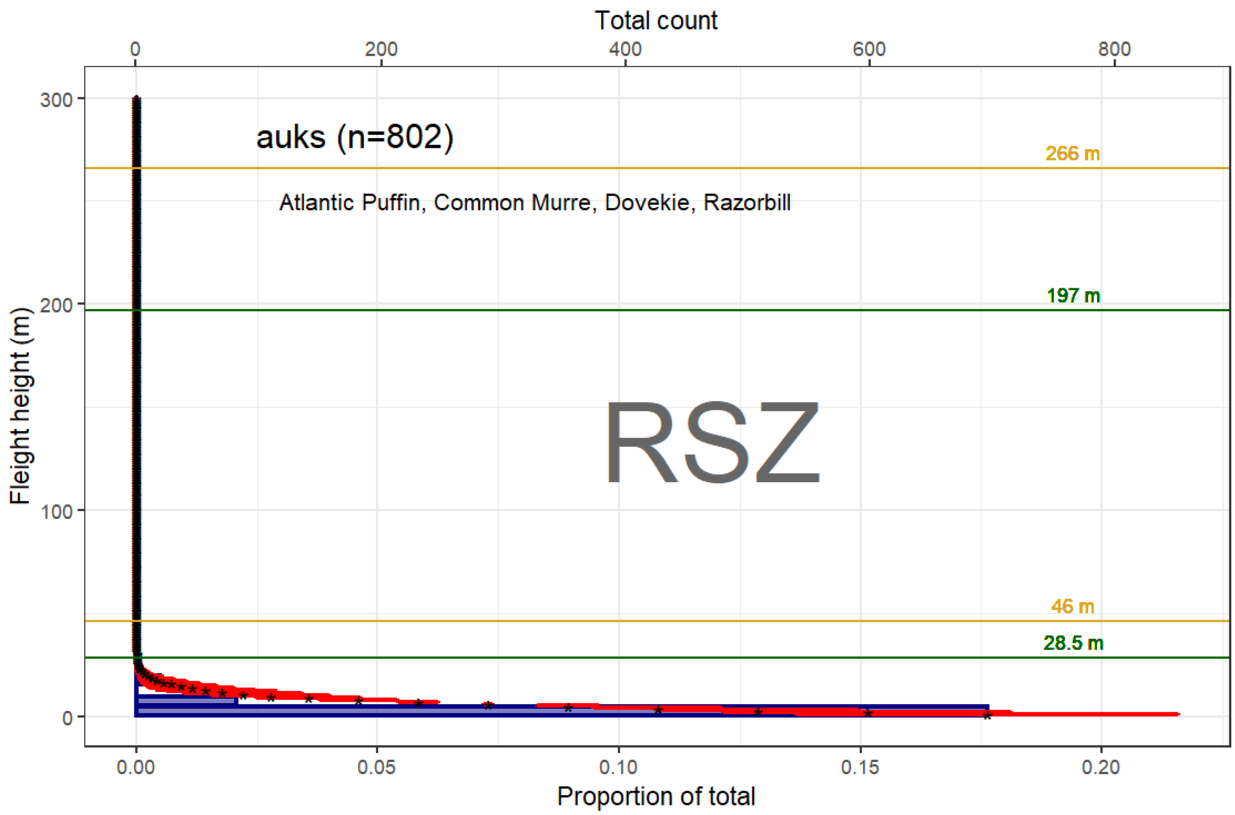

Figure 3-35. Flight heights of auks (m) derived from the Northwest Atlantic Seabird Catalog, showing the actual number of birds in 5 m intervals (blue bars), and the modeled average flight height in 1 m intervals (asterisk) and the standard deviation (red lines), in relation to the upper and lower limits of the Rotor Swept Zone (RSZ) for an 8-10 MW turbine (dark green), and a 12 MW turbine (gold).

Table 3-37: Summary of auk vulnerability. CV = collision vulnerability; DV = displacement vulnerability; PV = population vulnerability.

Taxonomic Group	Species	Collision Vulnerability		DV	PV
		Minimum RSZ	Maximum RSZ		
Auks	Atlantic Puffin	Minimal (0.2)	Minimal (0.2)	High (0.8)	Medium (0.53)
	Common Murre	Minimal (0.23)	Minimal (0.23)	High (0.8)	Low (0.4)
	Dovekie	Minimal (0.23)	Minimal (0.23)	Medium (0.7)	Low (0.4)
	Razorbill	Minimal (0.2)	Minimal (0.2)	High (0.8)	Medium (0.6)

3.10.8.4 Risk Analysis

This analysis suggests that the potential for impacts to auk populations is “minimal” to “medium” because the birds have minimal to medium exposure and medium to high vulnerability to displacement due to avoidance behaviors. However, there is uncertainty about how displacement will affect individual fitness (e.g., will it increase energy expenditure due to avoidance). 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. Since auks have a "medium" population vulnerability score, the final risk score was not adjusted.

3.11 Mitigation

In general, exposure of bird populations has been avoided by siting the Project offshore in an offshore Wind Energy Area designated by BOEM. To minimize or mitigate the potential for bird strikes and habitat loss, the Project will use best practices identified in the Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (Bureau of Ocean Energy Management (BOEM) 2016). These include:

- Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.2 mi (1 nm) by 1.2 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This wide spacing of WTGs will allow avian species to avoid individual WTGs and minimize risk of potential collision.
- Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations.
- Revolution Wind will comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian species.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (see Appendix D of the Project's COP).

Revolution Wind is developing an avian post-construction monitoring plan for the Project that will summarize the approach to monitoring; describe overarching monitoring goals and objectives; identify the key avian species, priority questions, and data gaps unique to the region and Project Area that will be addressed through monitoring; and describe methods and time frames for data collection, analysis, and reporting. Post-construction monitoring will assess impacts of the Project with the purpose of filling select information gaps and supporting validation of the Project's Avian Risk Assessment. Focus may be placed on improving knowledge of ESA-listed species occurrence and movements offshore, avian collision risk, species/species-group displacement, or similar topics. Where possible, monitoring conducted by Revolution Wind will build on and align with post-construction monitoring conducted by the other Orsted/Eversource offshore wind projects in the Northeast region. Revolution Wind will engage with federal and state agencies and environmental groups (eNGOs) to identify appropriate monitoring options and technologies, and to facilitate acceptance of the final plan.

Following the mitigation measures detailed in the Vineyard Wind Biological Assessment (BOEM 2019), Revolution Wind will provide an annual report to BOEM and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, O&M, and decommissioning. The report will contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with Federal or research bands will be reported to the United States Geological Survey Bird Band Laboratory, available at https://www.pwrc.usgs.gov/bbl/.

3.12 Summary and Conclusions

This assessment considered the potential impacts on birds during construction and operation of Project components within the Lease Area. Any exposure of birds to construction activities is considered temporary. Overall, construction and operation activities occurring in the Lease Area are not expected to affect the populations of coastal or marine birds (Table 3-38).

The Lease Area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species. Coastal birds that may forage in the Lease Area occasionally, visit the area sporadically, or pass through on their spring and/or fall migrations, include shorebirds (e.g., sandpipers, plovers), waterbirds (e.g., cormorants, grebes), waterfowl (e.g., scoters, mergansers), wading birds (e.g., herons, egrets), raptors (e.g., falcons, eagles), and songbirds (e.g., warblers, sparrows). Overall, with the exception of migratory falcons and songbirds, coastal birds are considered to have minimal exposure to the Lease Area. Falcons, primarily Peregrine Falcons, may be exposed to the Lease Area. Some migratory songbirds, particularly Blackpoll Warbler, may also be exposed to the Lease Area during fall migration, but population-level impacts are unlikely because exposure of the population to the Lease Area is expected to be minimal to low and limited to migration.

Of the marine birds, loons, sea ducks, gulls, terns, and auks received up to medium overall exposure assessment. Loons, sea ducks, gannets, and auks are documented to avoid wind farms, but displacement from the Lease Area is unlikely to affect populations because there is likely available foraging habitat outside the Lease Area.

Federally listed/protected species were also assessed, including the Golden Eagle, Bald Eagle, Red Knot, Piping Plover, and Roseate Tern. The Project is not expected to affect listed species populations. Eagle exposure to the Lease Area is considered minimal because these species are rarely detected in the offshore environment. Red Knots and Piping Plovers have the potential to be exposed only during migration and vulnerability to collision is considered low because shorebirds fly substantially above the RSZ during migrations. While tracked Roseate Terns were estimated to have passed through the northern portion of the Lease Area, individual impacts are unlikely because the birds were not detected in the Lease Area during surveys and they are expected to be primarily flying below the RSZ. Black-capped Petrels are highly unlikely to pass through the Lease Area, and are considered to have low vulnerability to collision because they are expected to fly below the RSZ.

Table 3-38: Overall summary of the assessment of potential effects on birds. The columns detailing vulnerability to collision, provide separate assessments for the two turbine options being considered by the Project detailed in Table 3-8, Section 3.2.5.2..

Group	Exposure	Relative Vulnerability to					Collision Risk Option Range	Displacement Risk
		Collision		Displacement		Population		
		Minimum RSZ	Maximum RSZ	Temporary	Permanent			
Shorebirds	min	.	.	.	.	.	**.**	**.**
Piping Plover	low – med	min – low	min – low	min	min	medium	**min – low**	**min.**
Red Knot	low – med	low	low	min	min	medium	**low**	**min.**
Wading Birds	min	.	.	.	.	.	**.**	**.**
Raptors (falcons)	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**
Coastal Waterbirds	min	.	.	.	.	.	**.**	**.**
Marine Birds		.						
Loons	low – med	min – low	min – low	high	high	low – med	**min – low**	**low – med**
Sea Ducks	min – med	min – low[1]	min – low[1]	high[1]	med[1]	low – med	**min – low**	**med**
Shearwaters, Petrels & Storm-Petrels	min – low	low	low	low – med	low – med	low – med	**min – low**	**min – low**
Black-capped Petrel	min	low	low	low – med	low – med	medium	**min**	**min**
Gannets & Cormorants								
Northern Gannet	min – low	low	low	med	med	low	**min – low**	**min – low**
Double-crested Cormorant	min – low	med	med	low	low	min	**min**	**min**
Gulls	min – med	low – med	low – med	low – med	low – med	min – med	**min – med**	**min – med**
Terns								
Common Tern	low – med	low	low	med – high	med – high	med	**low**	**low – med**
Roseate Tern	min – low	low	low	med – high	med – high	high	**low**	**low**
Auks	min – med	min	min	med – high	med – high	low – med	**min**	**min – med**

[1]Excluding Red-breasted Merganser

4 Part IV: References

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5 Part V: Supporting Information.

Table V-1: Seasonal and annual effort corrected counts (count/km of survey transect) for all species or unidentified species groups within the OCS-A-0486 Lease Area and the OSAMP aerial survey area.

		Mean effort corrected count (count/km)											
		Lease Area					OSAMP aerial survey area						
Taxonomic Grouping	Species	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	Num. obs	Total count
Ducks, Geese, and Swans	Brant	0	0	0	0	0	<0.001	0	0.001	0	0	1	7
Sea Ducks	Black Scoter	0	0	0	0	0	0.071	0.044	0.214	0	0.015	22	575
	Common Eider	<0.001	0	0.002	0	0	0.038	0.114	0.014	0	<0.001	38	277
	Long-tailed Duck	0.002	0.006	0	0	0	0.002	0.005	<0.001	0	0	12	27
	Red-breasted Merganser	0	0	0	0	0	<0.001	0	0.001	0	0	4	5
	Surf Scoter	0.006	0	0.022	0	0	0.009	0.014	0.006	0	0.025	14	158
	White-winged Scoter	0.012	0.006	0.034	0	0.004	0.012	0.023	0.009	0	0.012	62	271
	Unidentified scoter	0.122	0.310	0.037	0	0.023	0.430	1.235	0.110	0	0.003	86	8621
Shorebirds	Unidentified shorebird	0	0	0	0	0	0.002	0	0.003	0.004	0	10	44
Phalaropes	Red-necked Phalarope	0	0	0	0	0	<0.001	0	0	0	0.004	1	15
	Unidentified Phalarope	0	0	0	0	0	<0.001	0	0	0	0.004	2	13
Skuas and Jaegers	Unidentified jaeger	0	0	0	0	0	<0.001	0	<0.001	0	<0.001	2	2
Auks	Common Murre	0.039	0.099	0.021	0	0	0.028	0.077	0.008	0	<0.001	299	563
	Dovekie	0.007	0.020	0.005	0	0	0.016	0.045	0.006	0	0	145	282
	Razorbill	0.011	0.019	0.015	0	0	0.024	0.039	0.036	0	0.003	141	535
	Unidentified auk	0.212	0.366	0.304	0	0.003	0.194	0.373	0.252	0	0.031	1361	4118
	Unidentified murre	0.006	0.017	0	0	0	0.002	0.007	0	0	0	21	47
Small Gulls	Bonaparte's Gull	<0.001	0.002	0	0	0	<0.001	0.002	0	0	0	5	16
Medium Gulls	Black-legged Kittiwake	0.022	0.060	0.008	0	0.007	0.046	0.135	0.006	<0.001	0.003	277	983
	Laughing Gull	0.001	0	0	0	0.011	0.002	<0.001	<0.001	0.002	0.017	44	63
	Ring-billed Gull	0	0	0	0	0	<0.001	0	<0.001	0	<0.001	4	4
Large Gulls	Great Black-backed Gull	0.037	0.032	0.032	0.052	0.015	0.060	0.091	0.037	0.053	0.052	784	1358
	Herring Gull	0.038	0.055	0.033	0.023	0.037	0.209	0.220	0.090	0.109	0.601	1518	5297
All Gulls	Unidentified gull	0.016	0.044	0.001	0	0.020	1.005	0.993	1.395	0.272	1.890	267	28509
Medium Terns	Common Tern	<0.001	0	0	<0.001	0	0.003	0	<0.001	0.009	0	30	45

		Mean effort corrected count (count/km)											
		Lease Area					OSAMP aerial survey area						
Taxonomic Grouping	Species	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	Num. obs	Total count
All Terns	Unidentified tern	0.003	0	0.003	0.009	0	0.009	0	0.014	0.019	0.007	99	164
Loons	Common Loon	0.054	0.079	0.092	0	0.010	0.105	0.205	0.125	0.002	0.011	1552	1958
	Red-throated Loon	0.007	0.007	0.019	0	0	0.010	0.016	0.016	0	0.001	163	223
	Unidentified loon	0.004	0.002	0.010	0	0	0.002	0.004	0.003	0	0	41	86
Storm-Petrels	Wilson's Storm-Petrel	0.033	0	0.015	0.100	0.012	0.053	0	0.013	0.165	0.025	530	1080
Shearwaters and Petrels	Cory's Shearwater	0.020	0	0	0.069	0	0.021	0	<0.001	0.069	0.007	107	456
	Great Shearwater	0.006	0	0	0.016	0.020	0.006	<0.001	<0.001	0.011	0.026	85	165
	Manx Shearwater	0	0	0	0	0	<0.001	0	0	0	0.002	6	5
	Northern Fulmar	0.004	0.010	0	0	0.006	0.007	0.025	<0.001	0	0.004	44	93
	Sooty Shearwater	0.002	0	0	0.006	0	<0.001	0	<0.001	0.002	0.003	15	19
	Unidentified petrel	0	0	0	0	0	0	0	0	0	<0.001	1	1
	Unidentified shearwater	0.015	0	0	0.054	0	0.016	<0.001	<0.001	0.054	0.026	67	385
Gannets	Northern Gannet	0.106	0.078	0.140	0	0.371	0.351	0.637	0.252	0.003	0.659	1473	7570
Cormorants	Double-crested Cormorant	0	0	0	0	0	0.001	<0.001	0.003	<0.001	0	9	26
	Great Cormorant	0	0	0	0	0	<0.001	<0.001	0	0	0	1	1
	Unidentified cormorant	0	0	0	0	0	<0.001	0	<0.001	0	0	3	3
Heron and Egrets	Great Egret	0	0	0	0	0	<0.001	0	0	<0.001	0	2	2
Passerines (perching birds, songbirds)	Unidentified passerine	<0.001	0	0	0.003	0	<0.001	0	0	0.003	0.001	9	25

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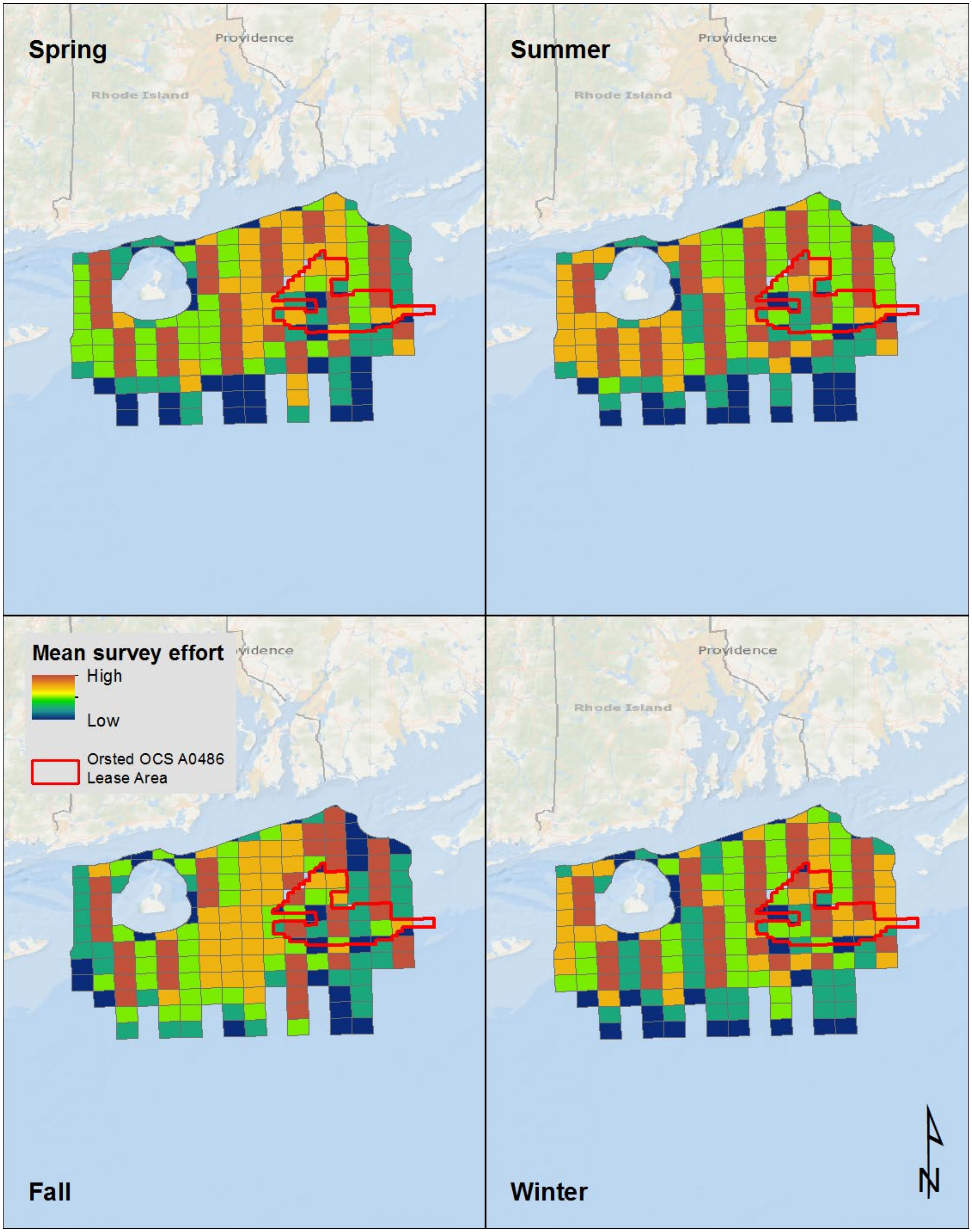

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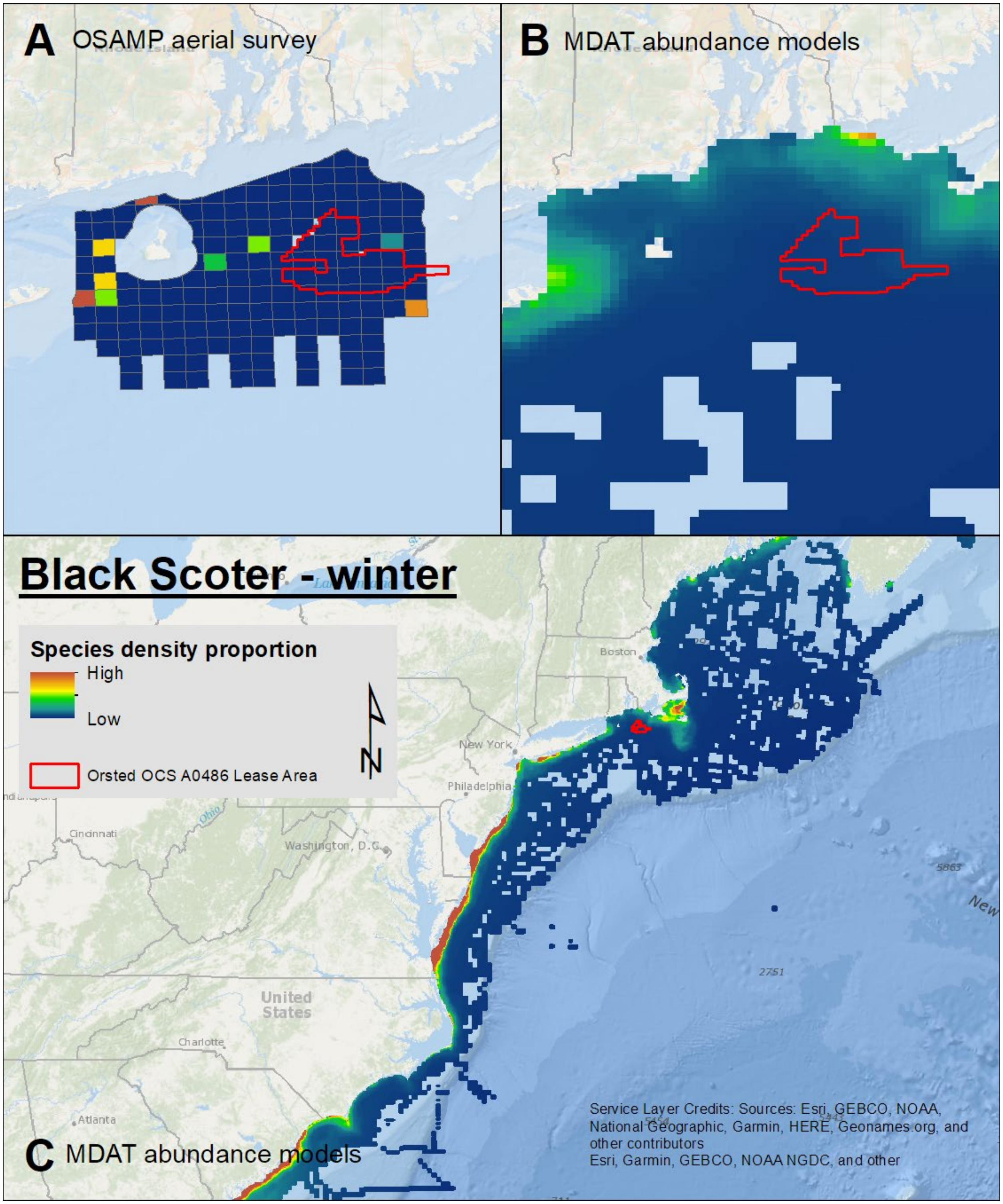

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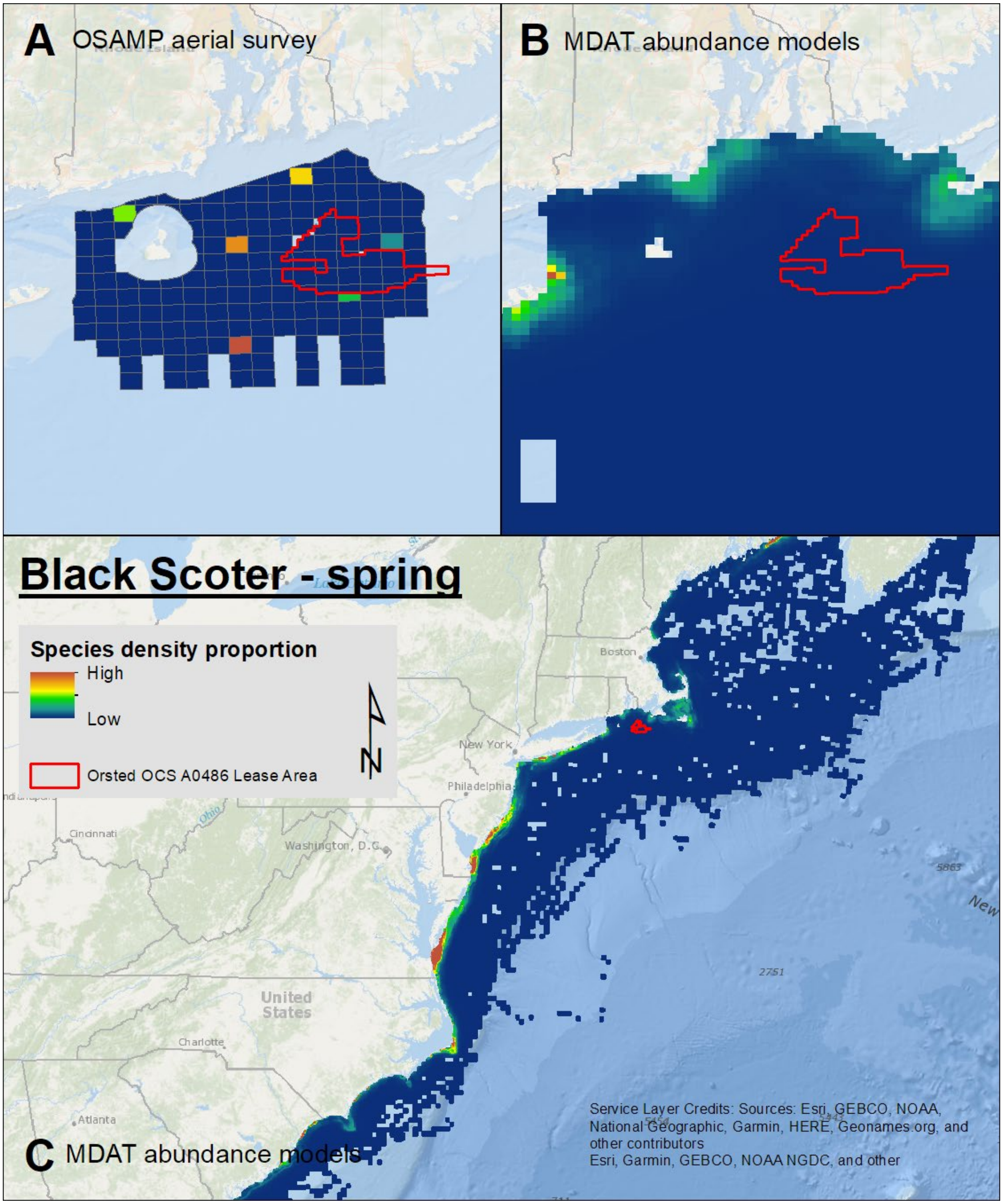

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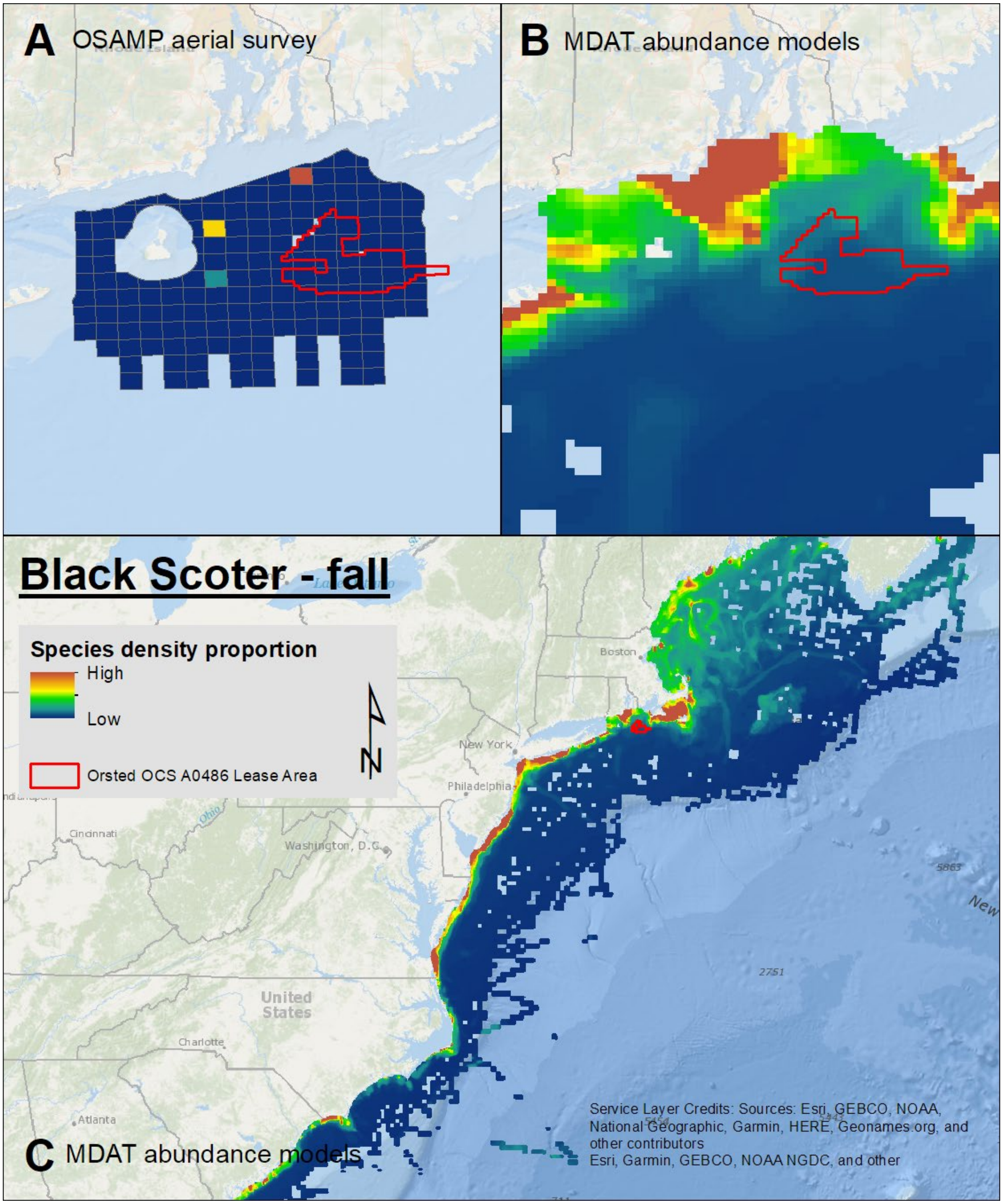

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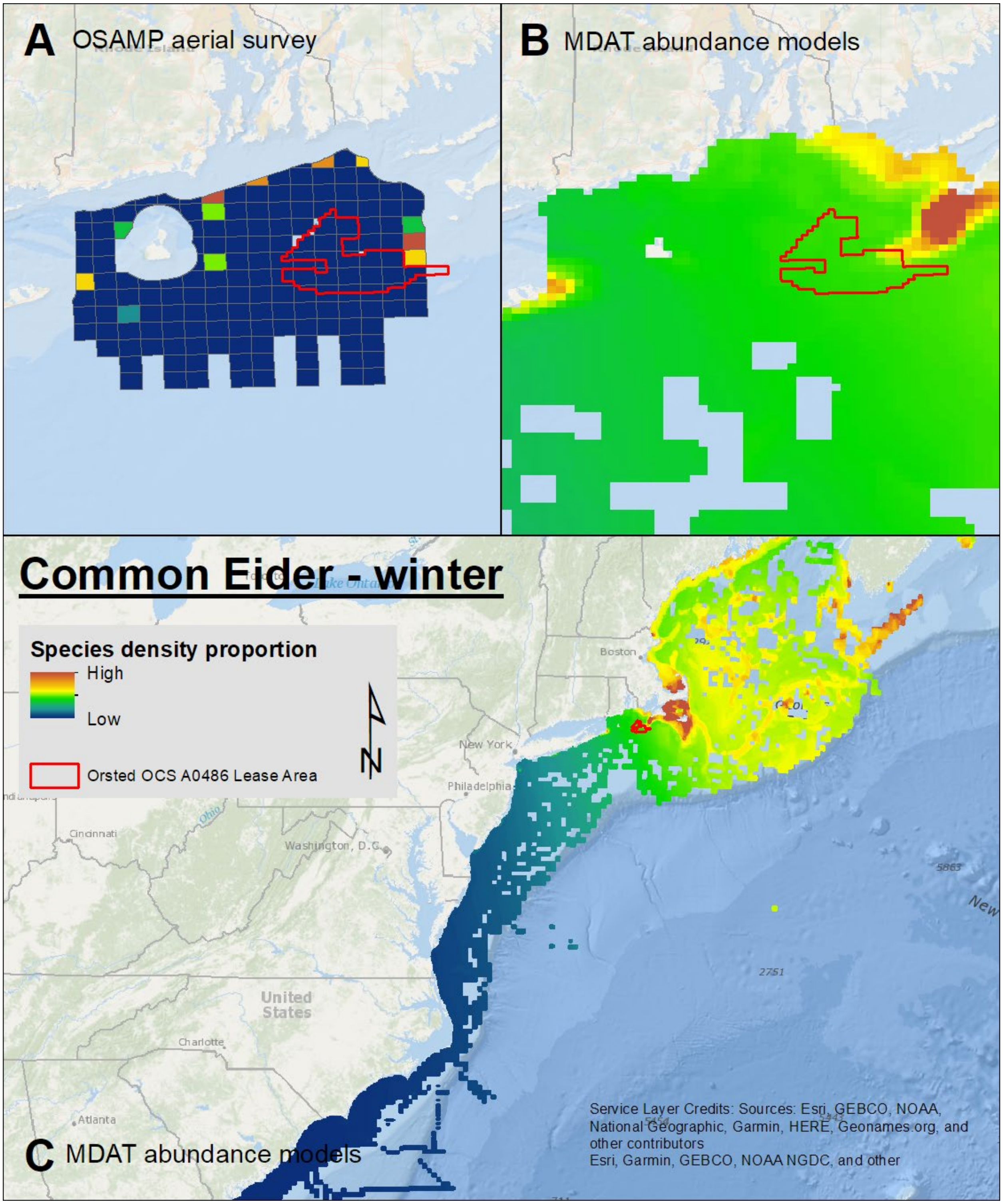

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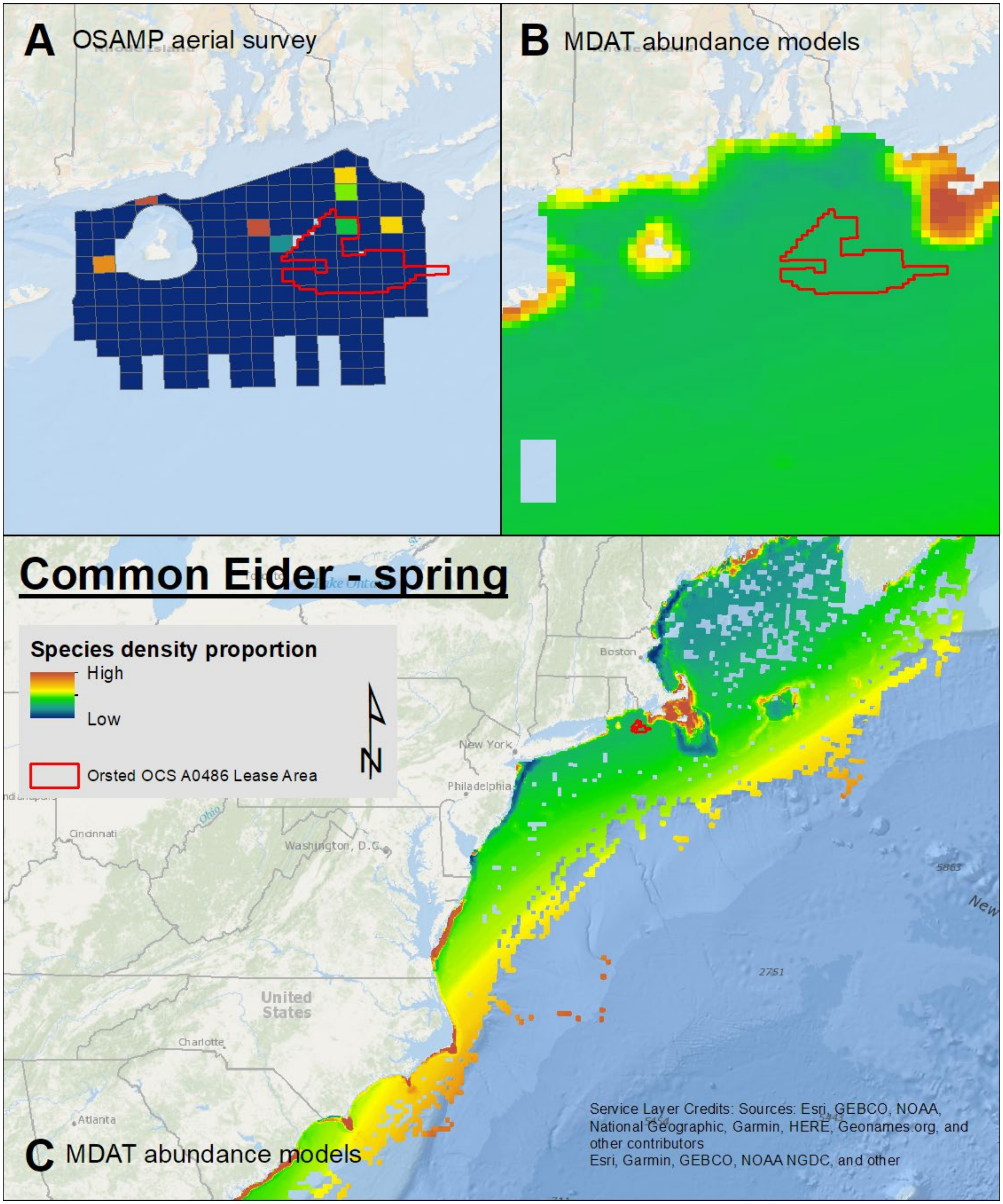

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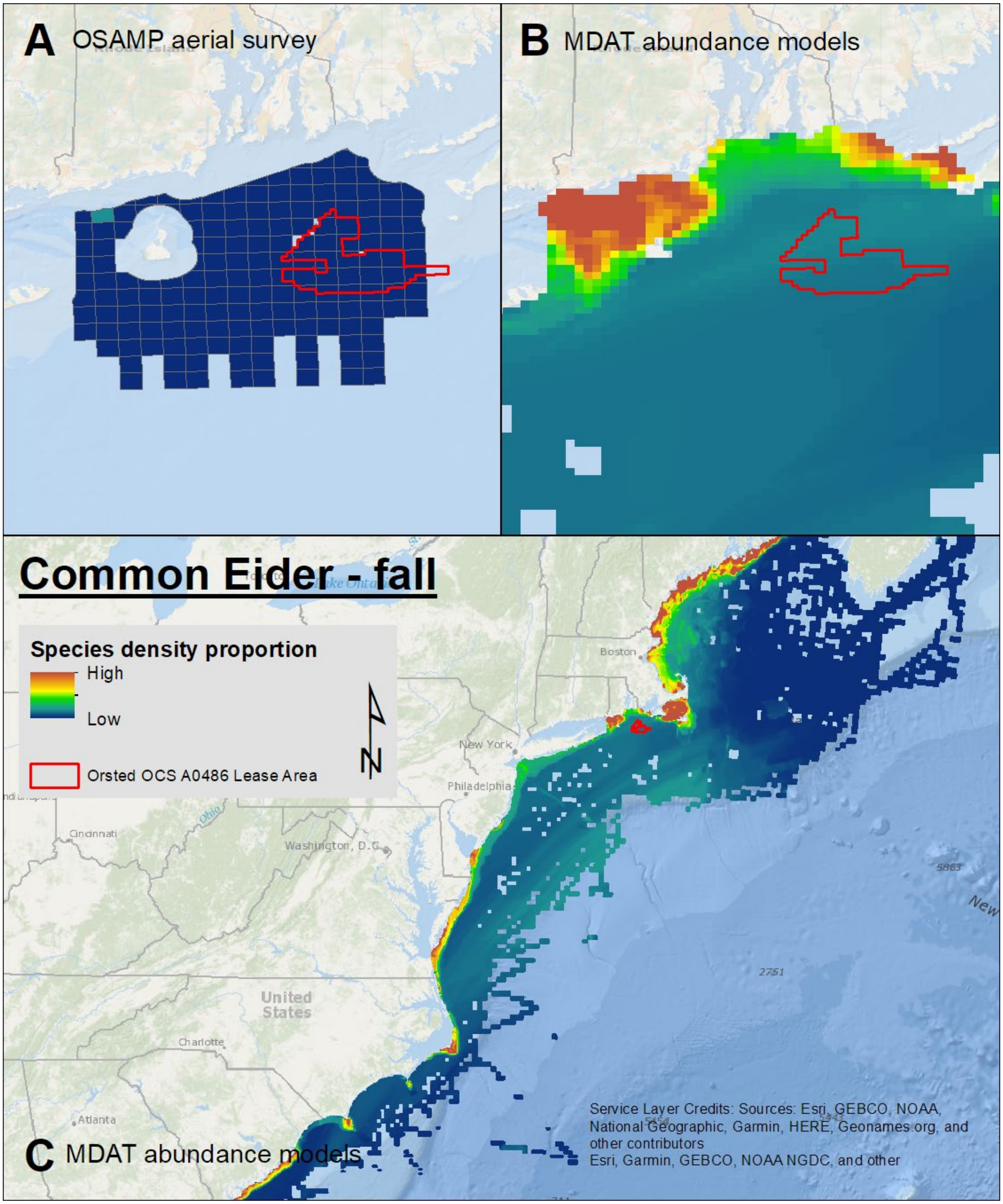

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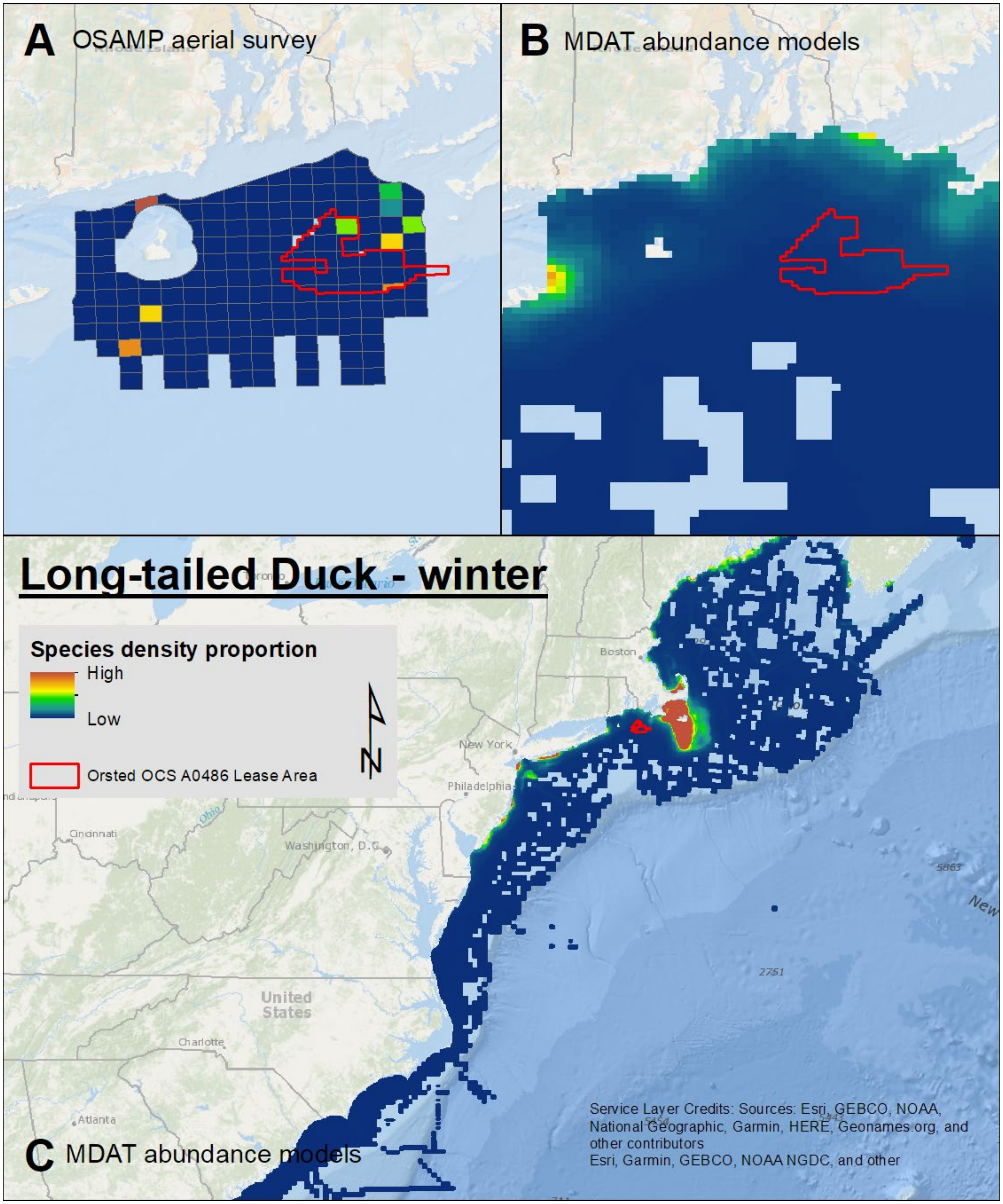

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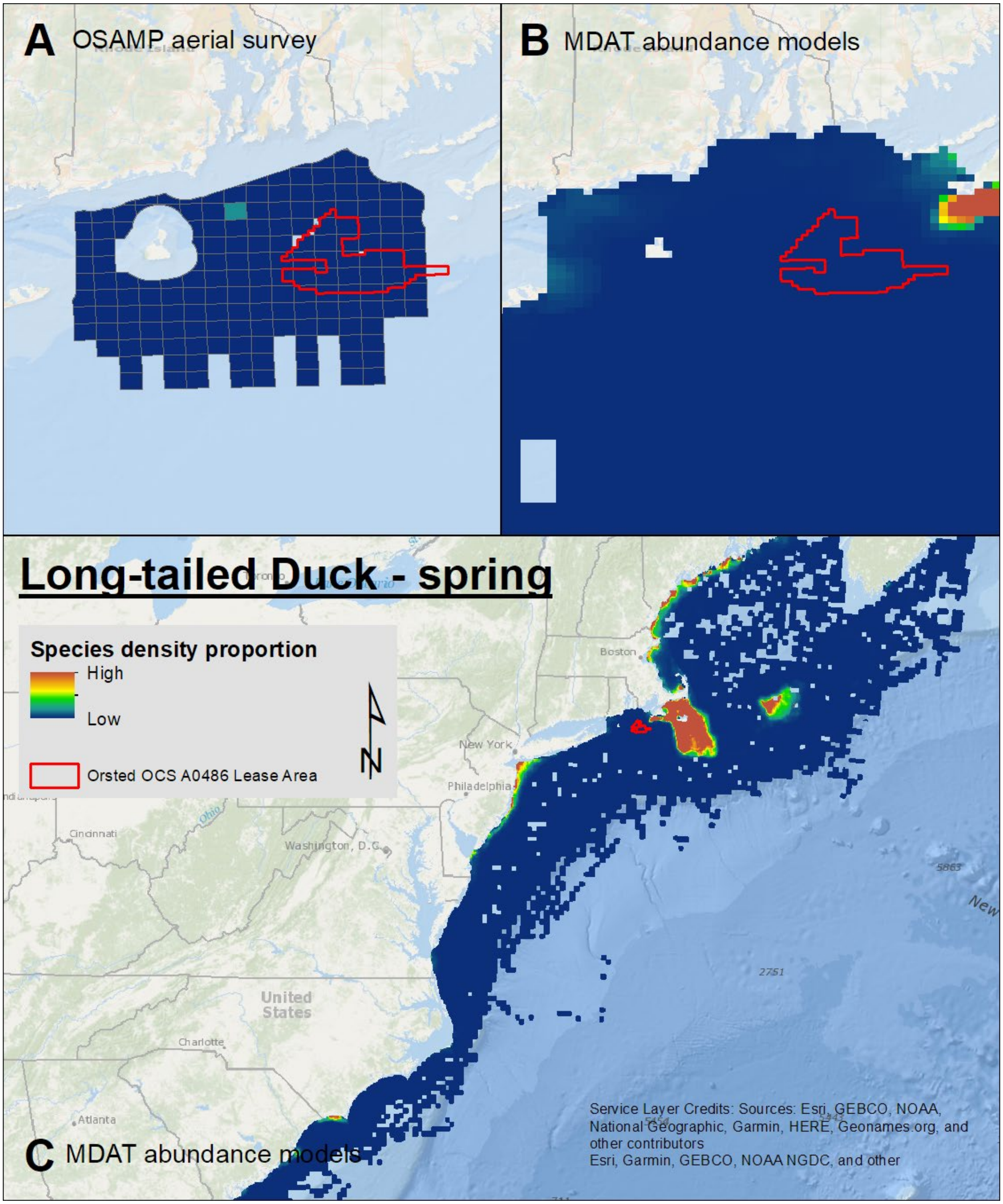

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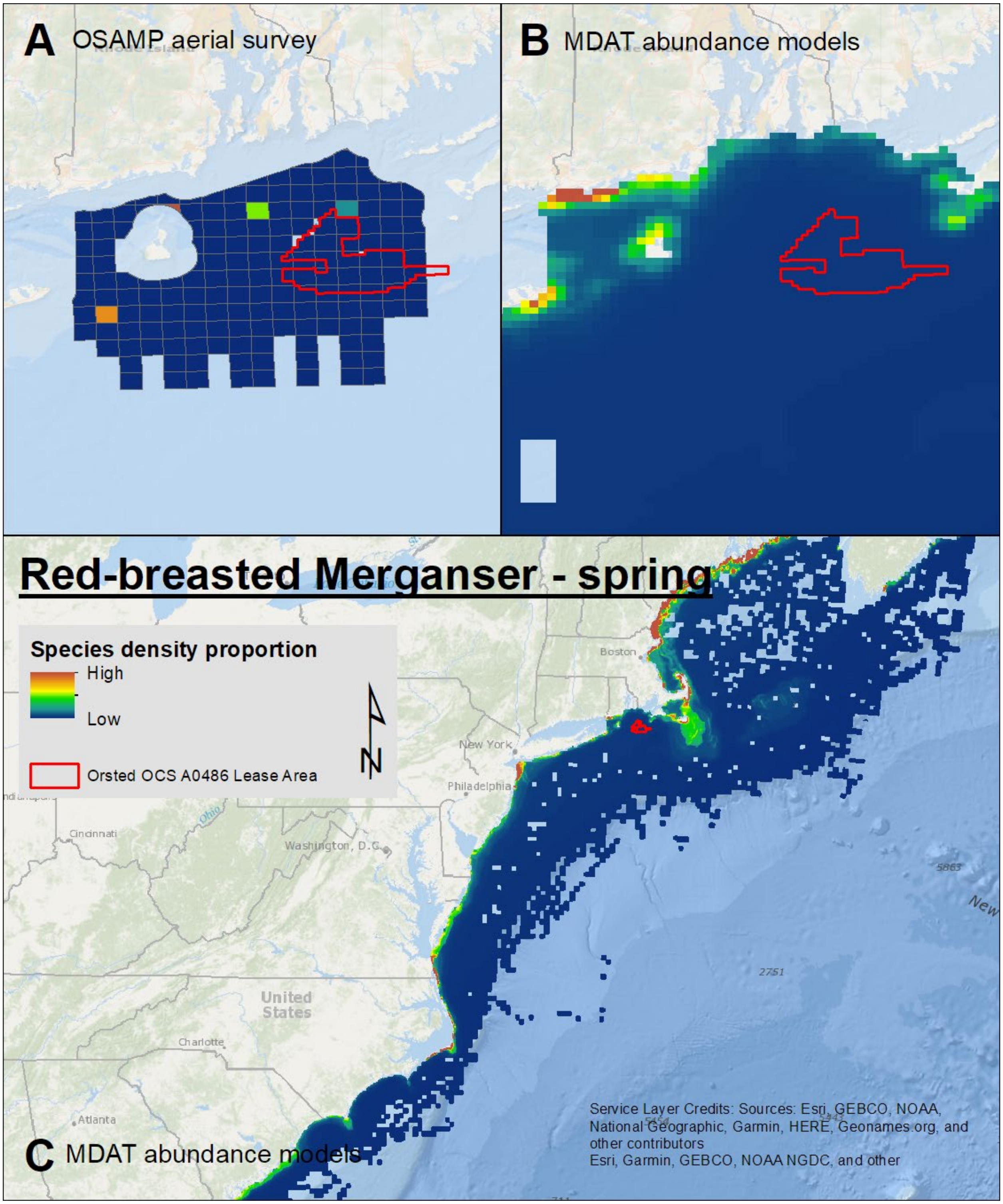

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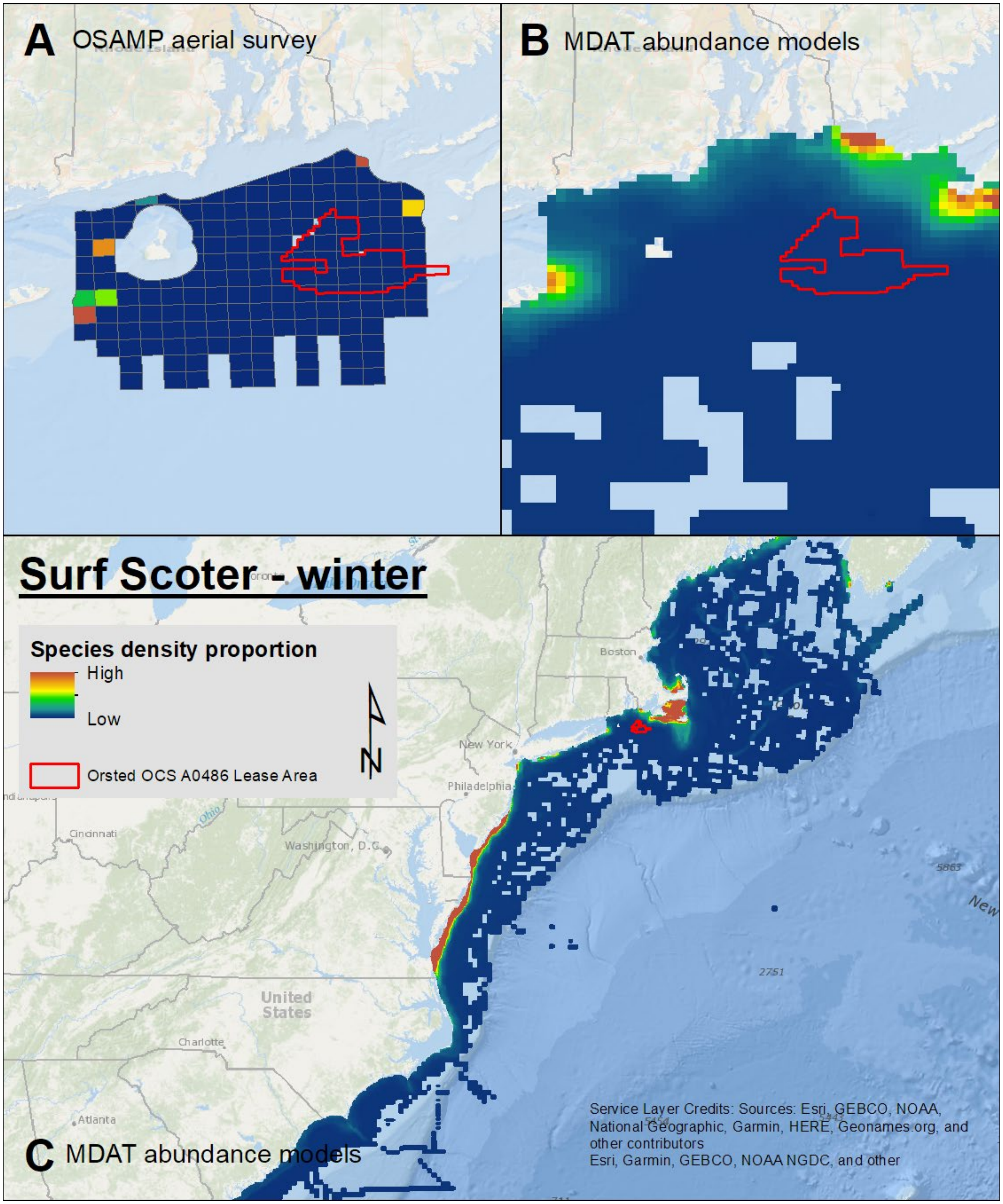

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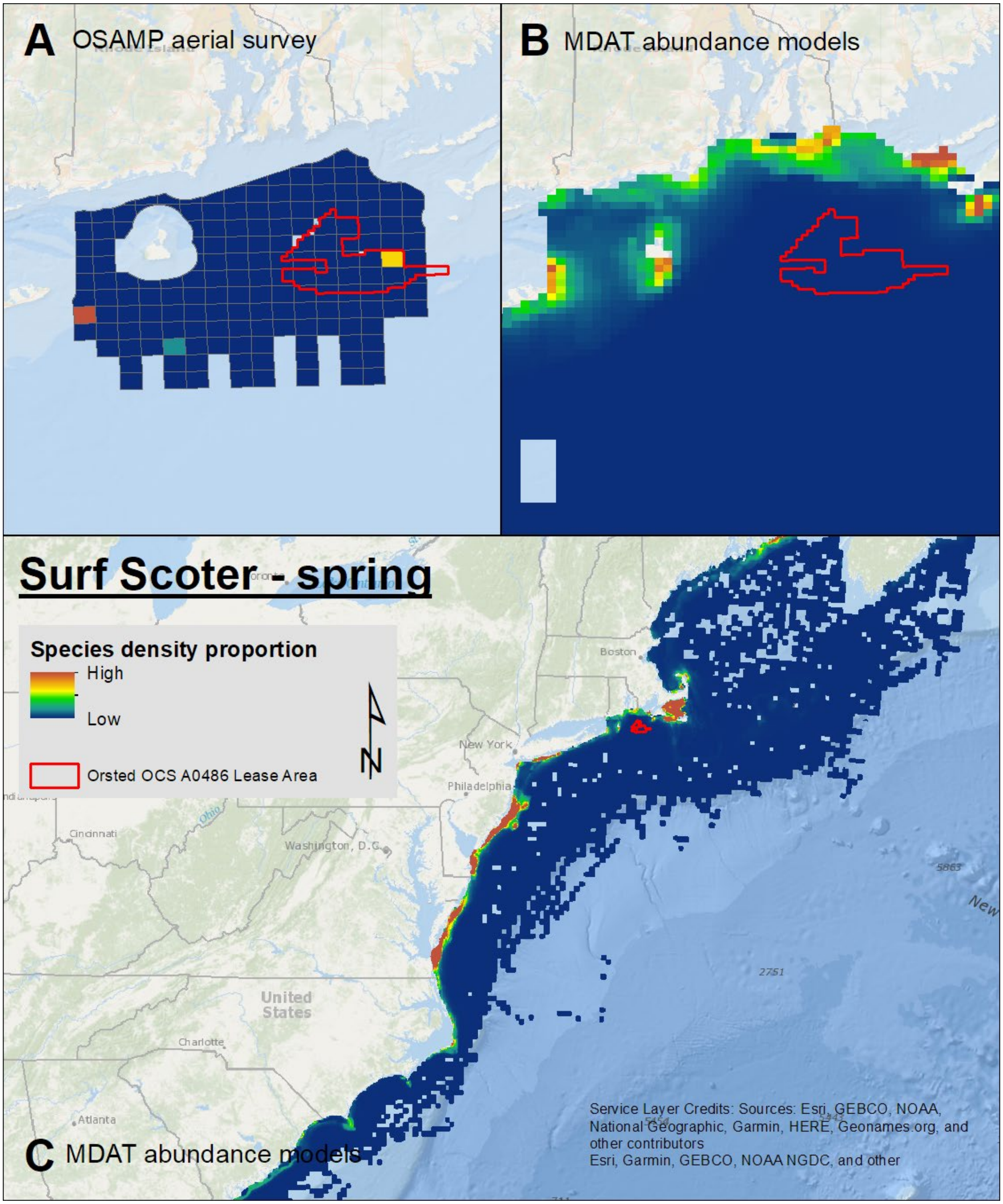

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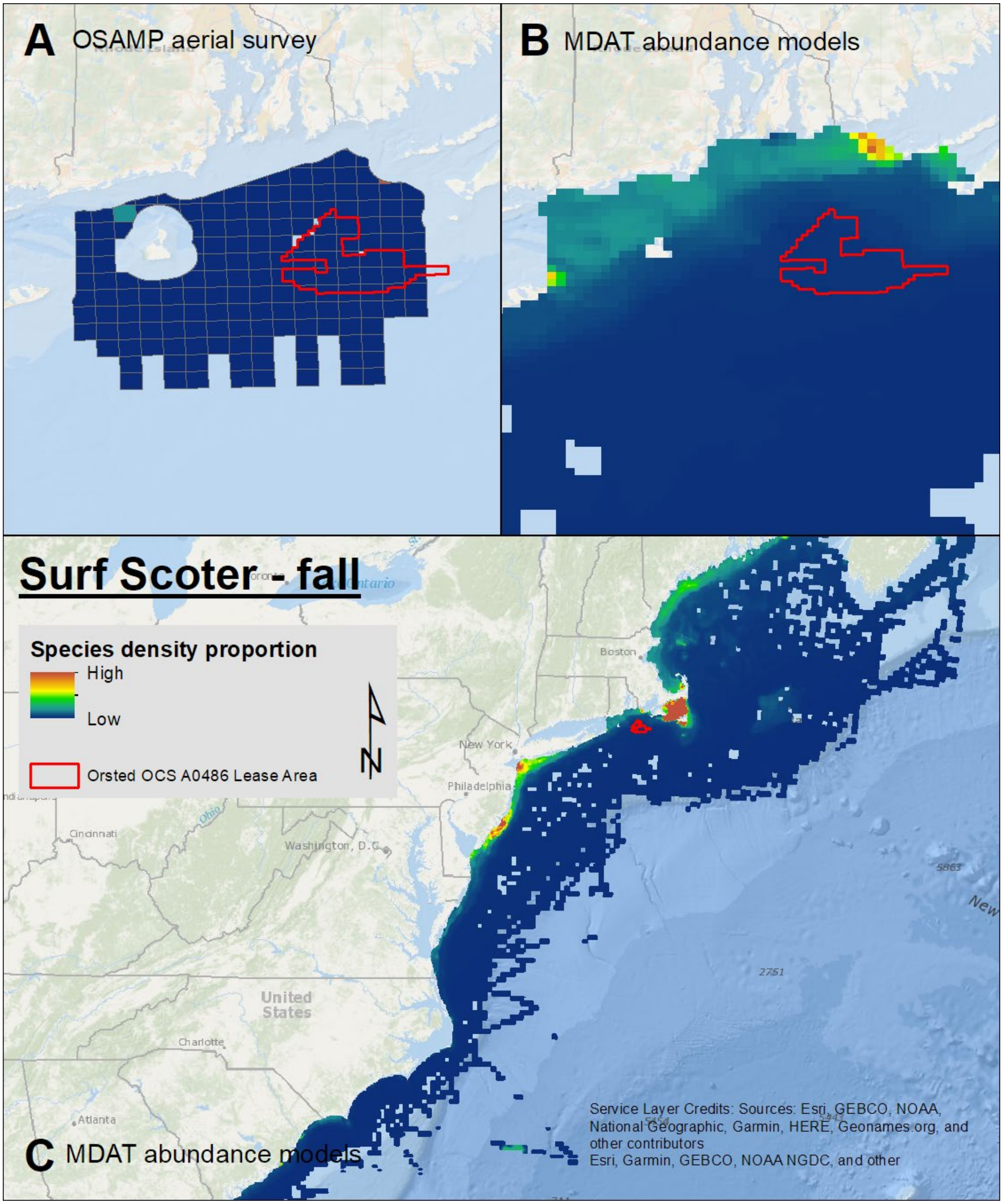

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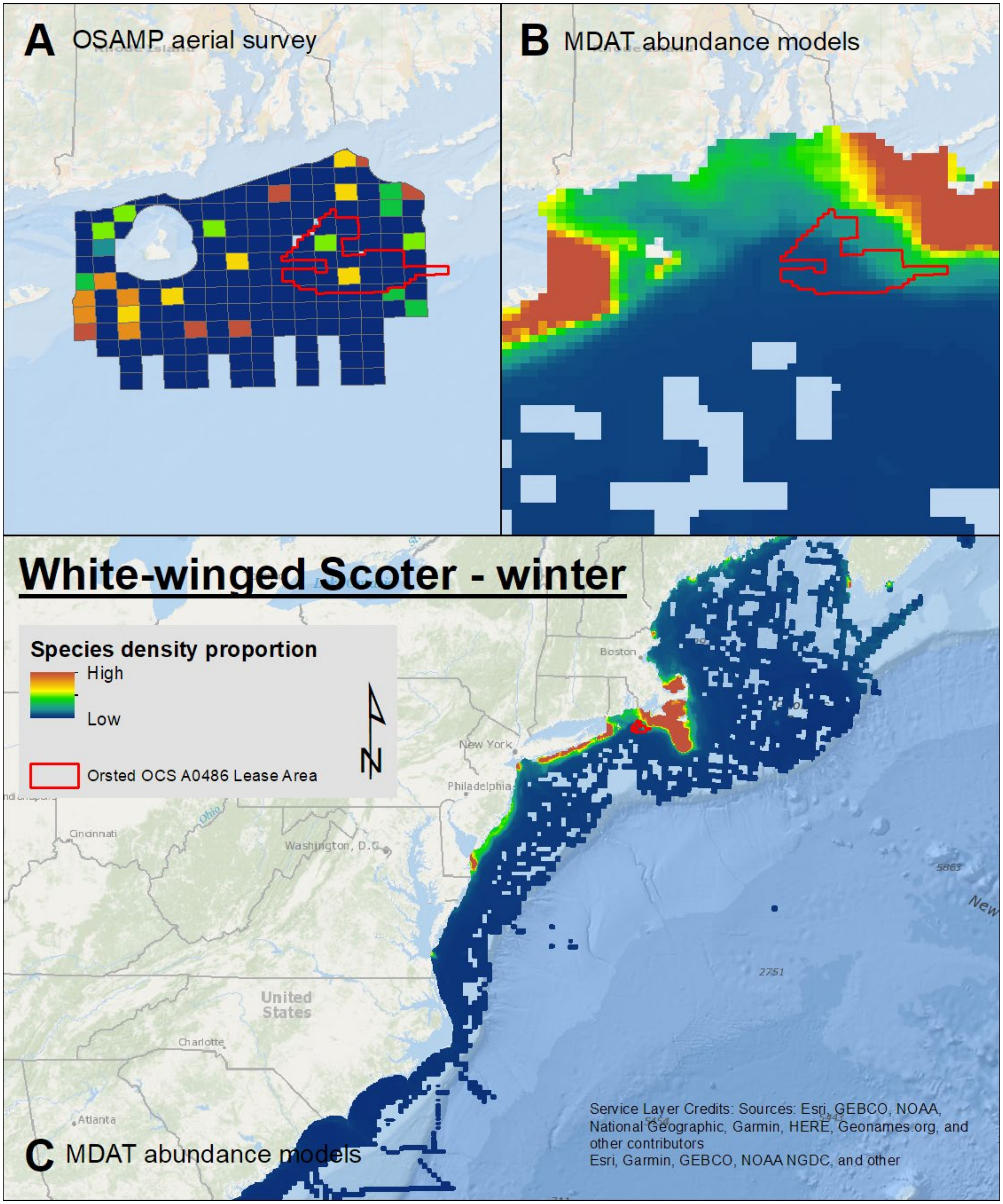

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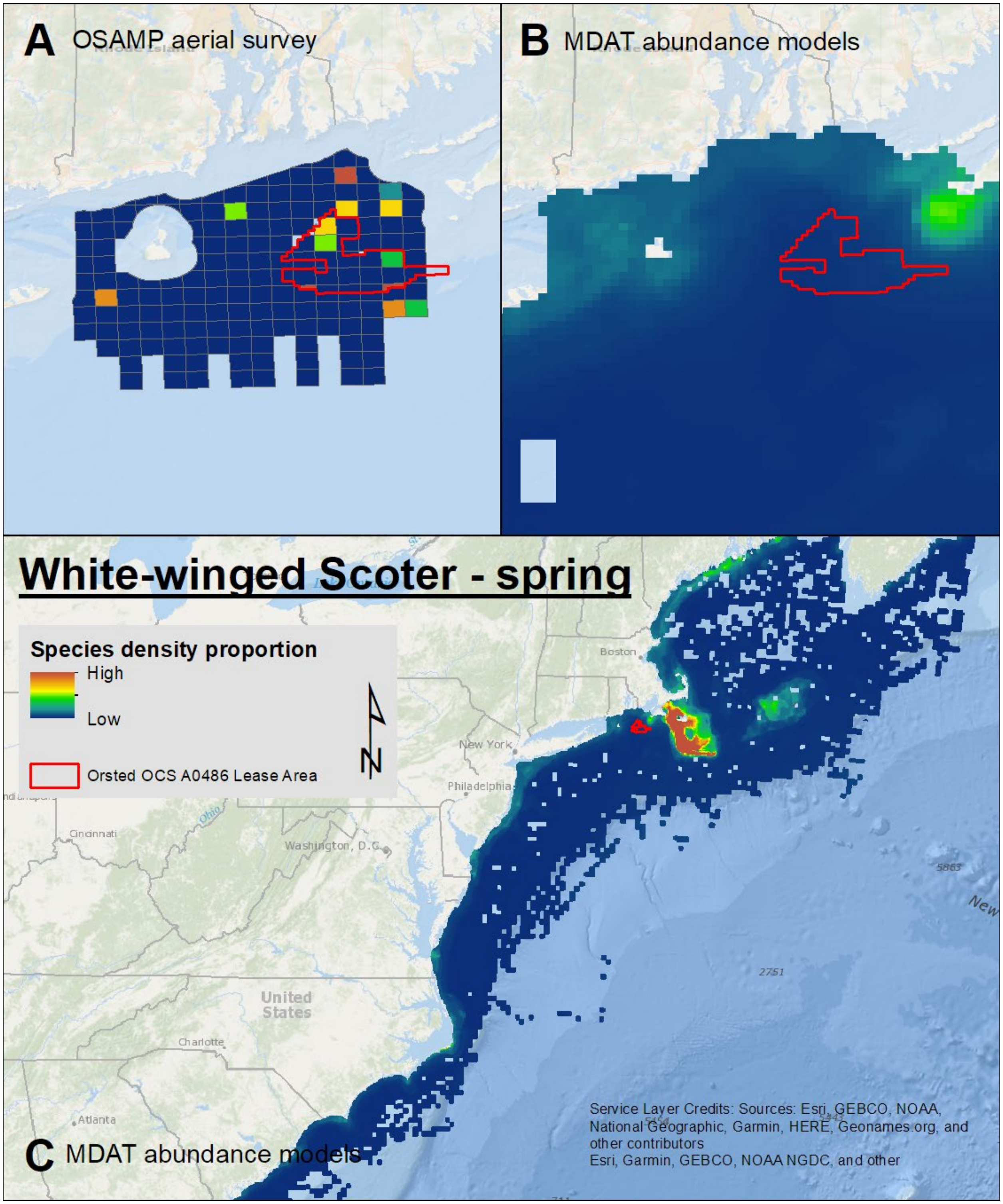

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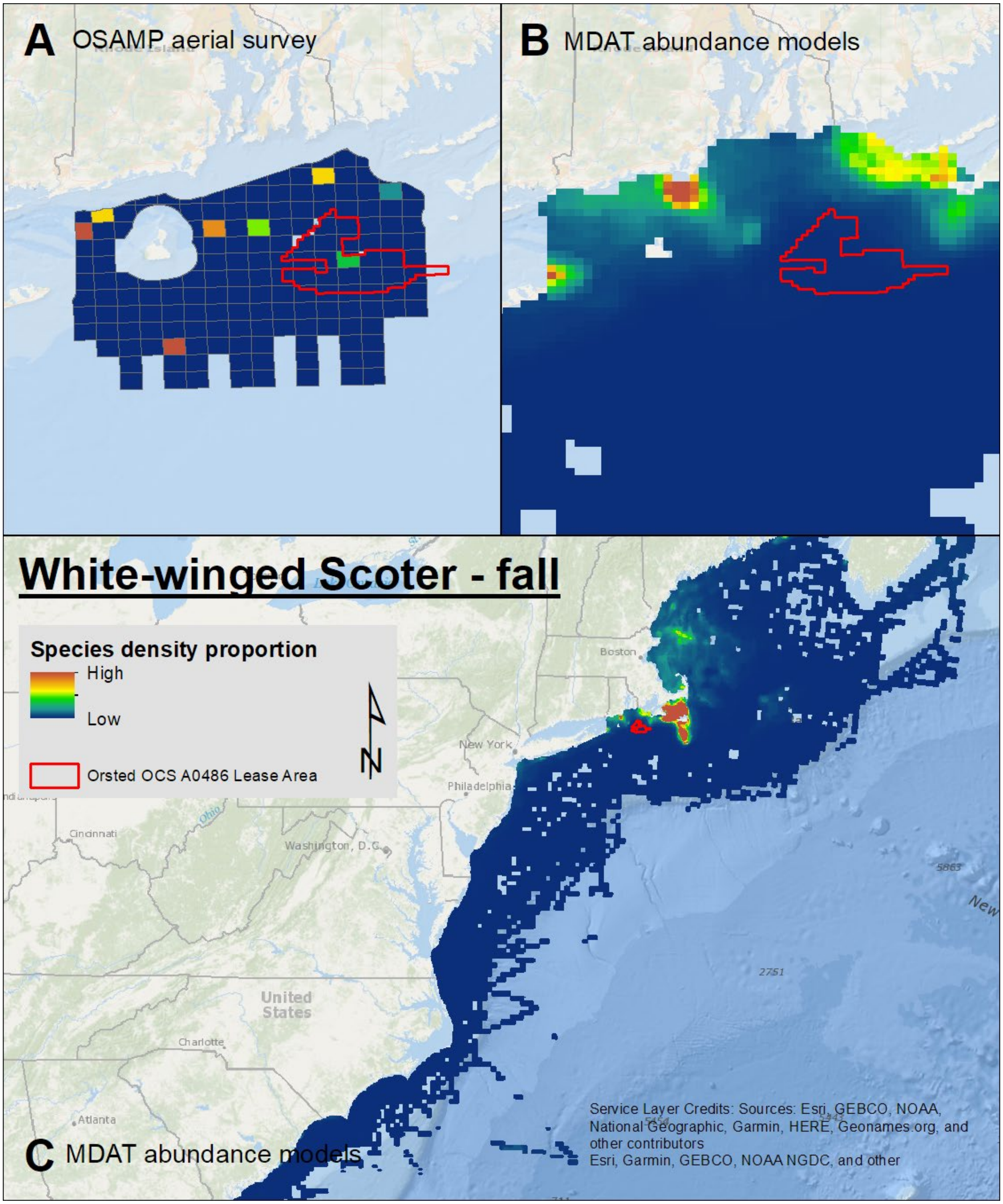

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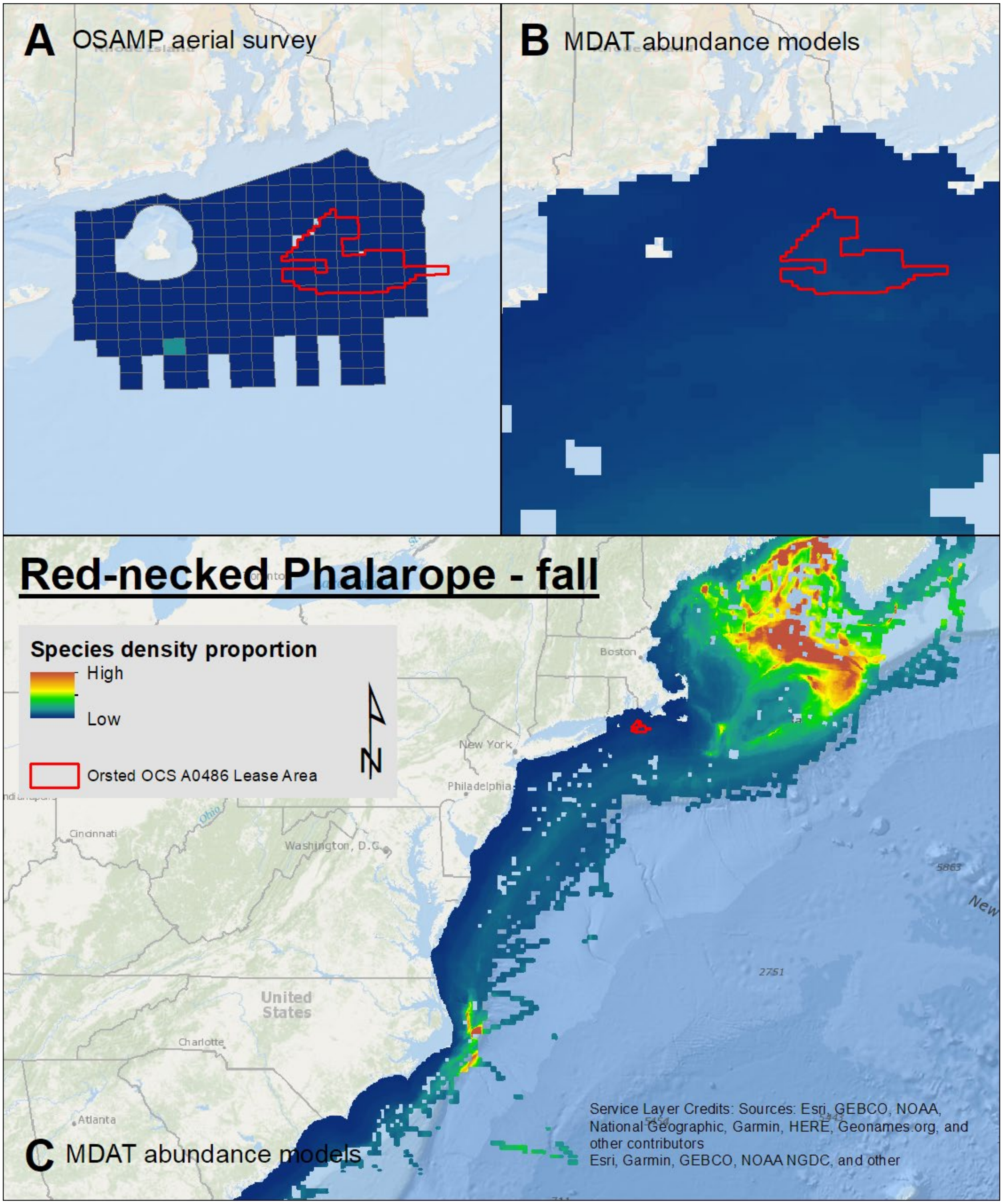
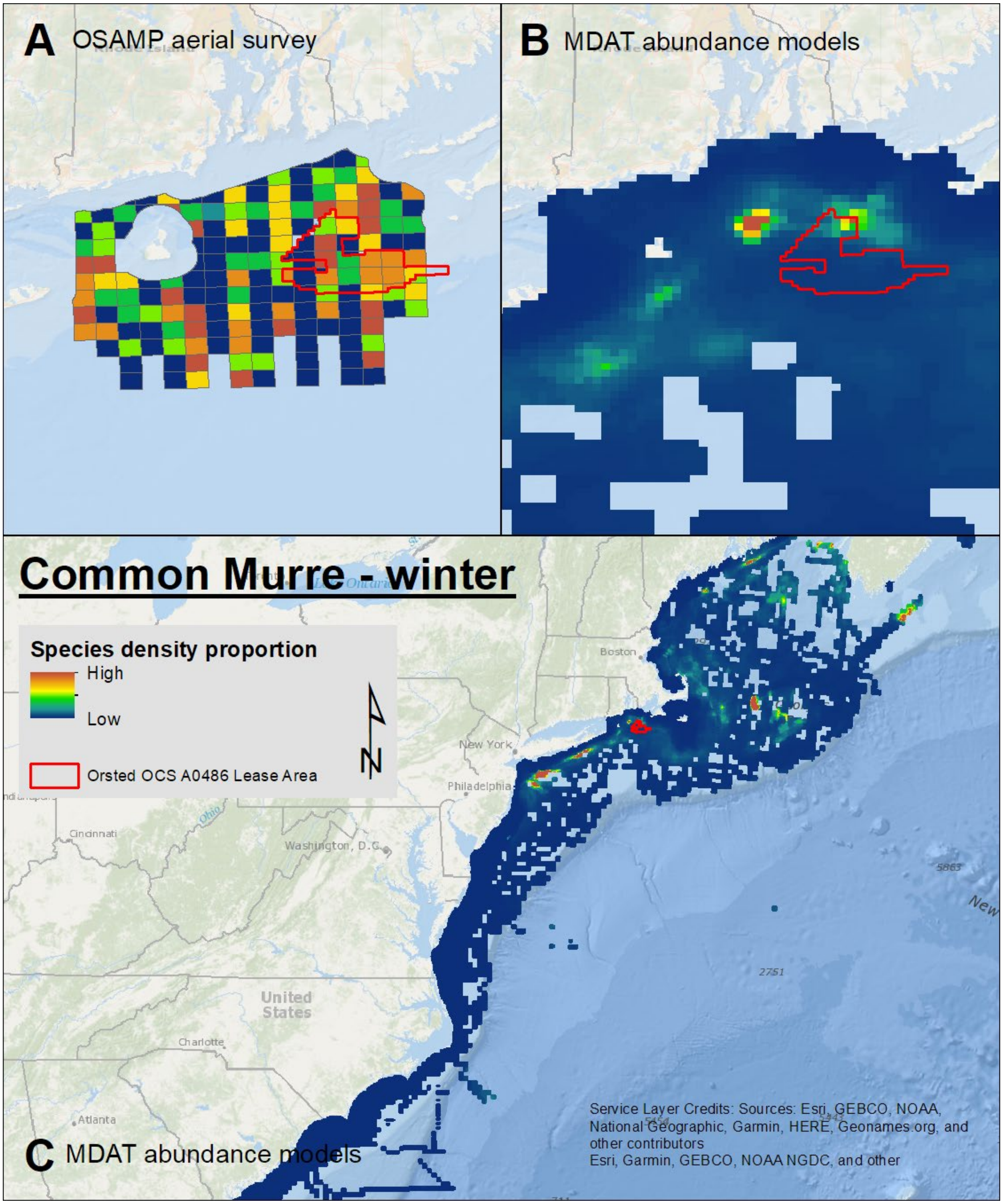
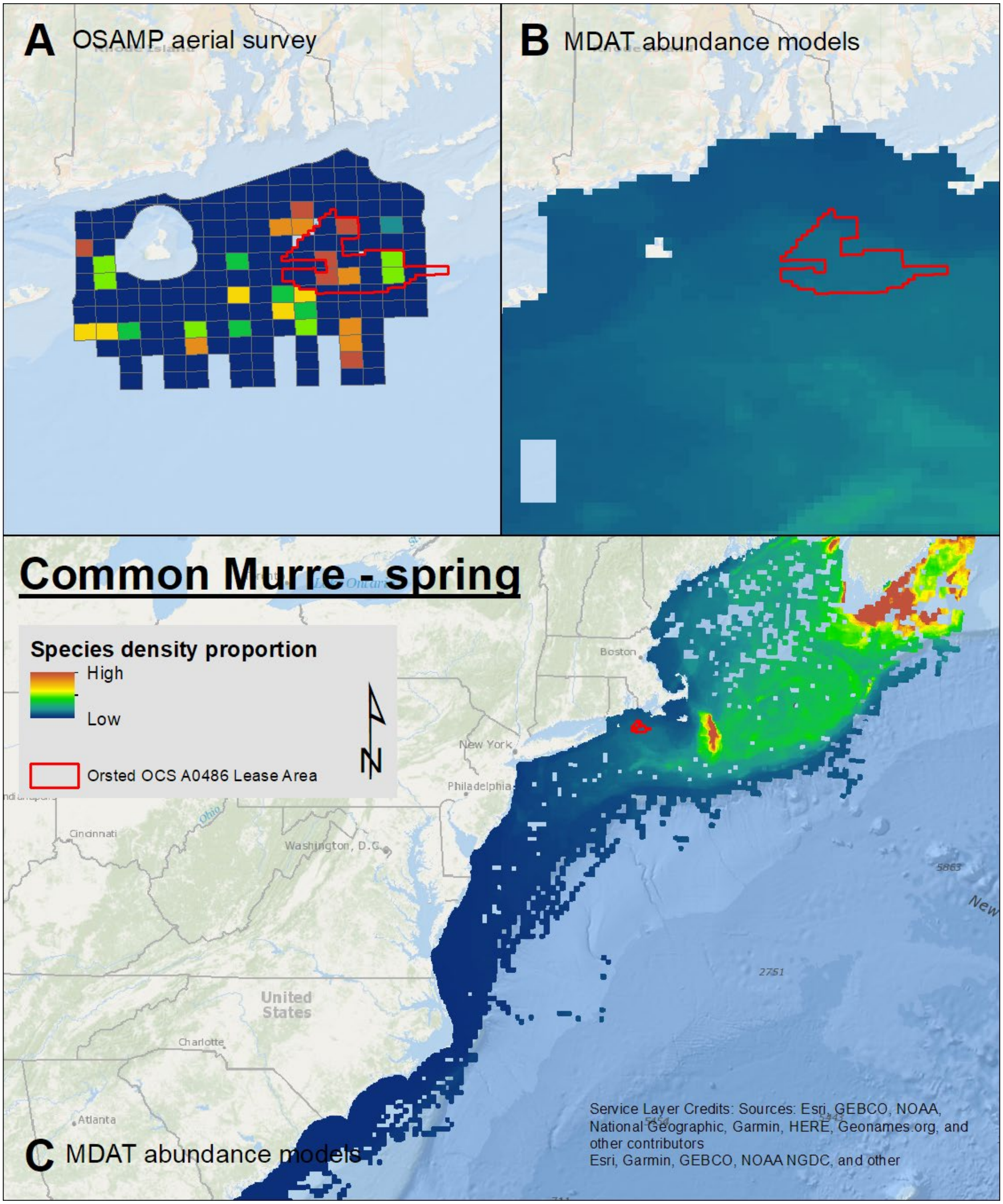


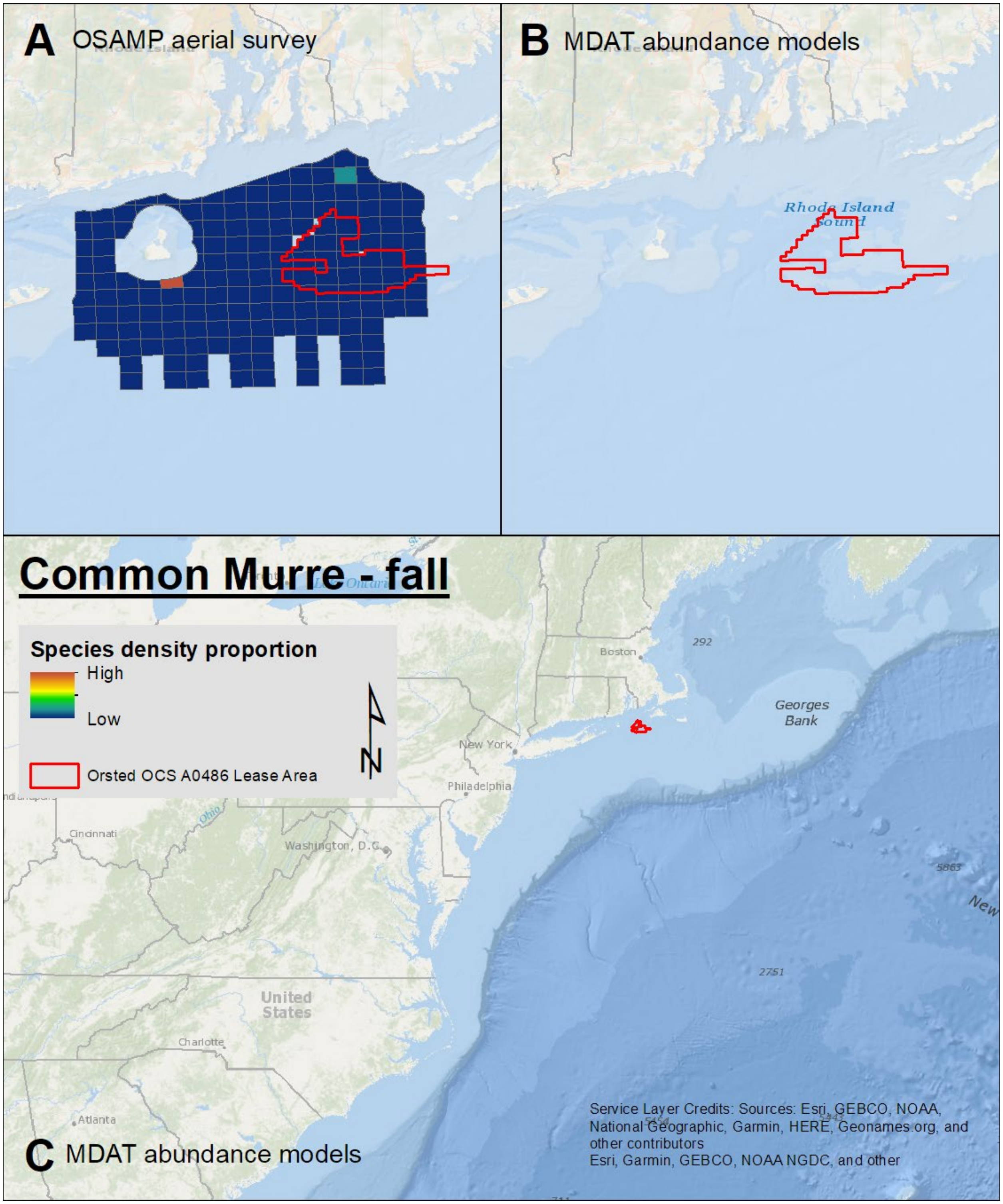
Map 17. Fall Red-necked Phalarope density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



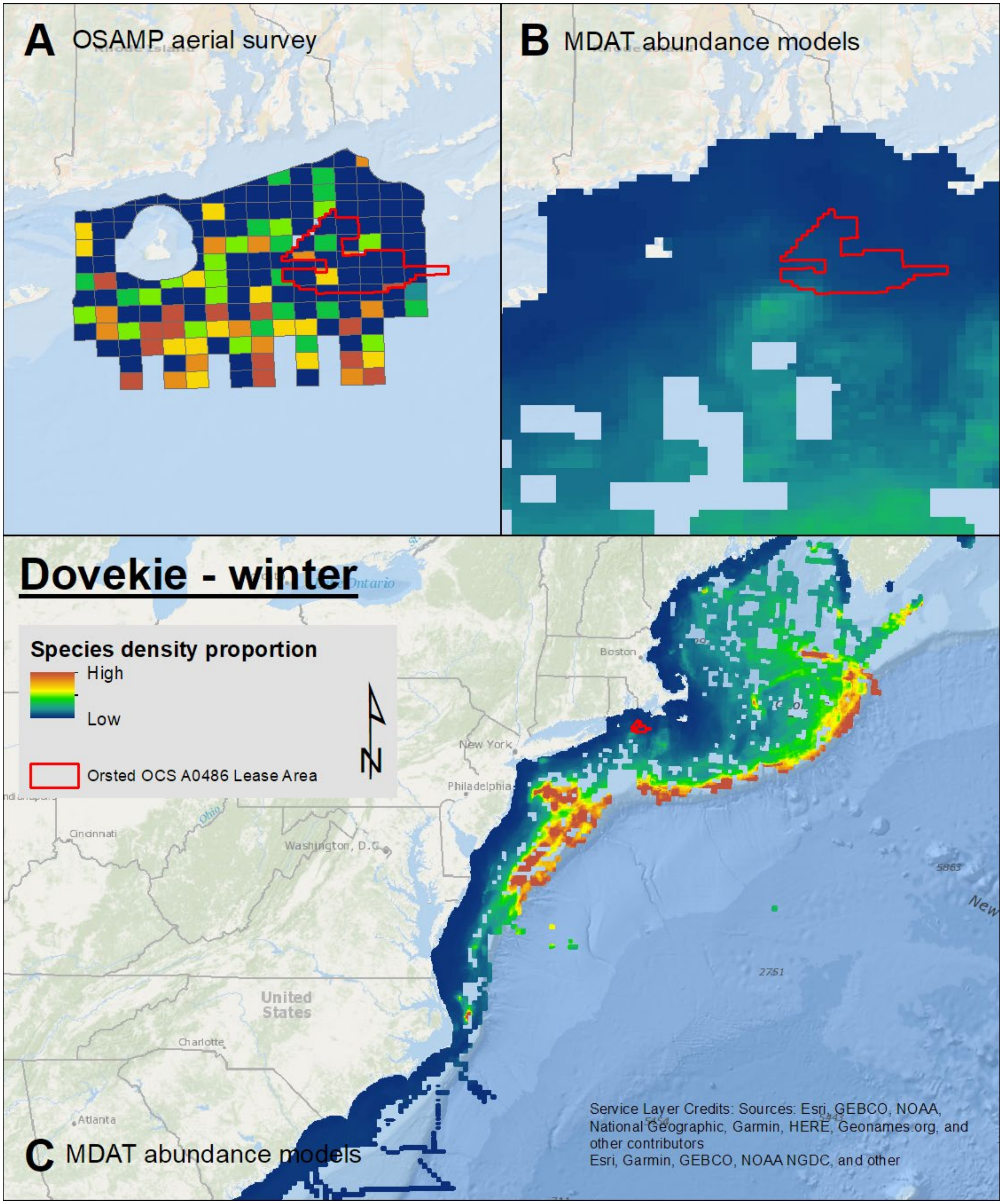
Map 18. Winter Common Murre density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



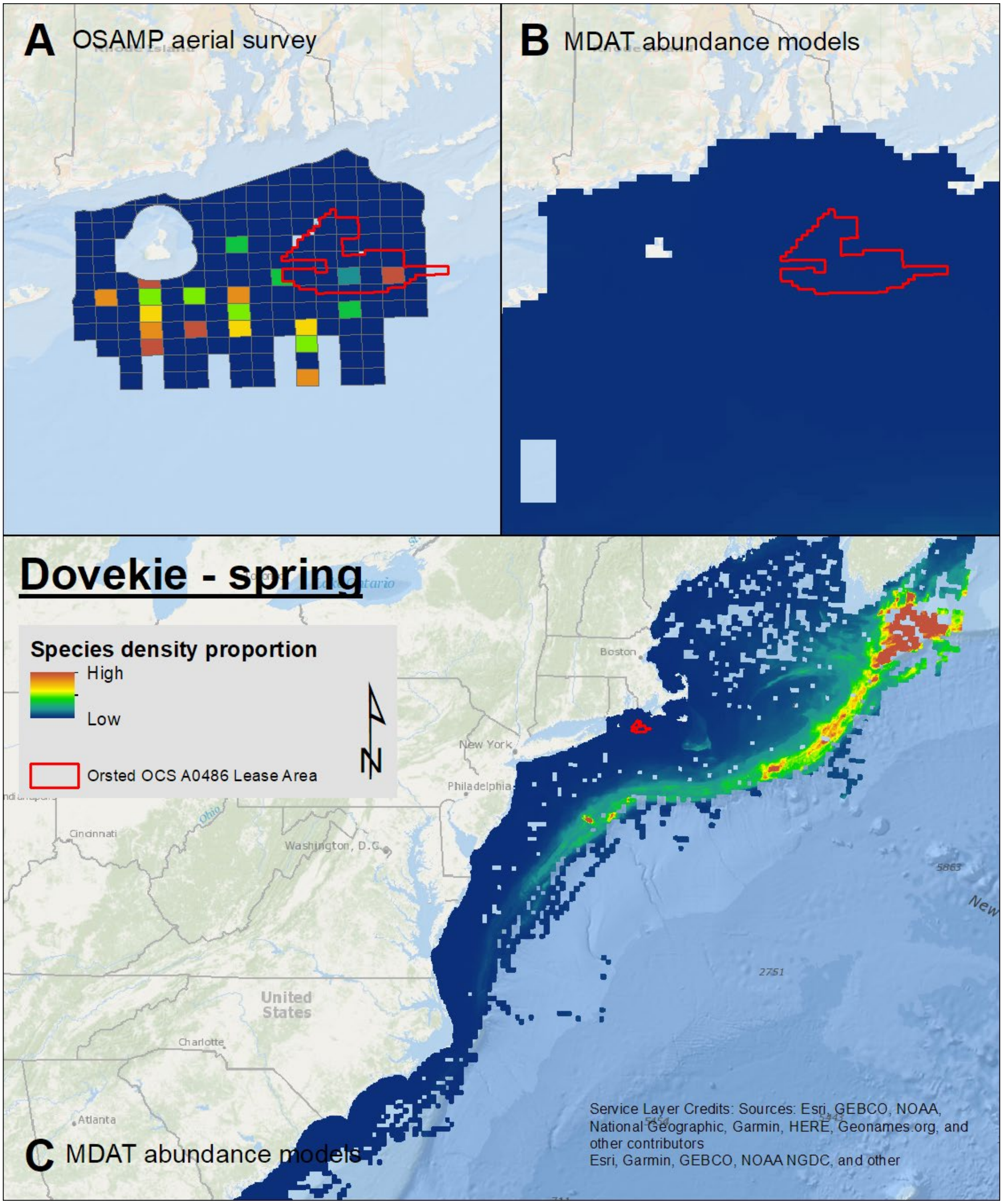
Map 19. Spring Common Murre density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



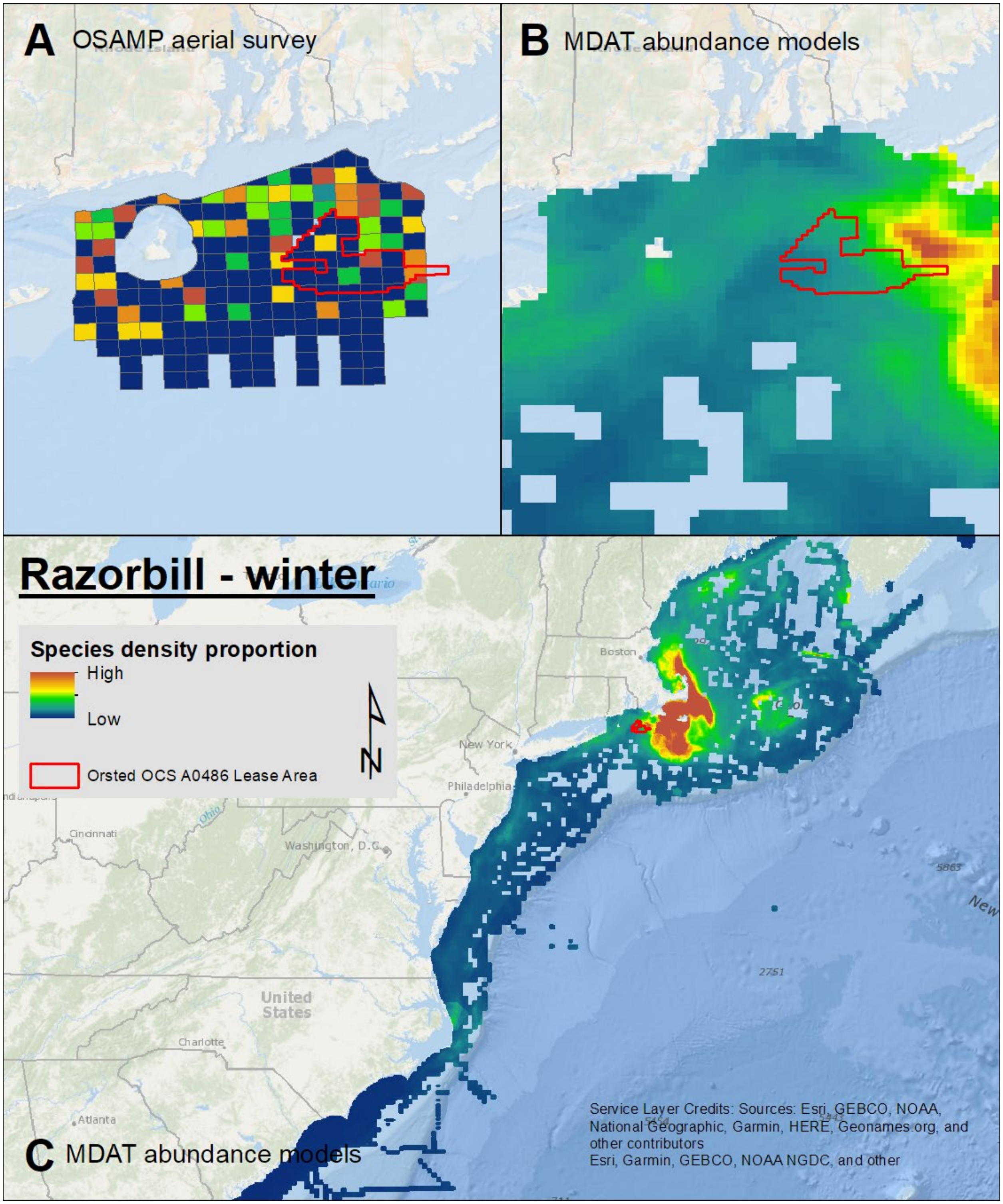
Map 20. Fall Common Murre density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



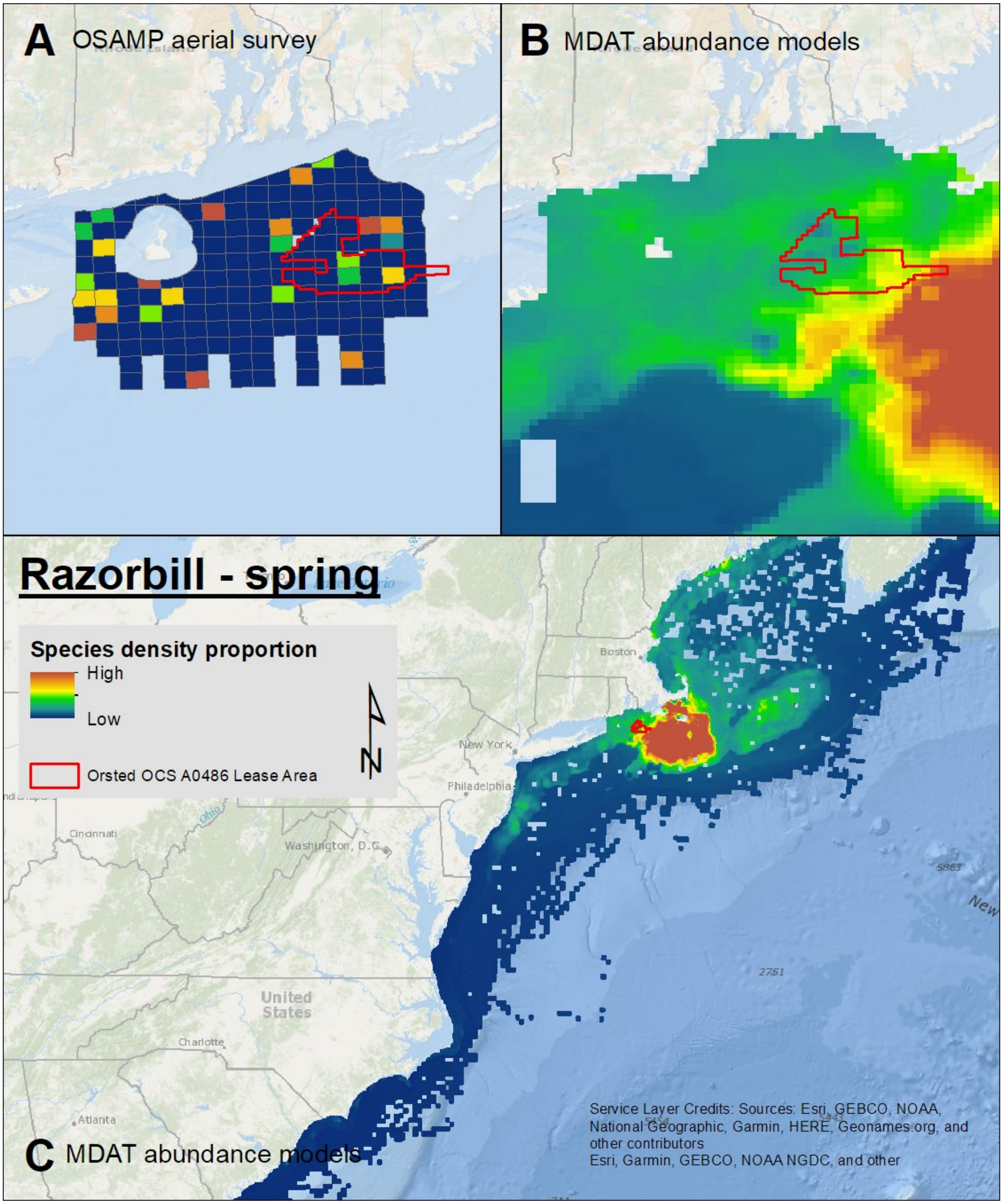
Map 21. Winter Dovekie density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



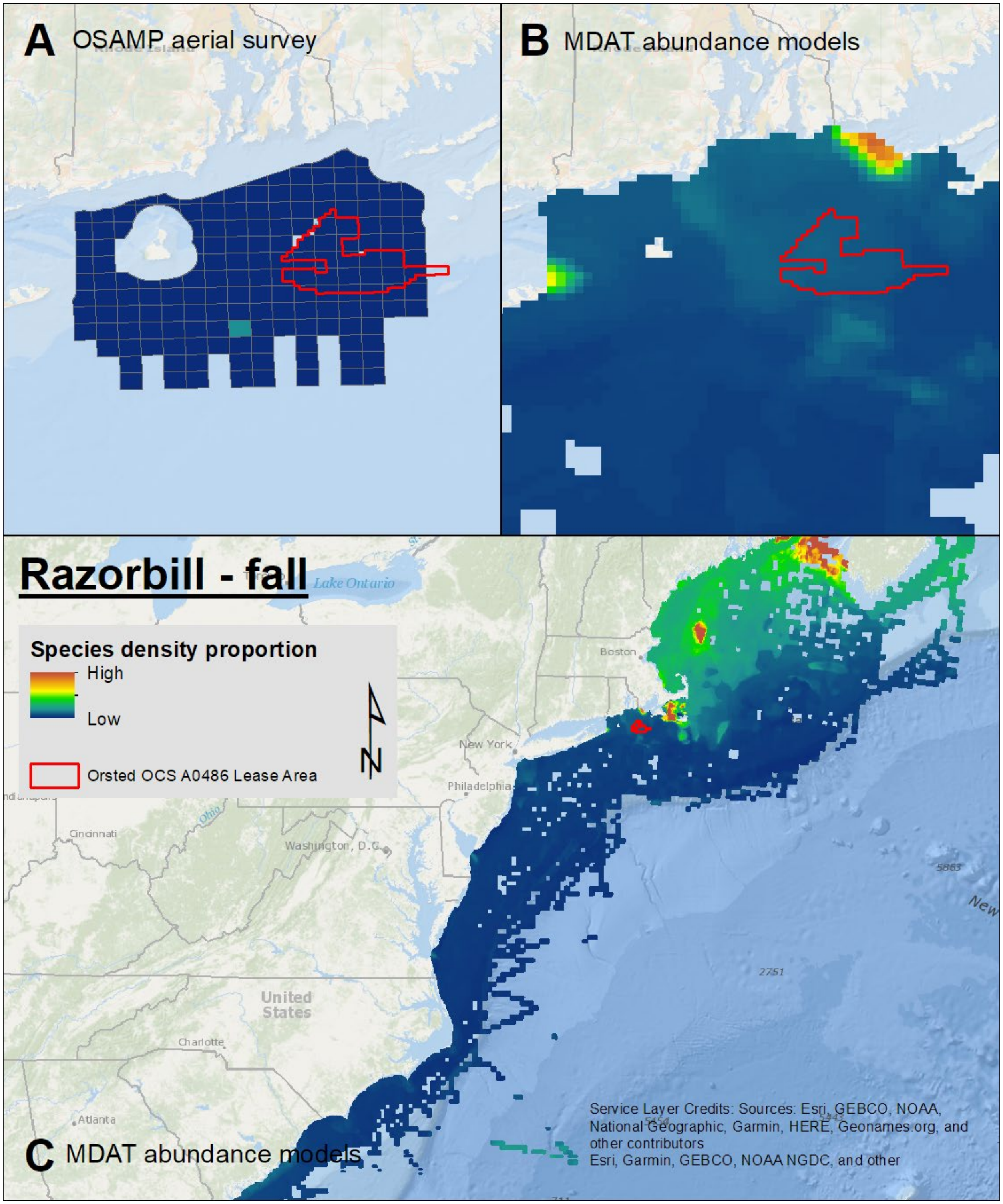
Map 22. Spring Dovekie density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



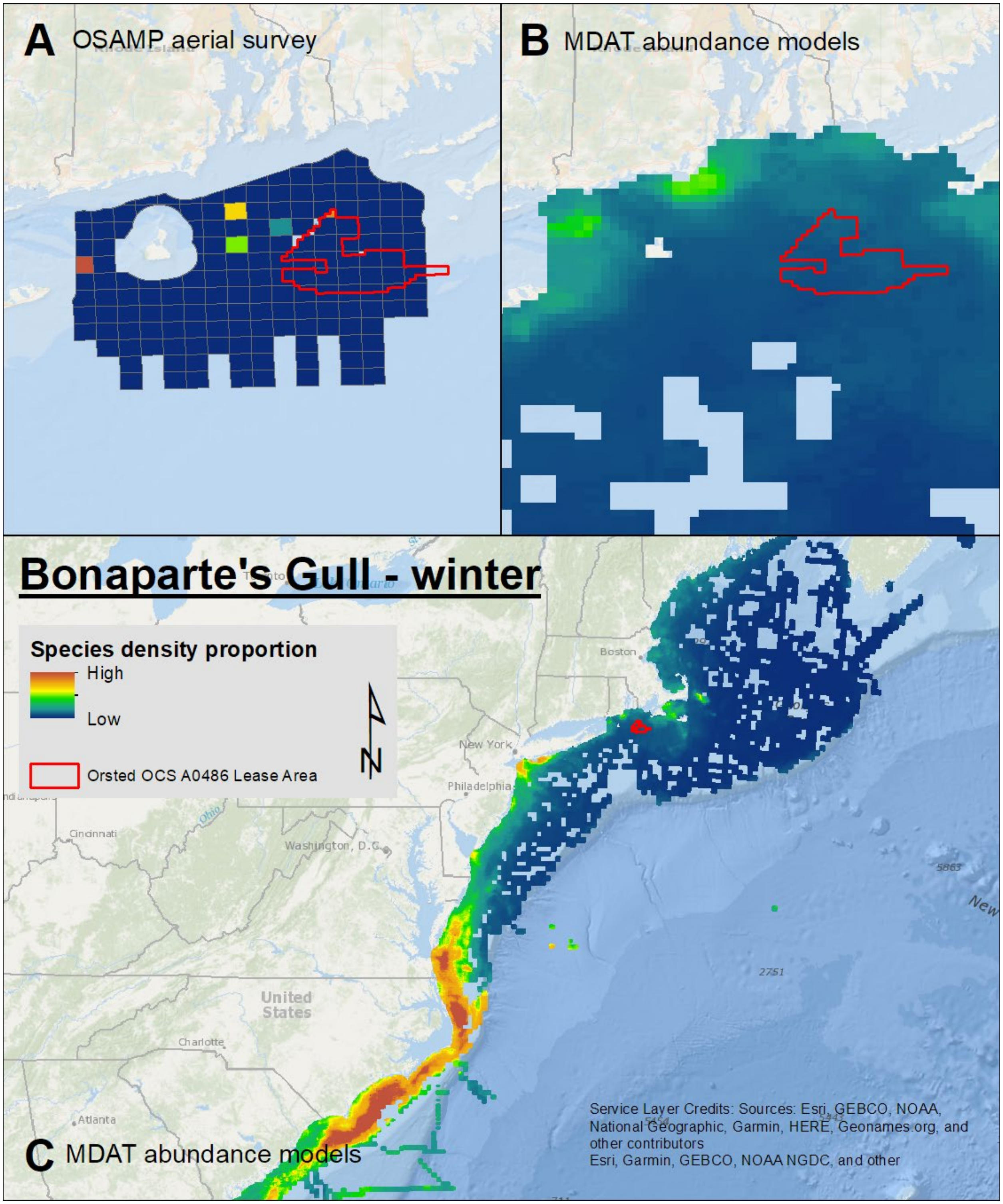
Map 23. Winter Razorbill density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



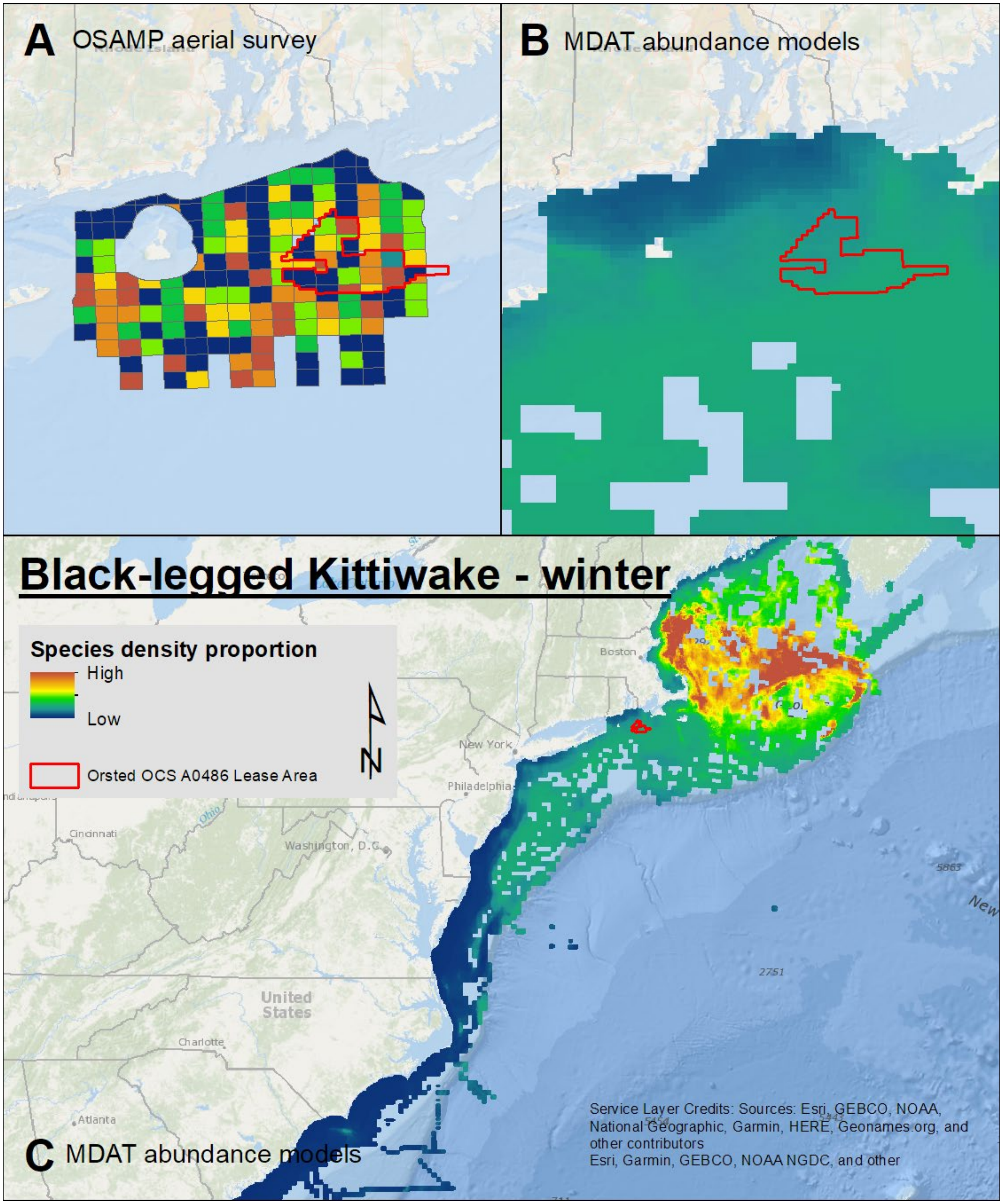
Map 24. Spring Razorbill density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



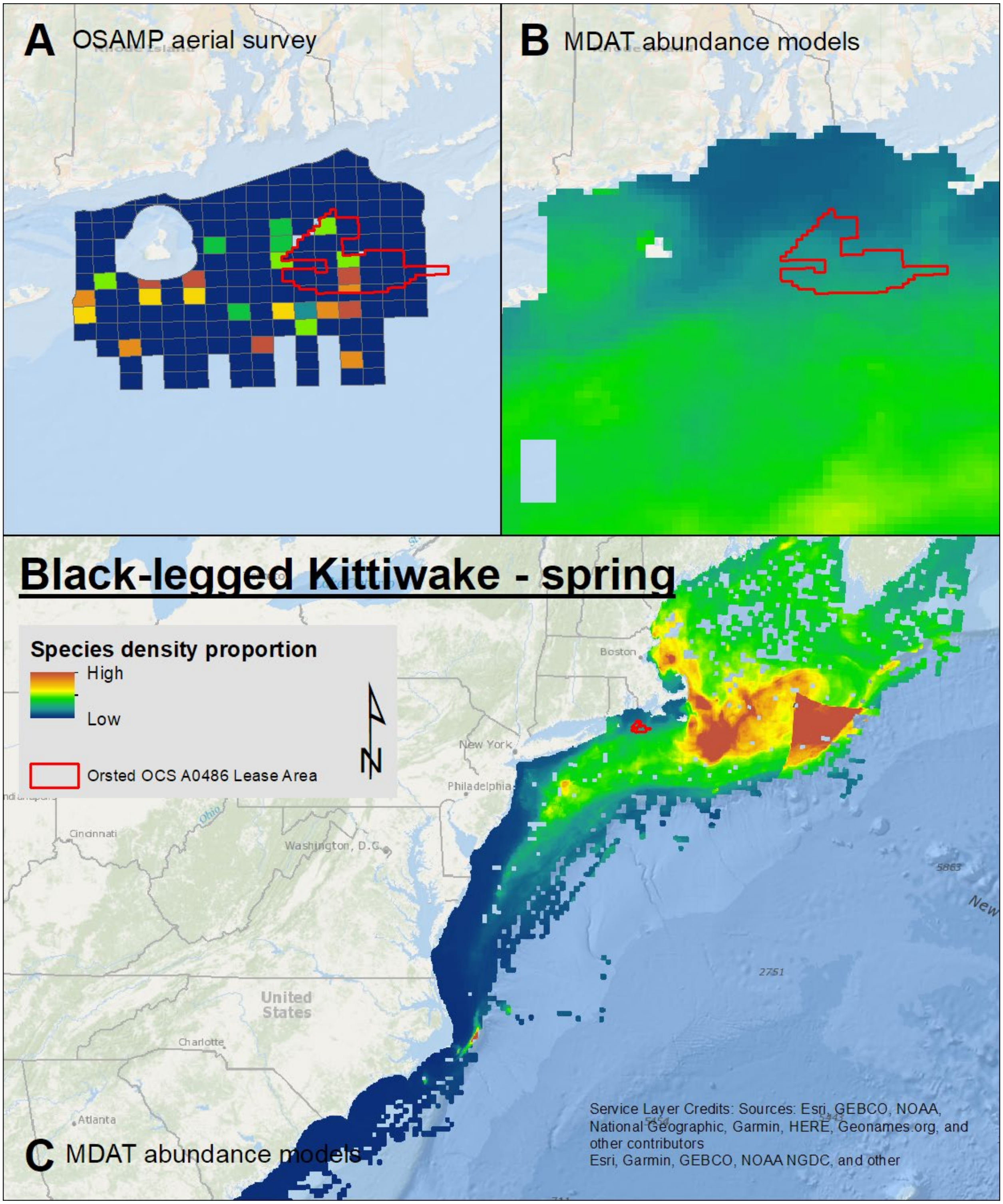
Map 25. Fall Razorbill density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



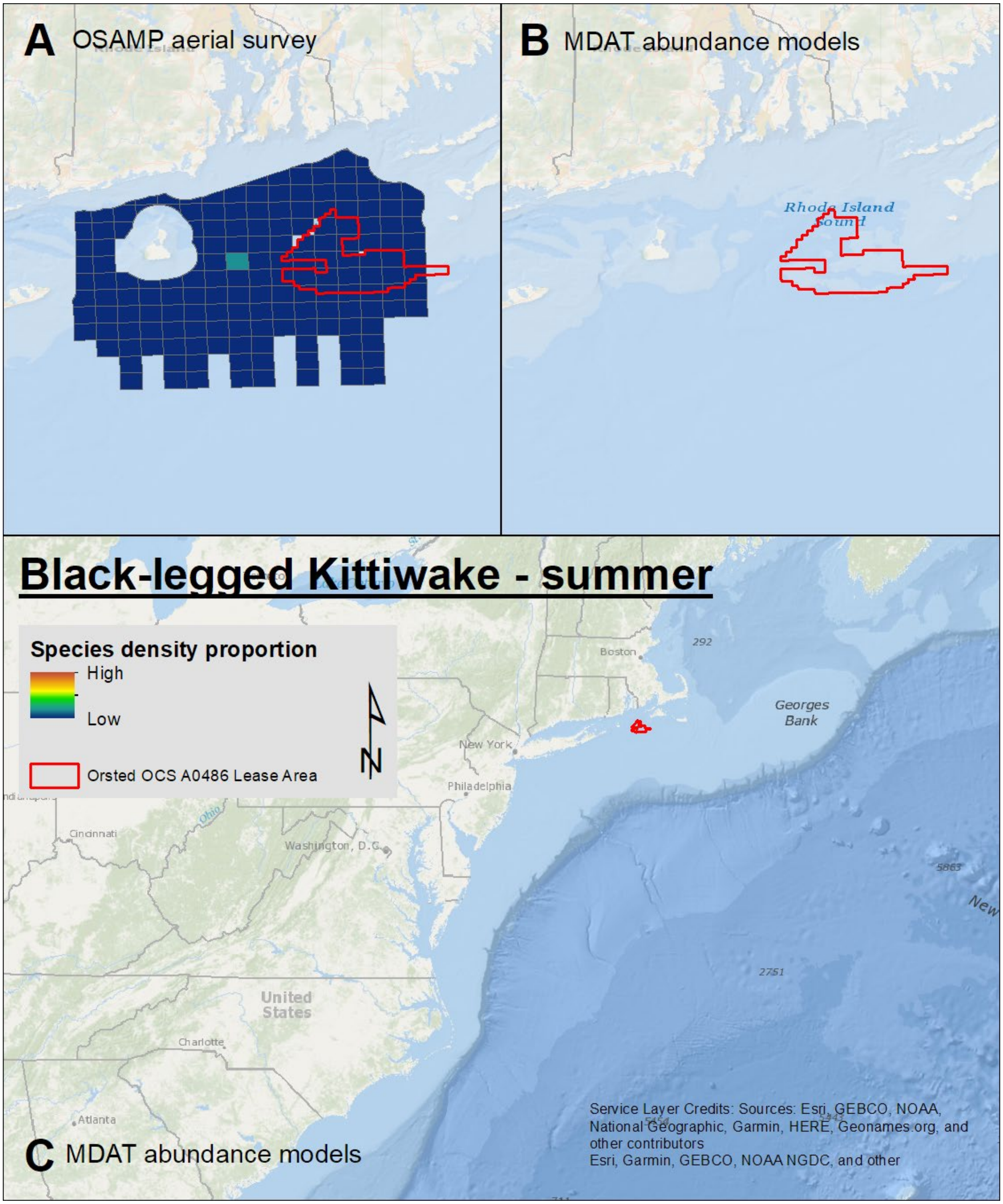
Map 26. Winter Bonaparte's Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



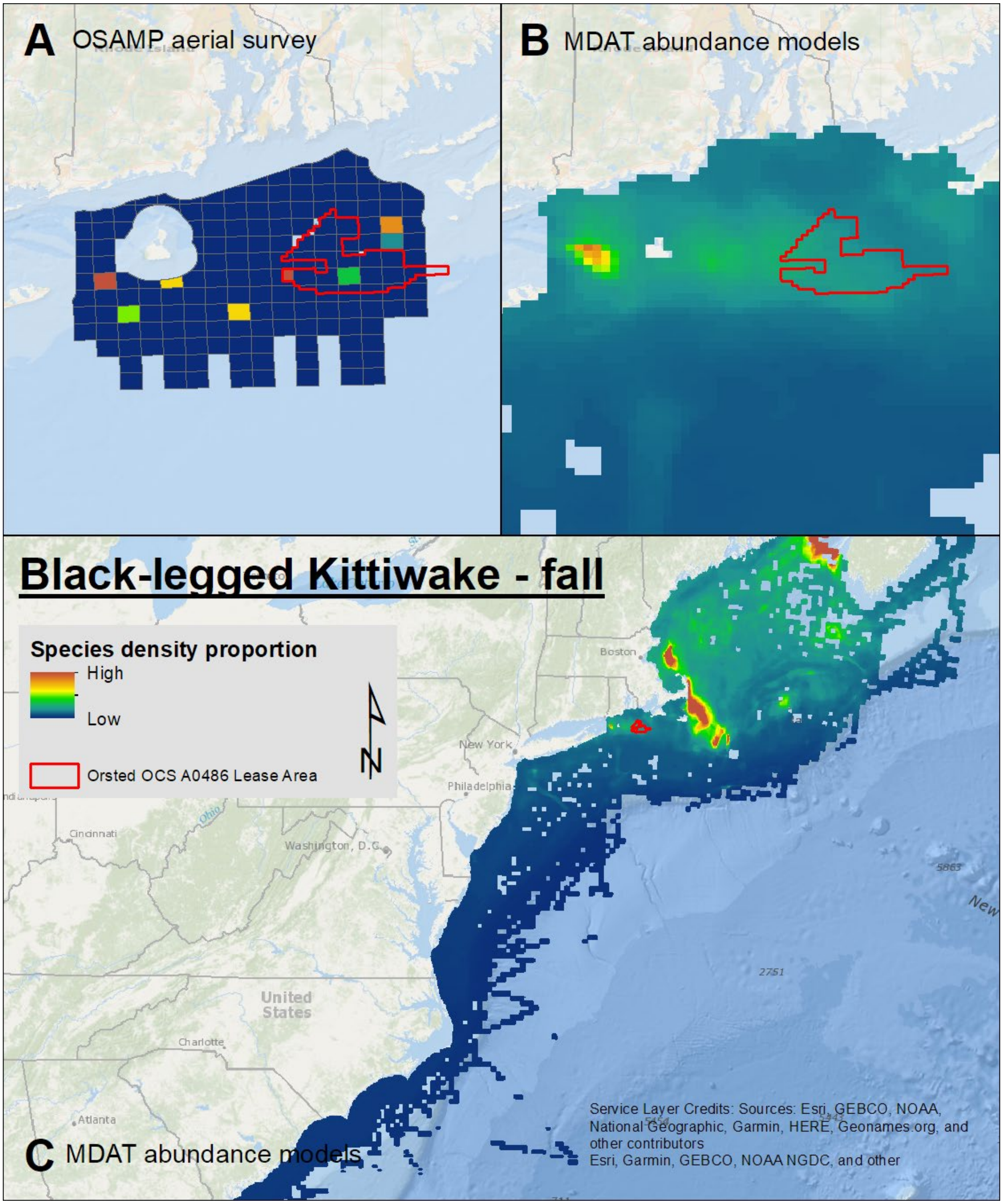
Map 27. Winter Black-legged Kittiwake density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



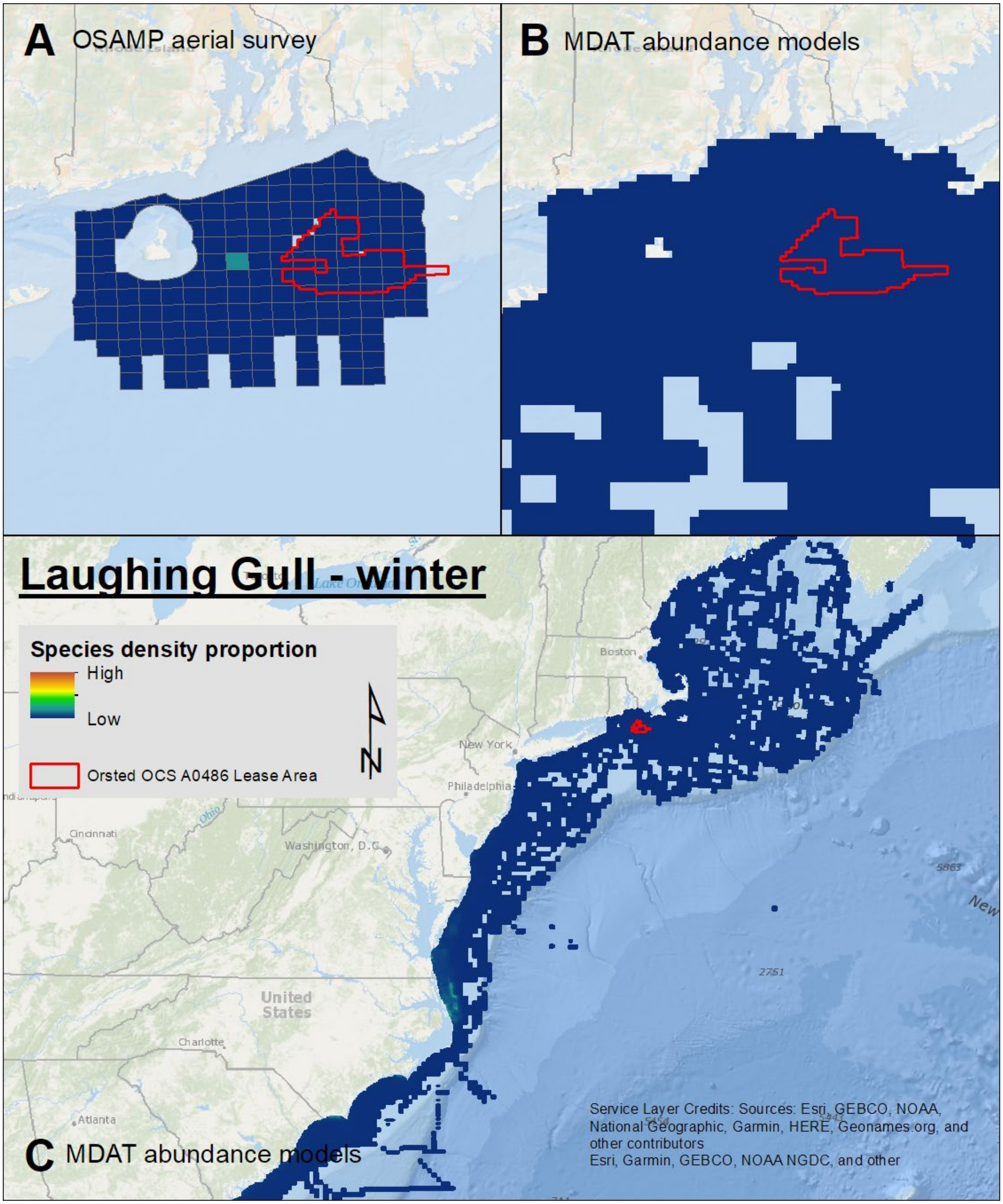
Map 28. Spring Black-legged Kittiwake density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



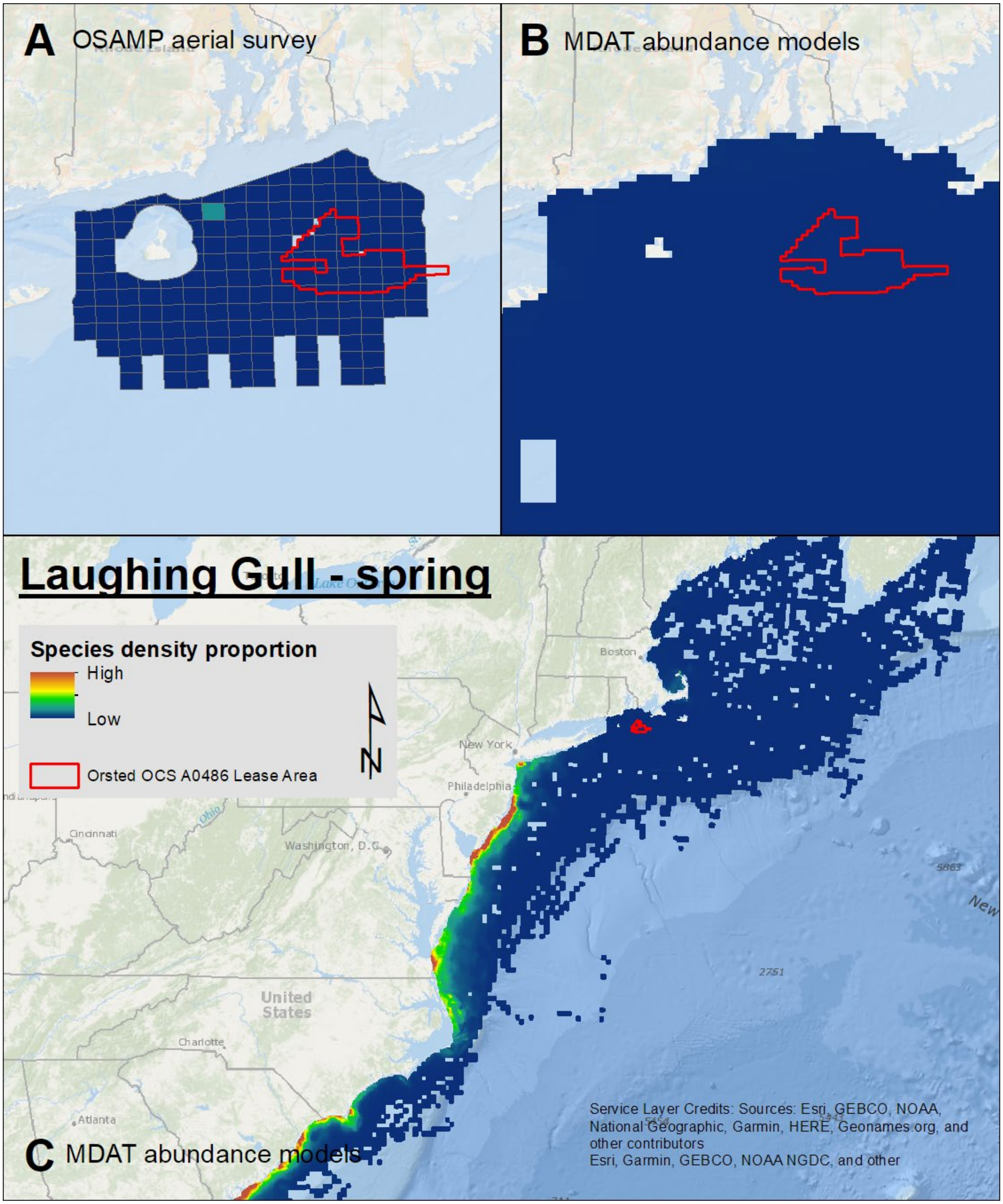
Map 29. Summer Black-legged Kittiwake density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



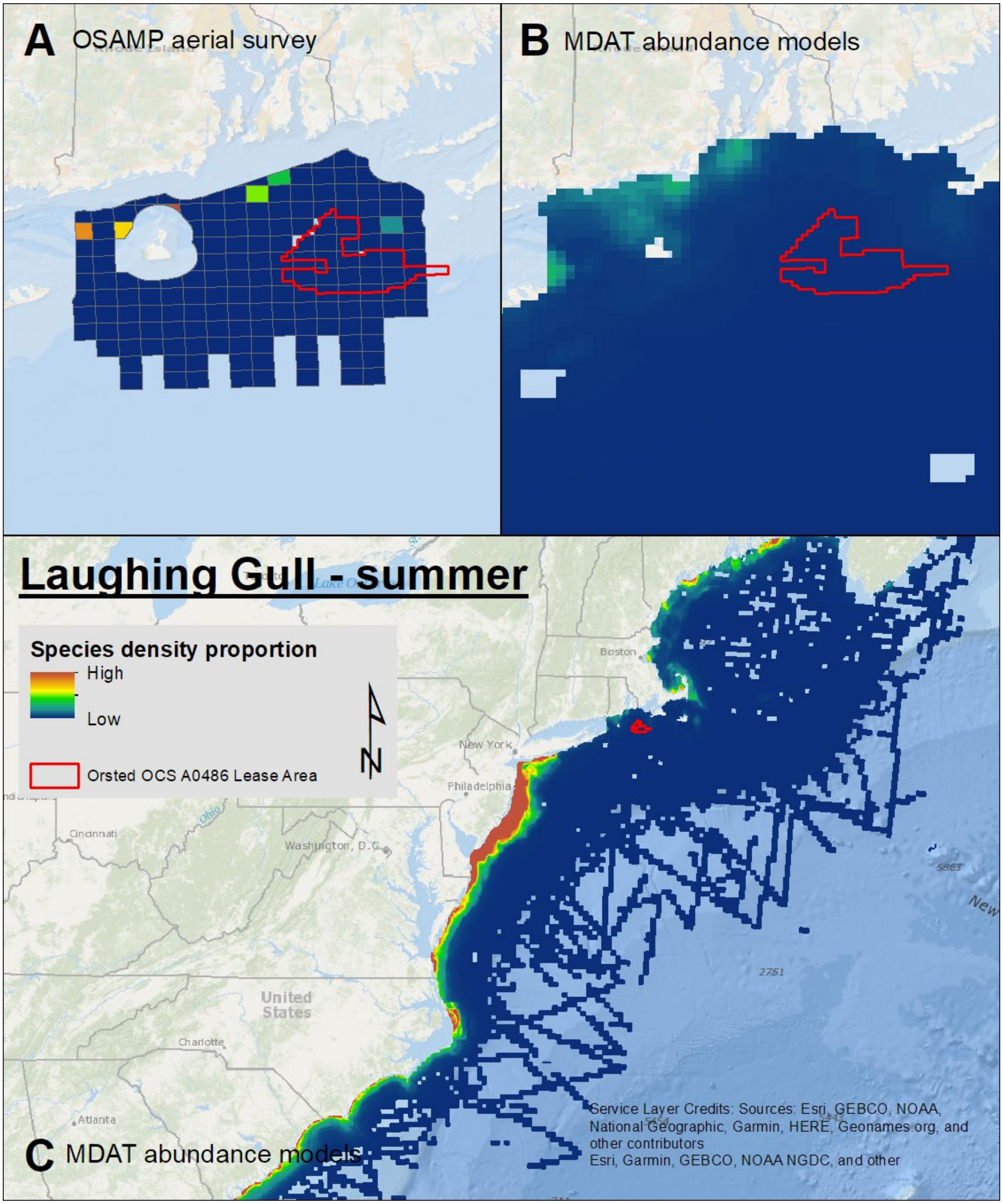
Map 30. Fall Black-legged Kittiwake density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



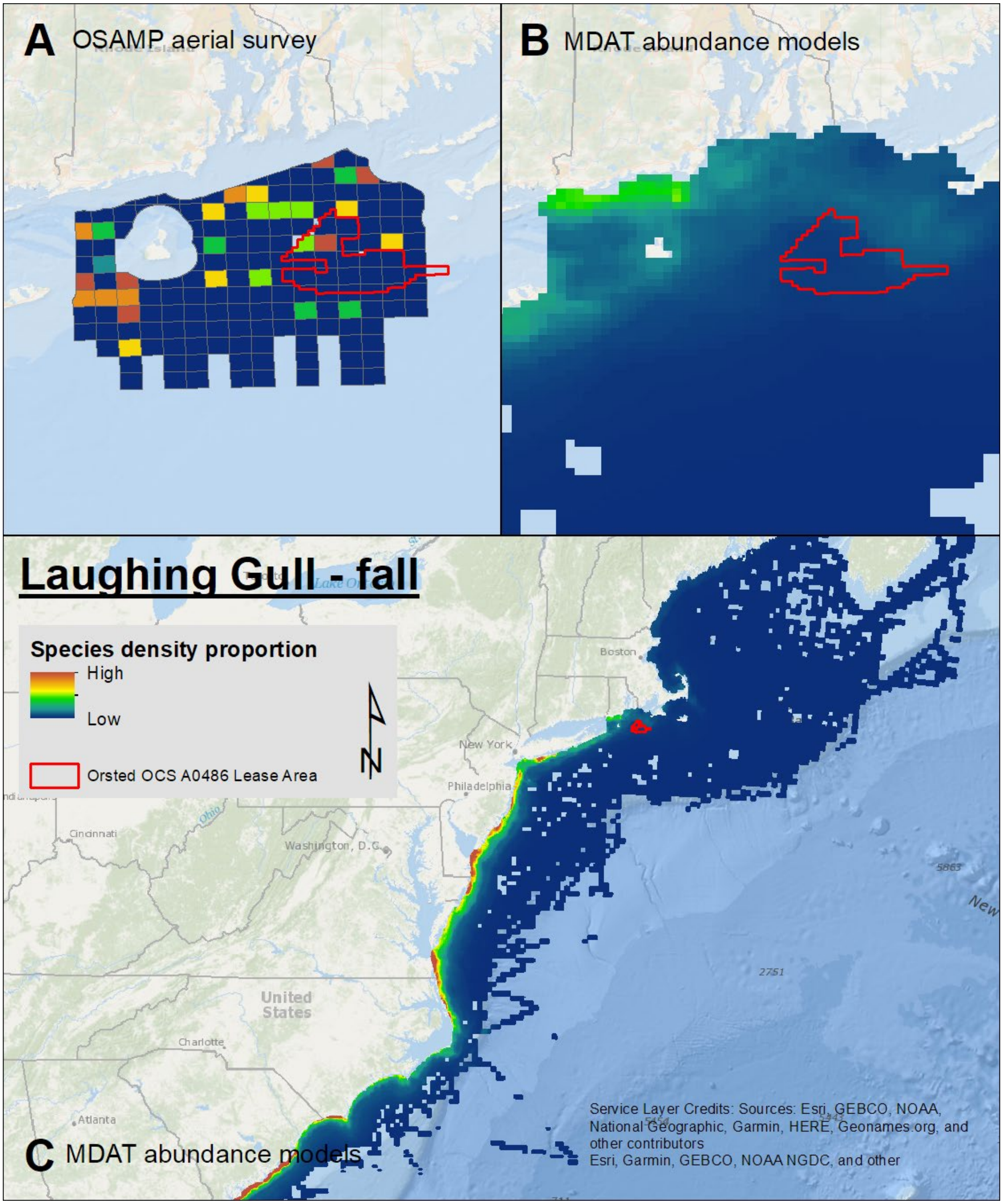
Map 31. Winter Laughing Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



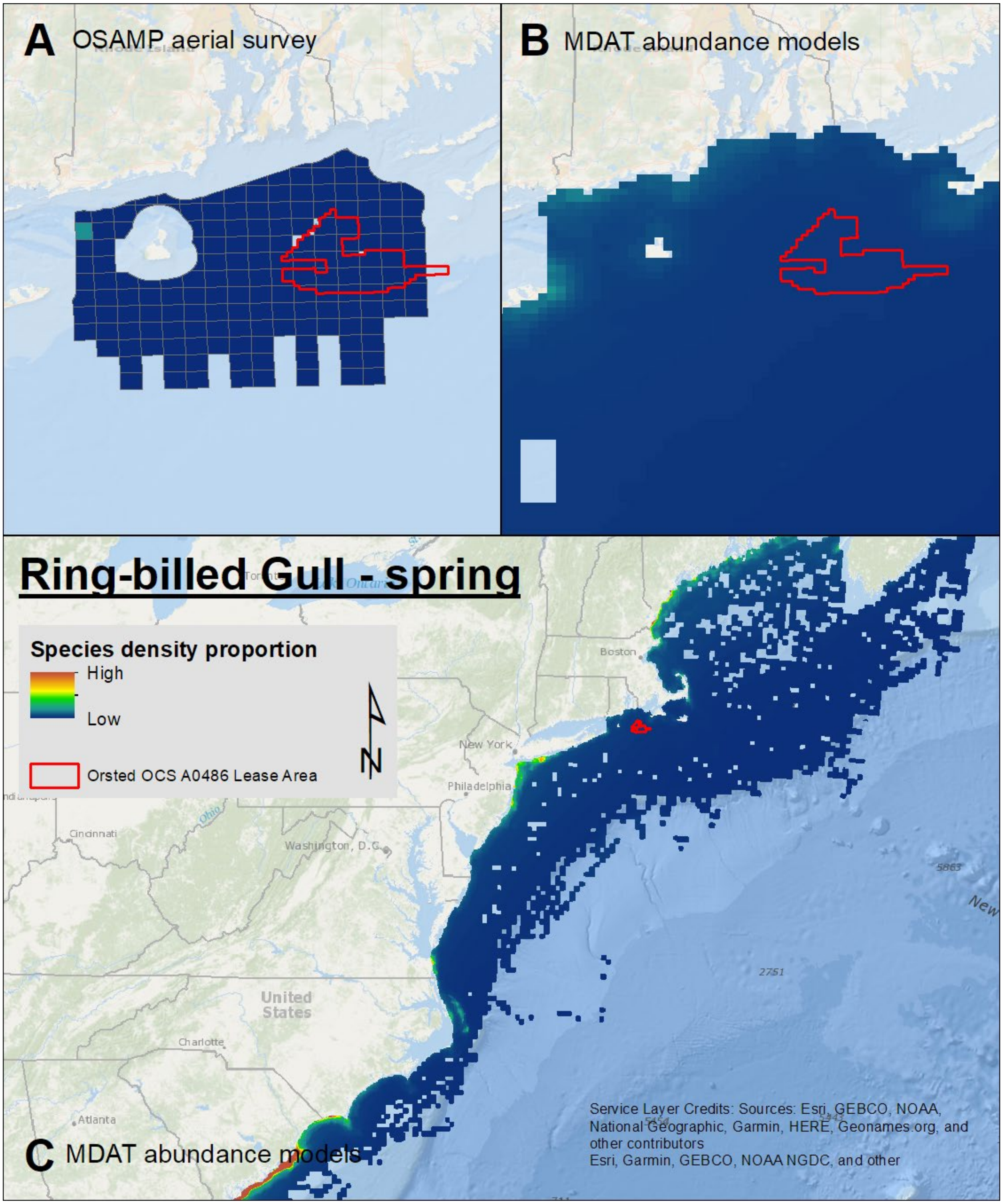
Map 32. Spring Laughing Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



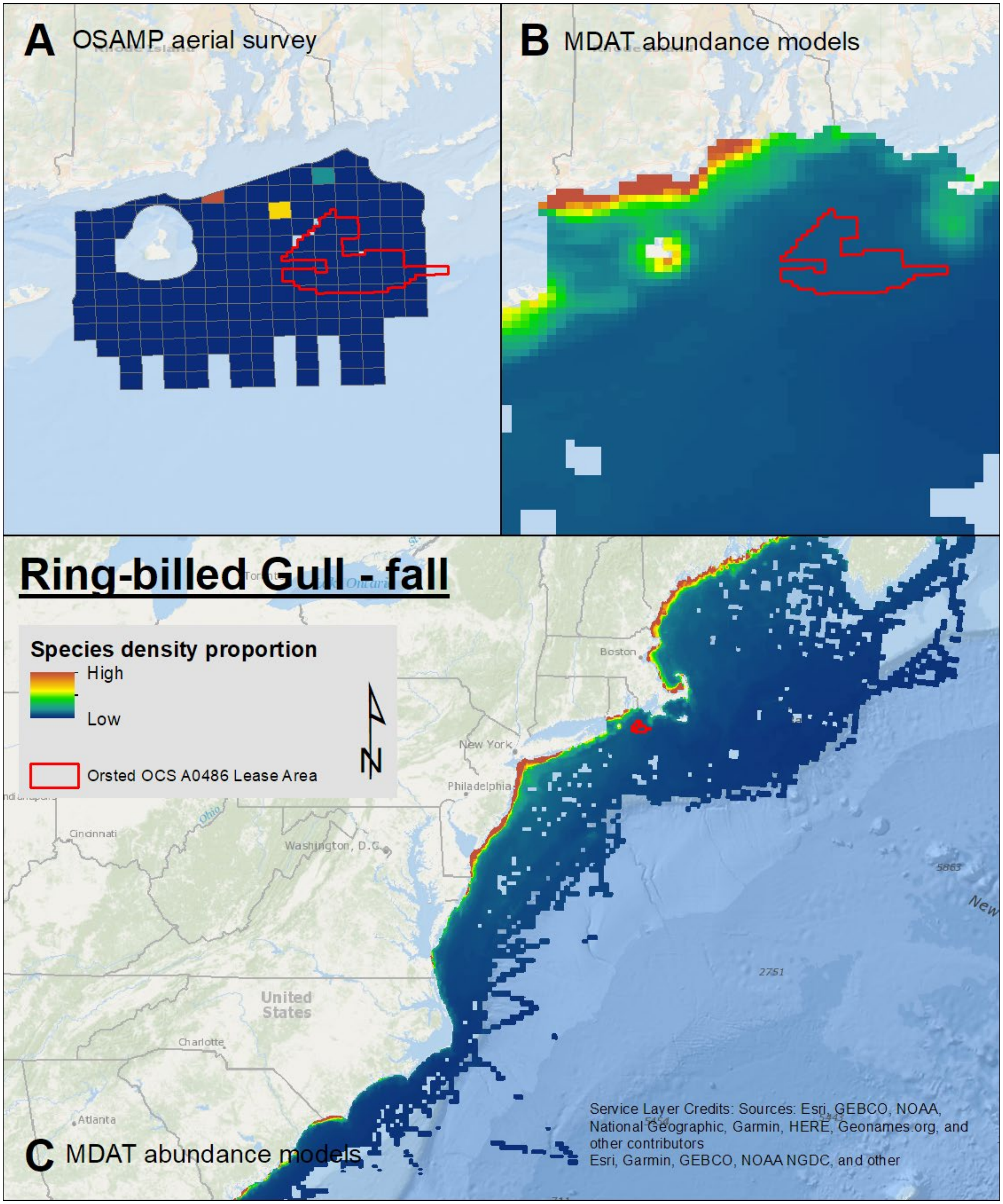
Map 33. Summer Laughing Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



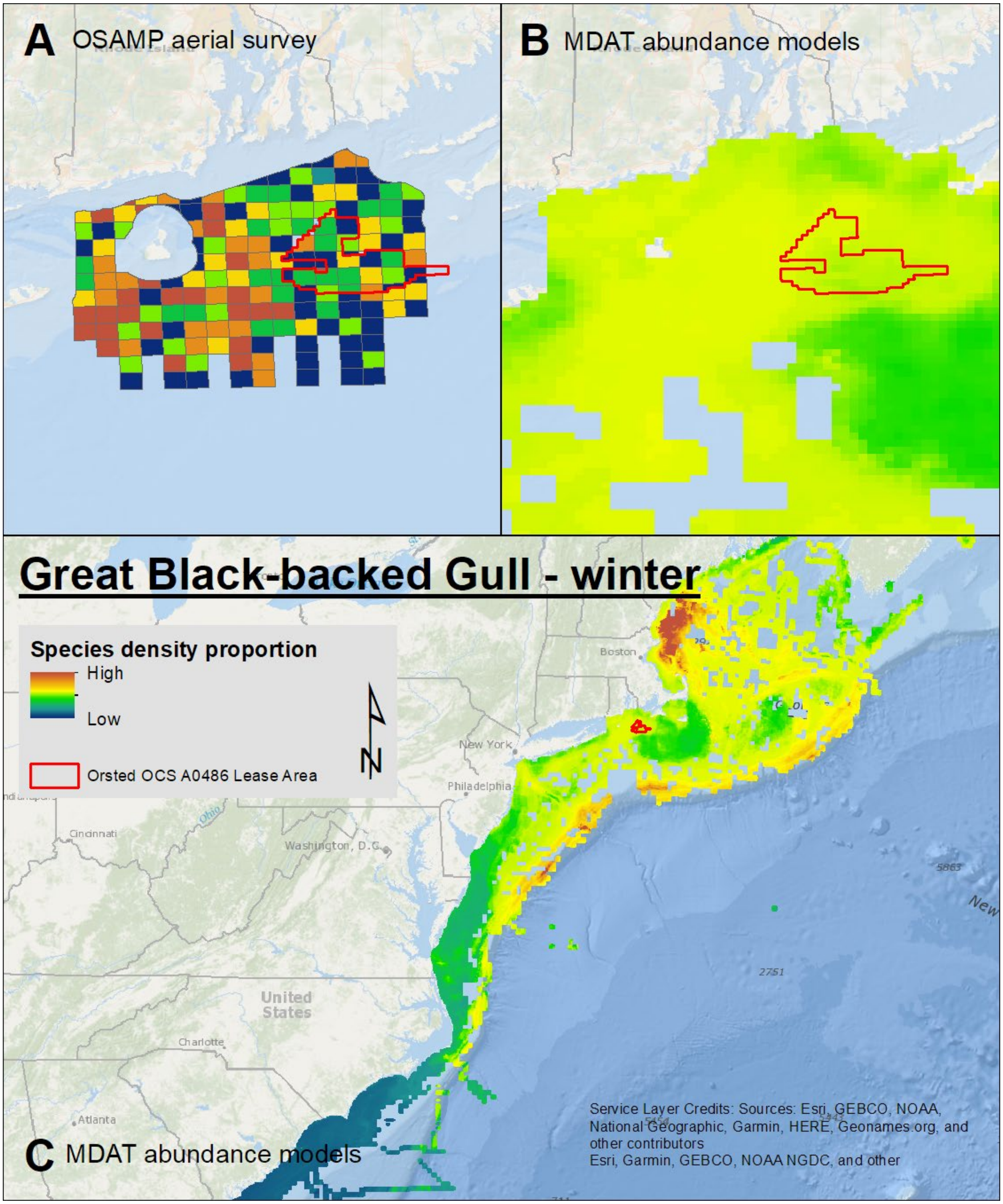
Map 34. Fall Laughing Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



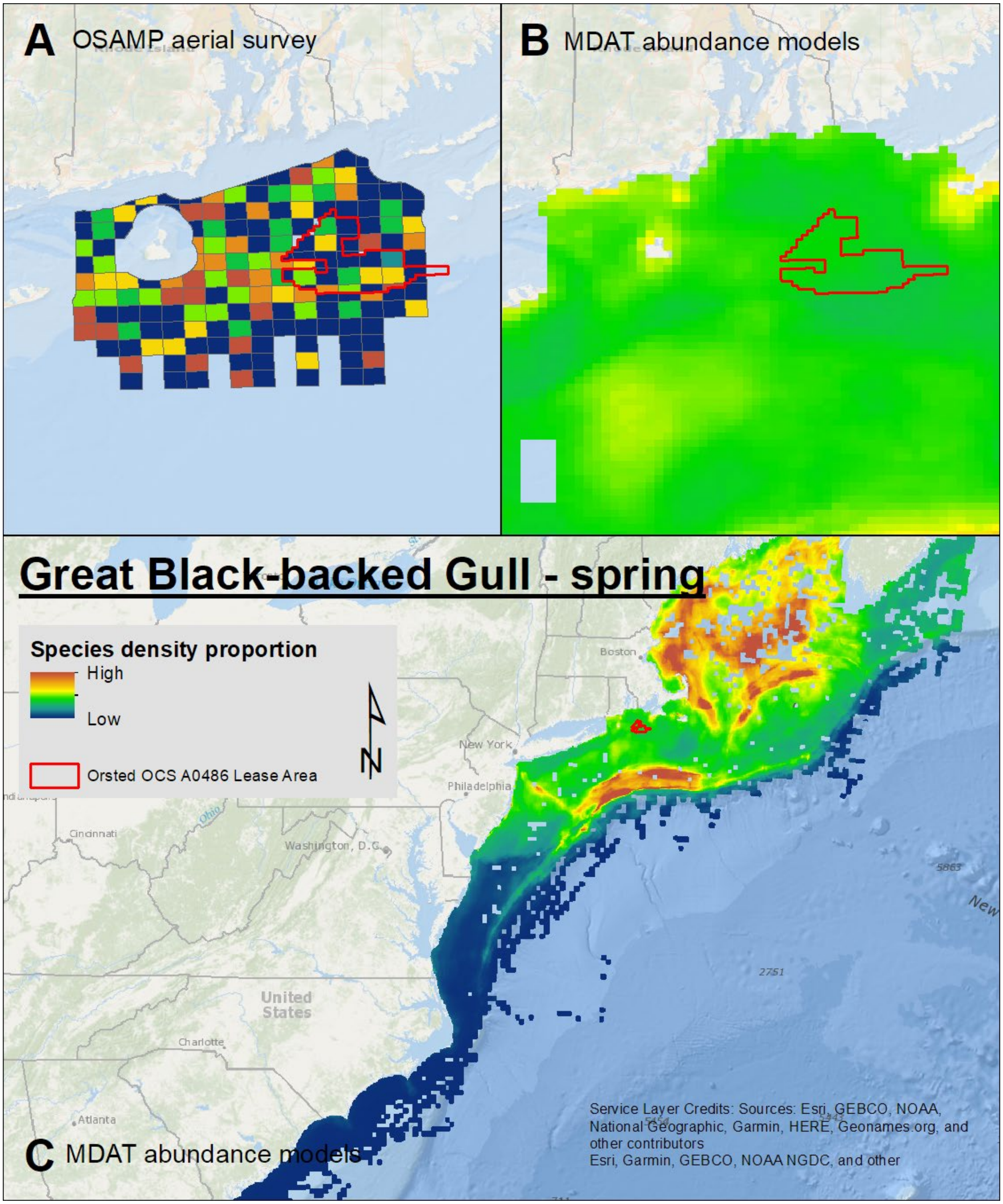
Map 35. Spring Ring-billed Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



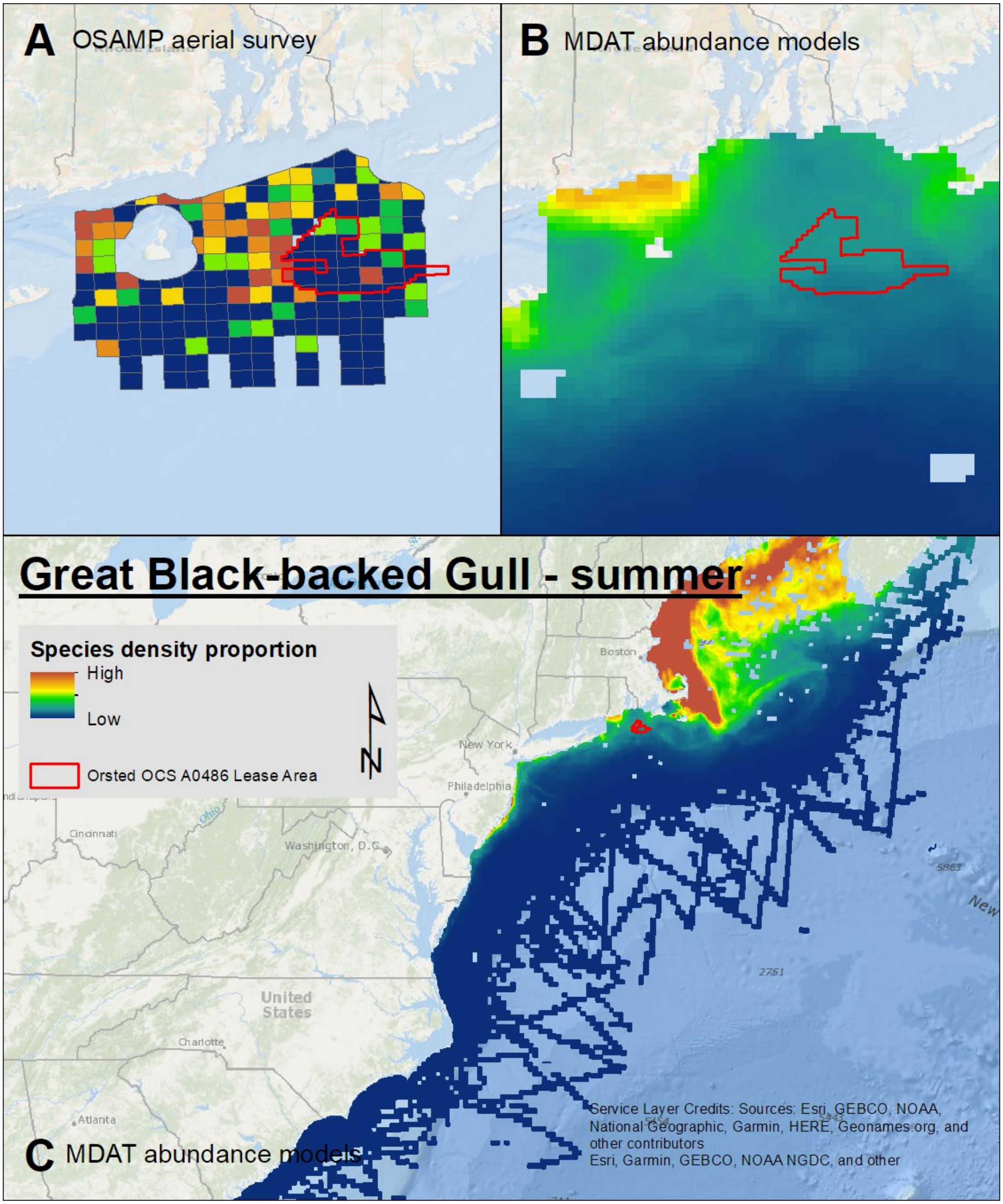
Map 36. Fall Ring-billed Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



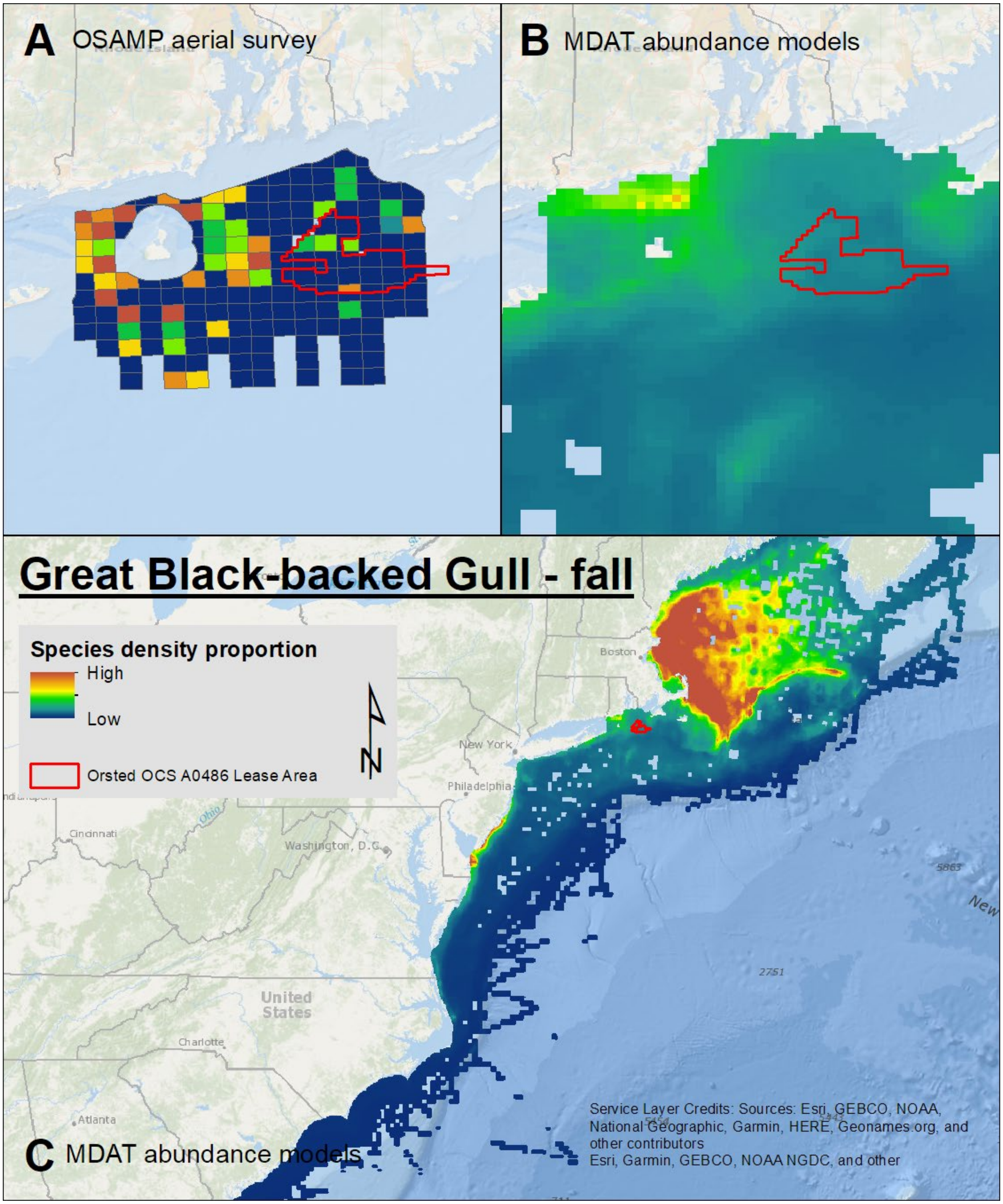
Map 37. Winter Great Black-backed Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



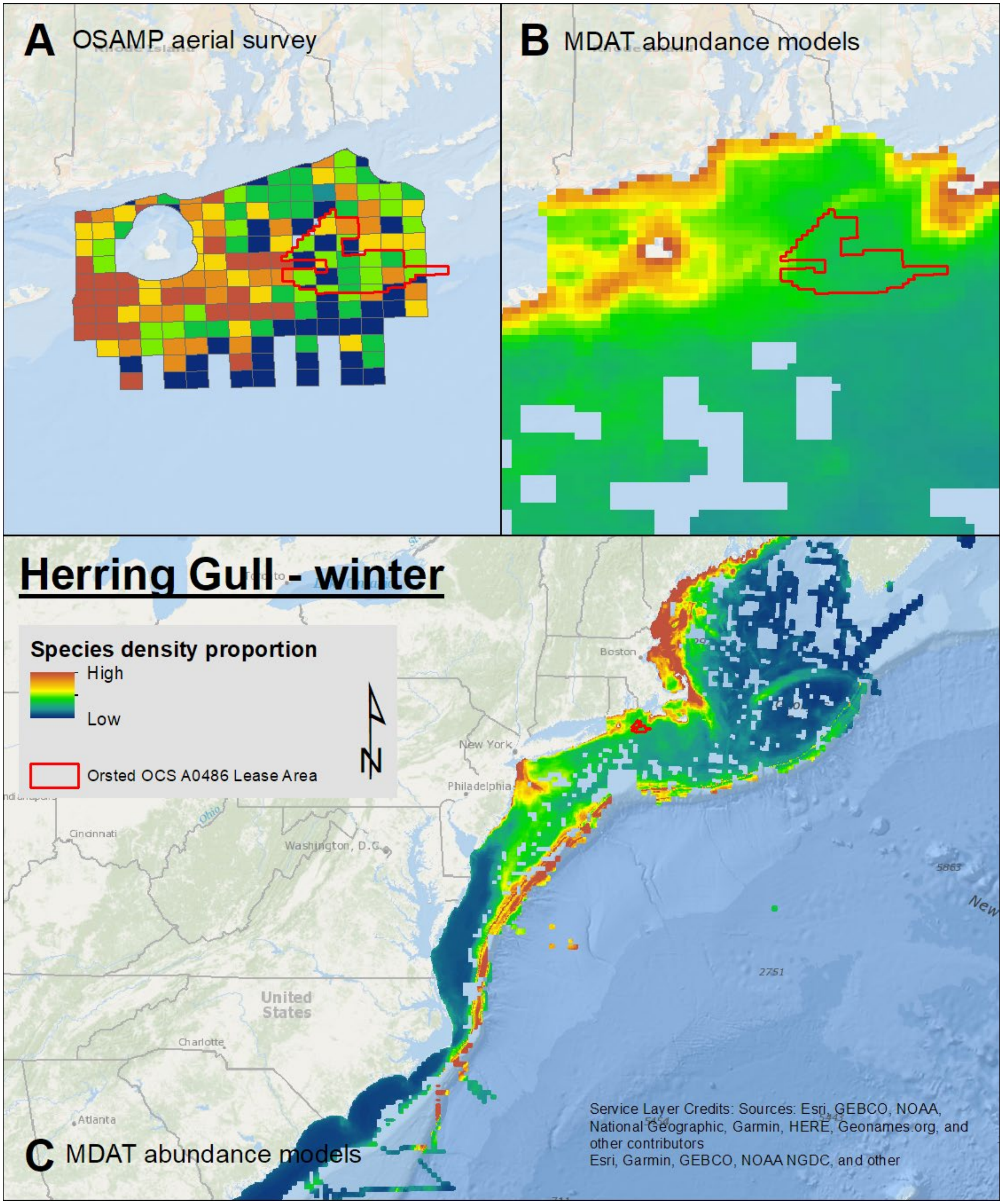
Map 38. Spring Great Black-backed Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



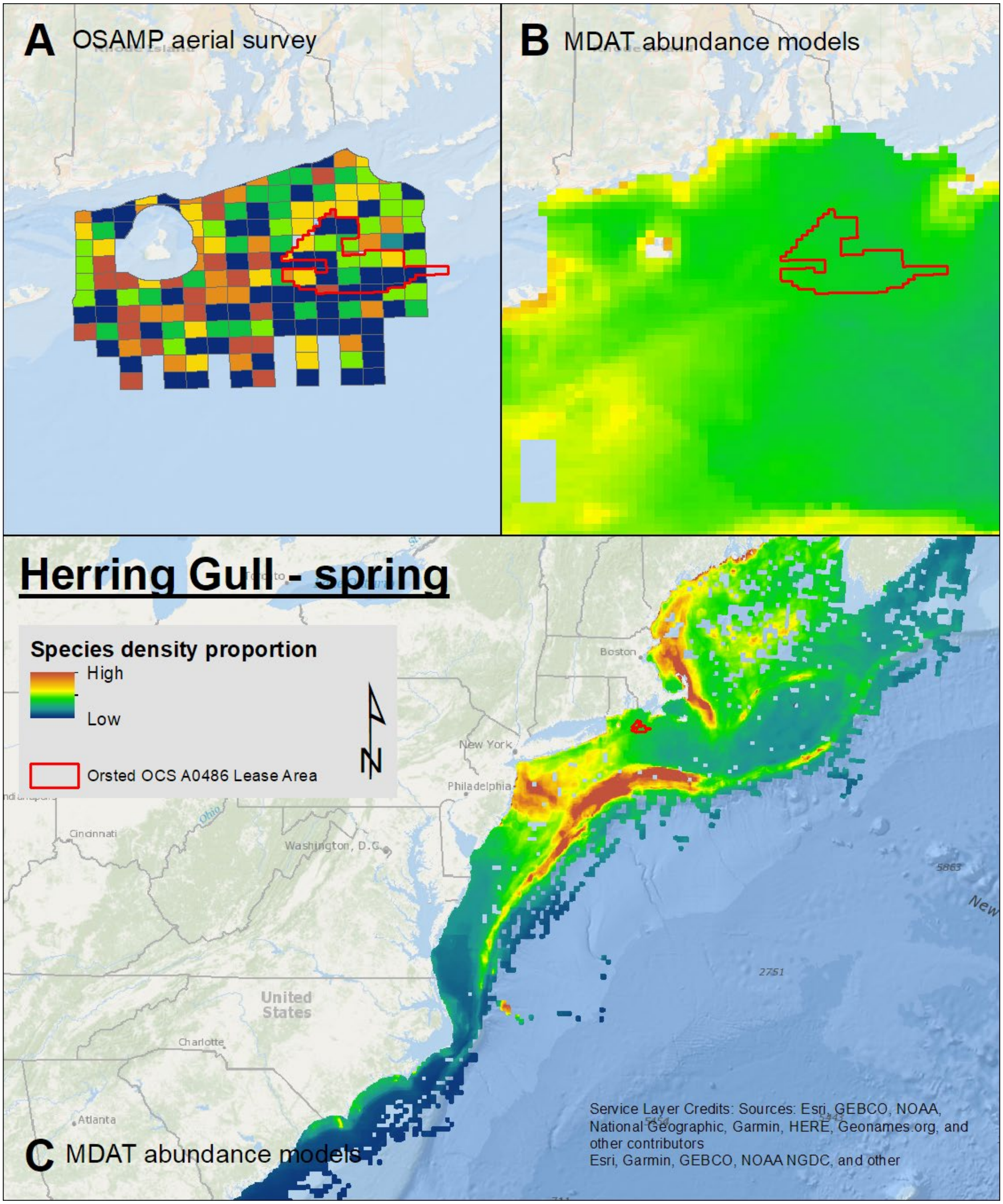
Map 39. Summer Great Black-backed Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



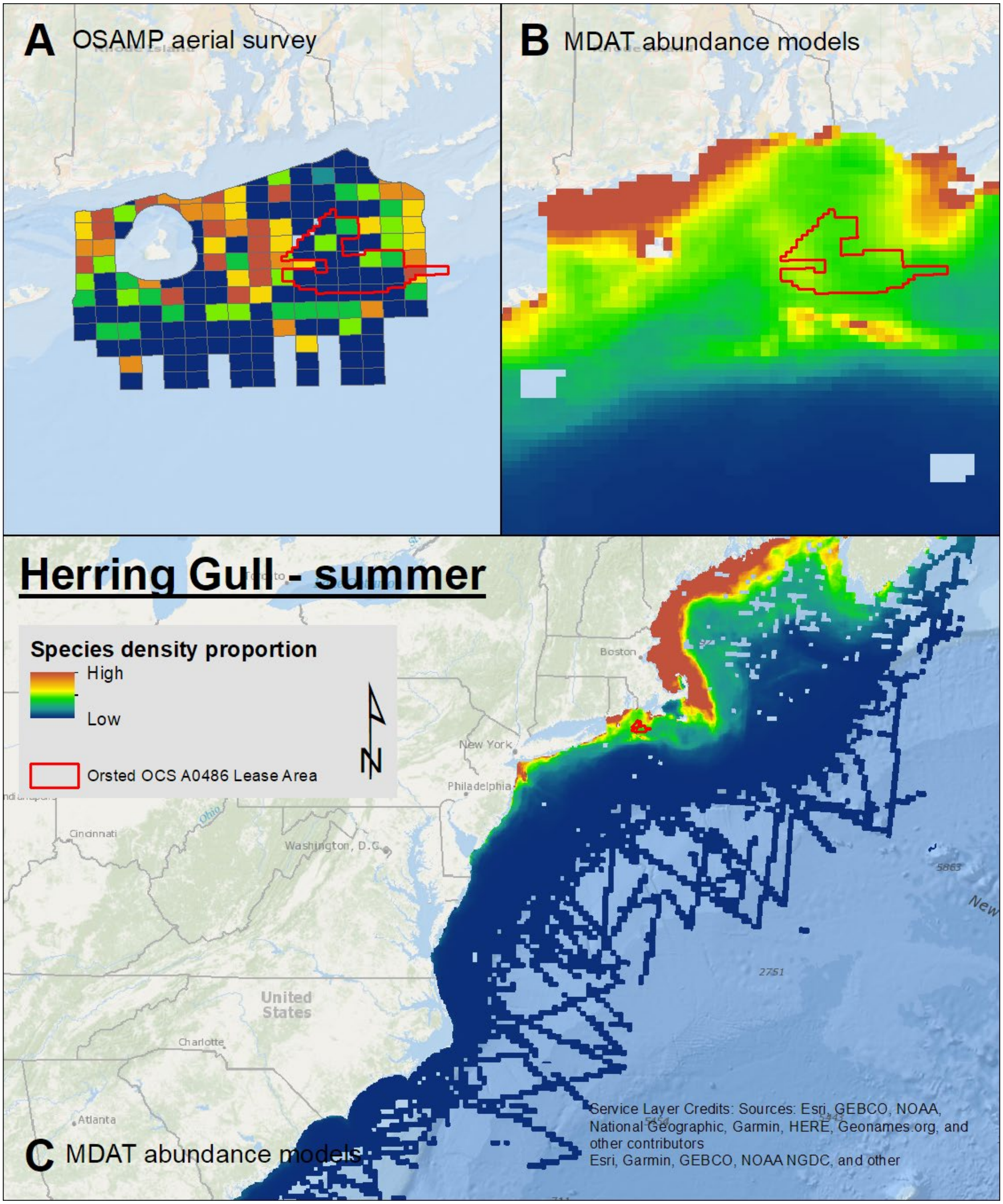
Map 40. Fall Great Black-backed Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



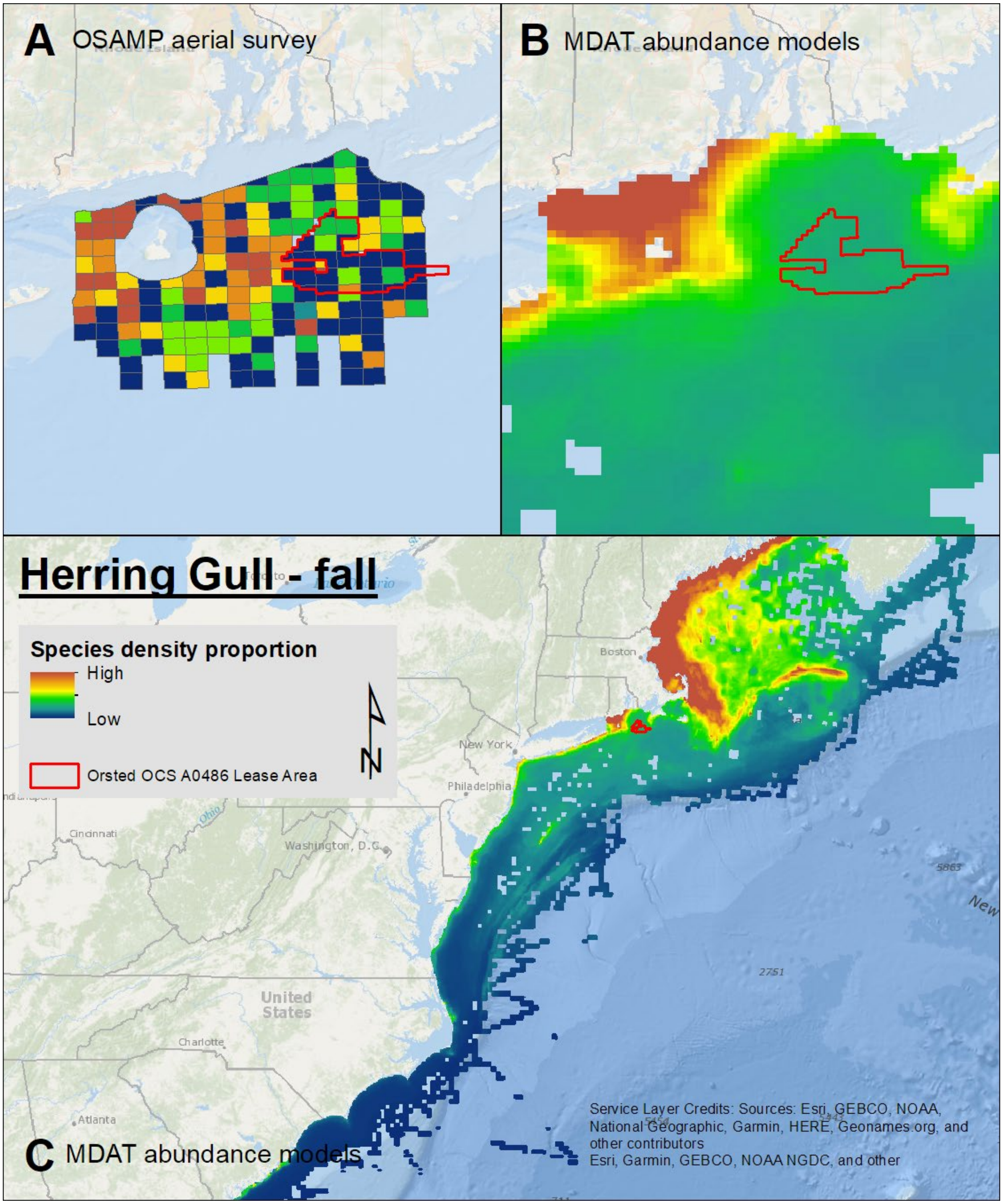
Map 41. Winter Herring Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



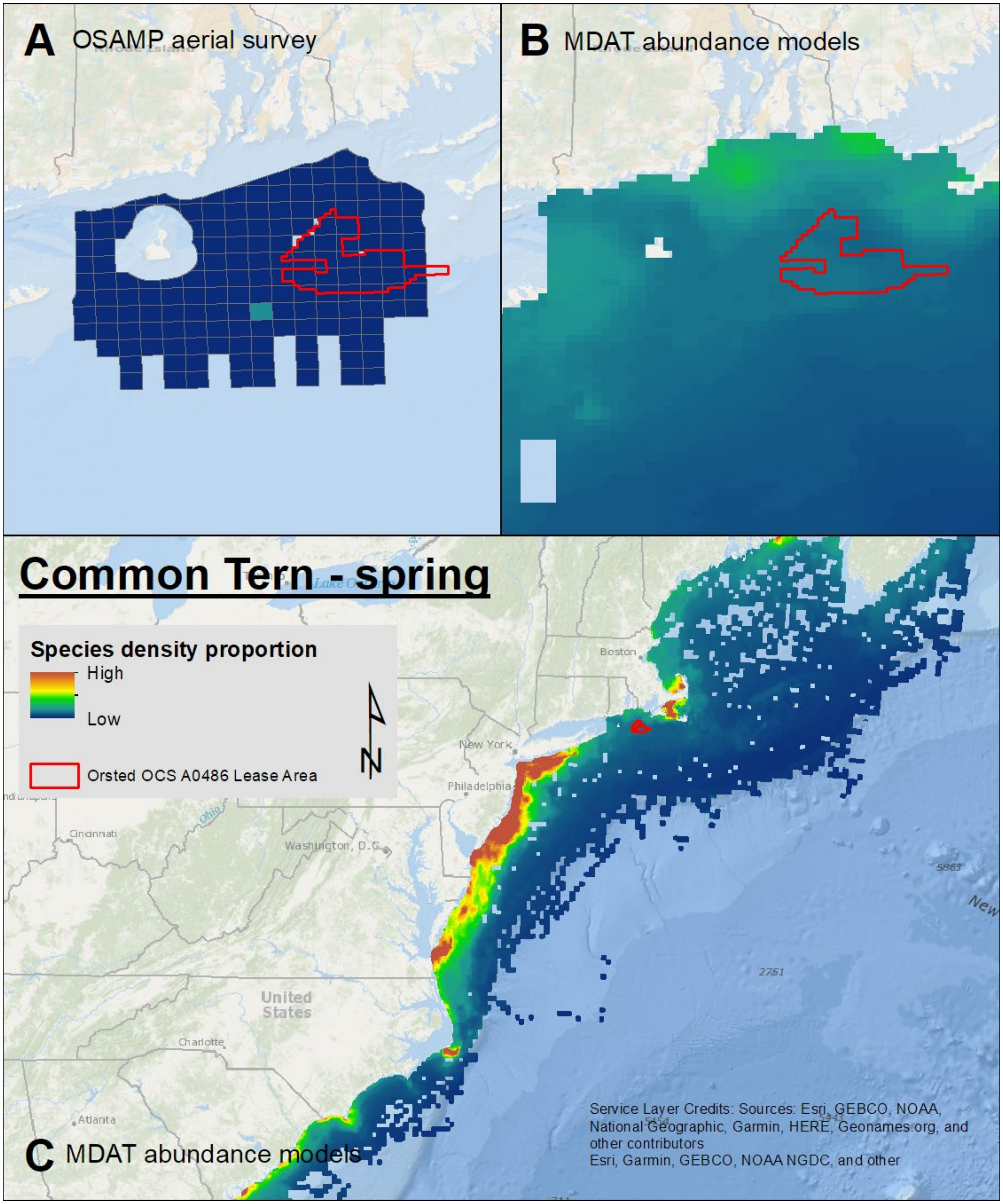
Map 42. Spring Herring Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



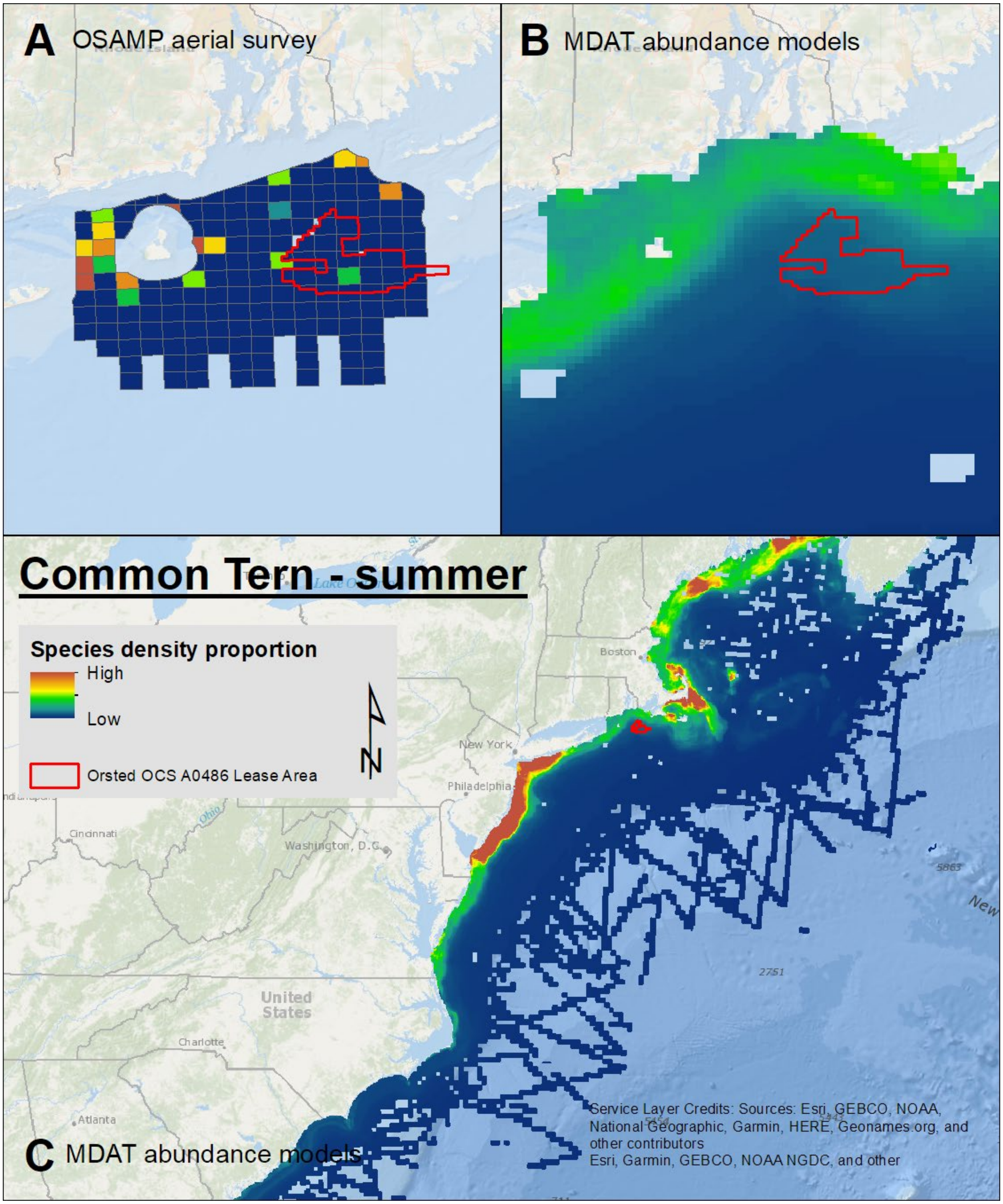
Map 43. Summer Herring Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



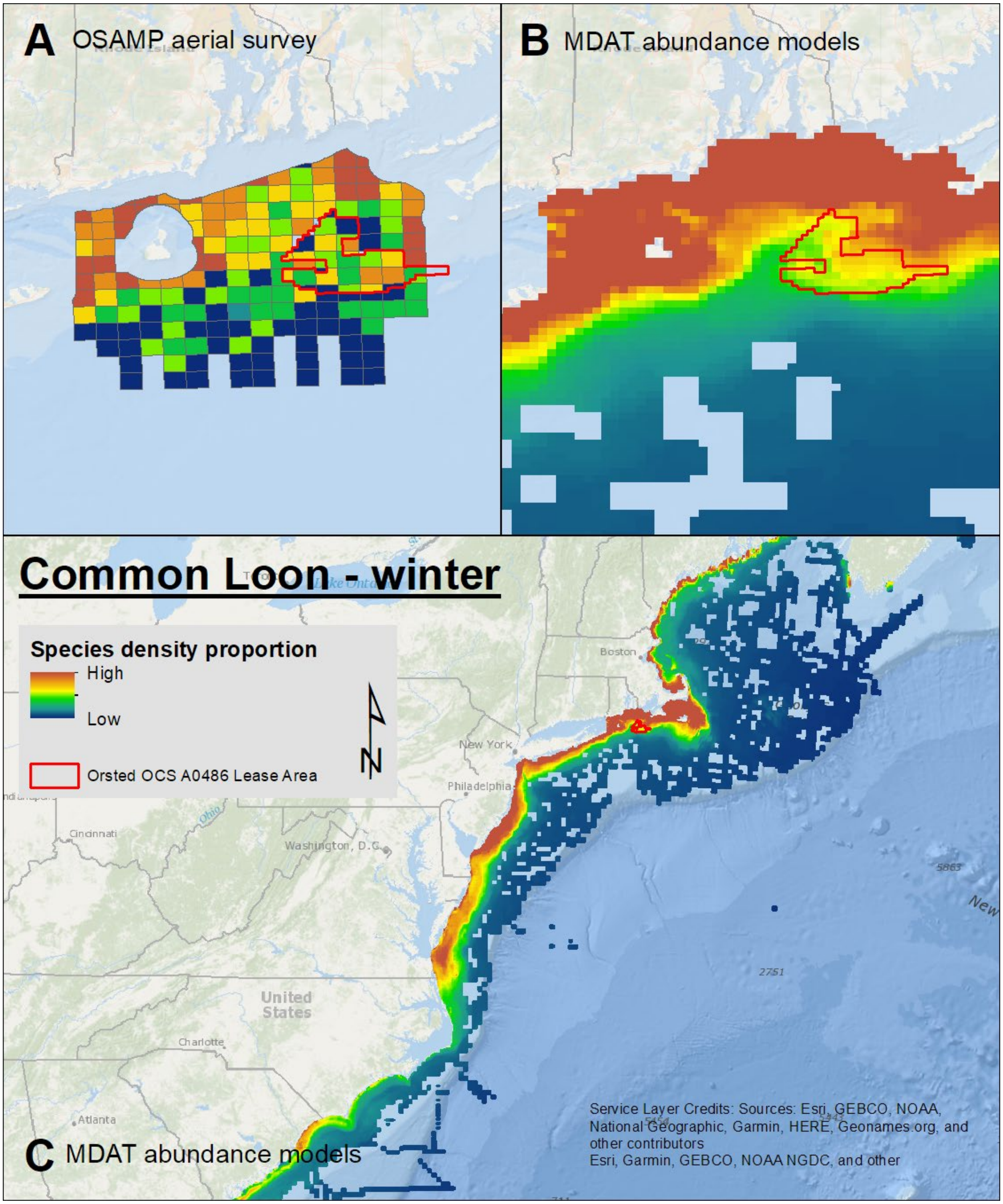
Map 44. Fall Herring Gull density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



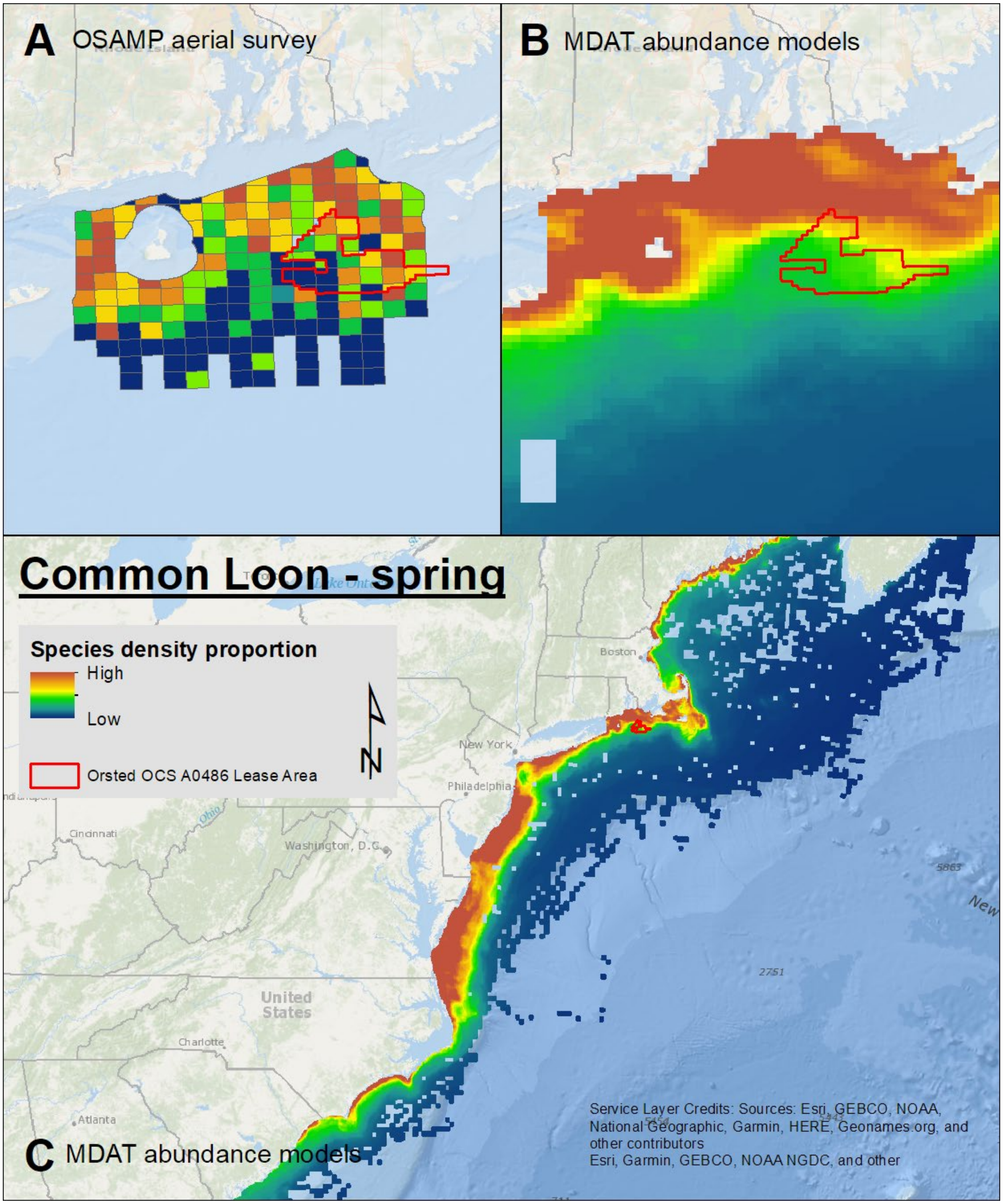
Map 45. Spring Common Tern density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



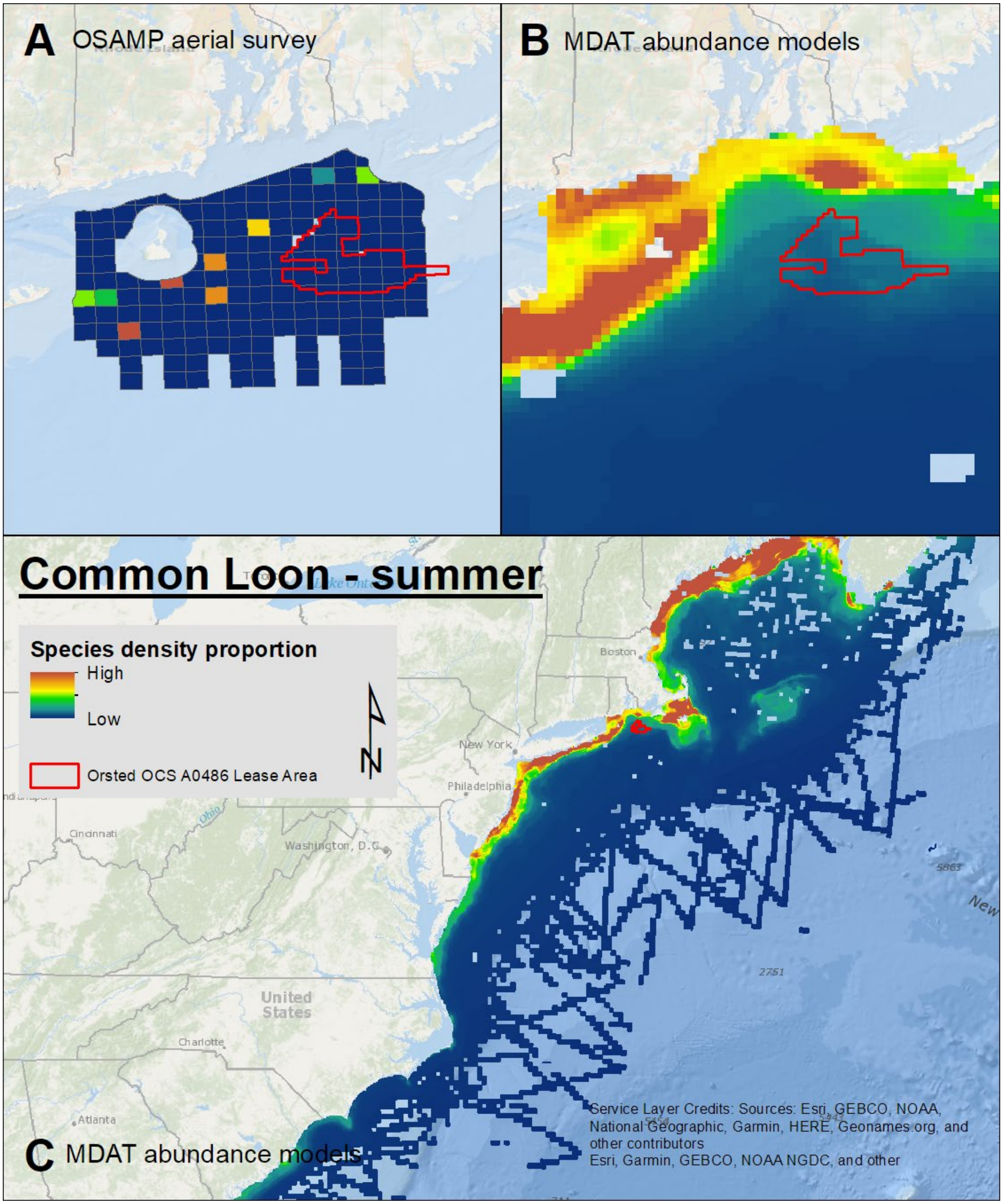
Map 46. Summer Common Tern density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



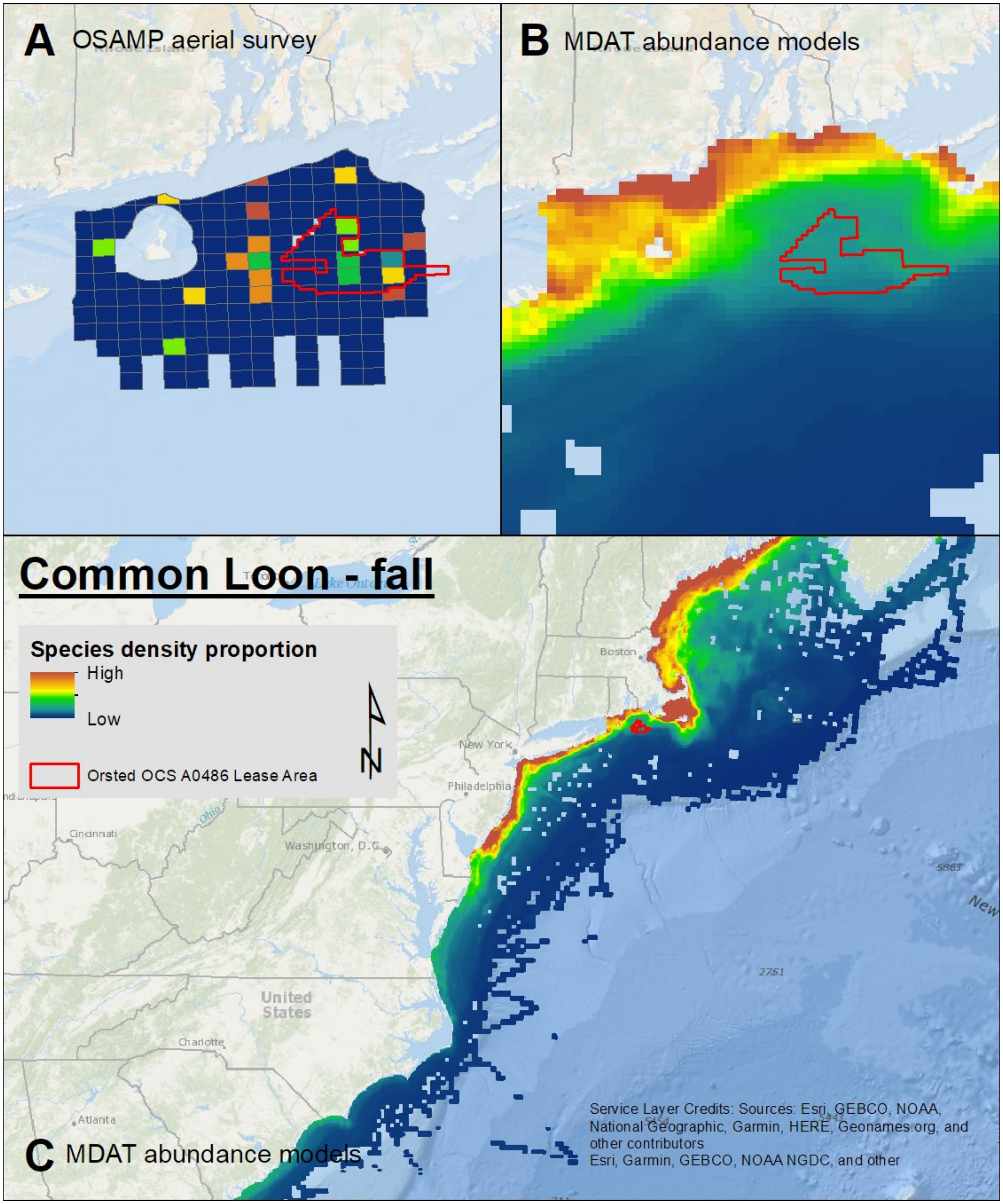
Map 47. Winter Common Loon density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



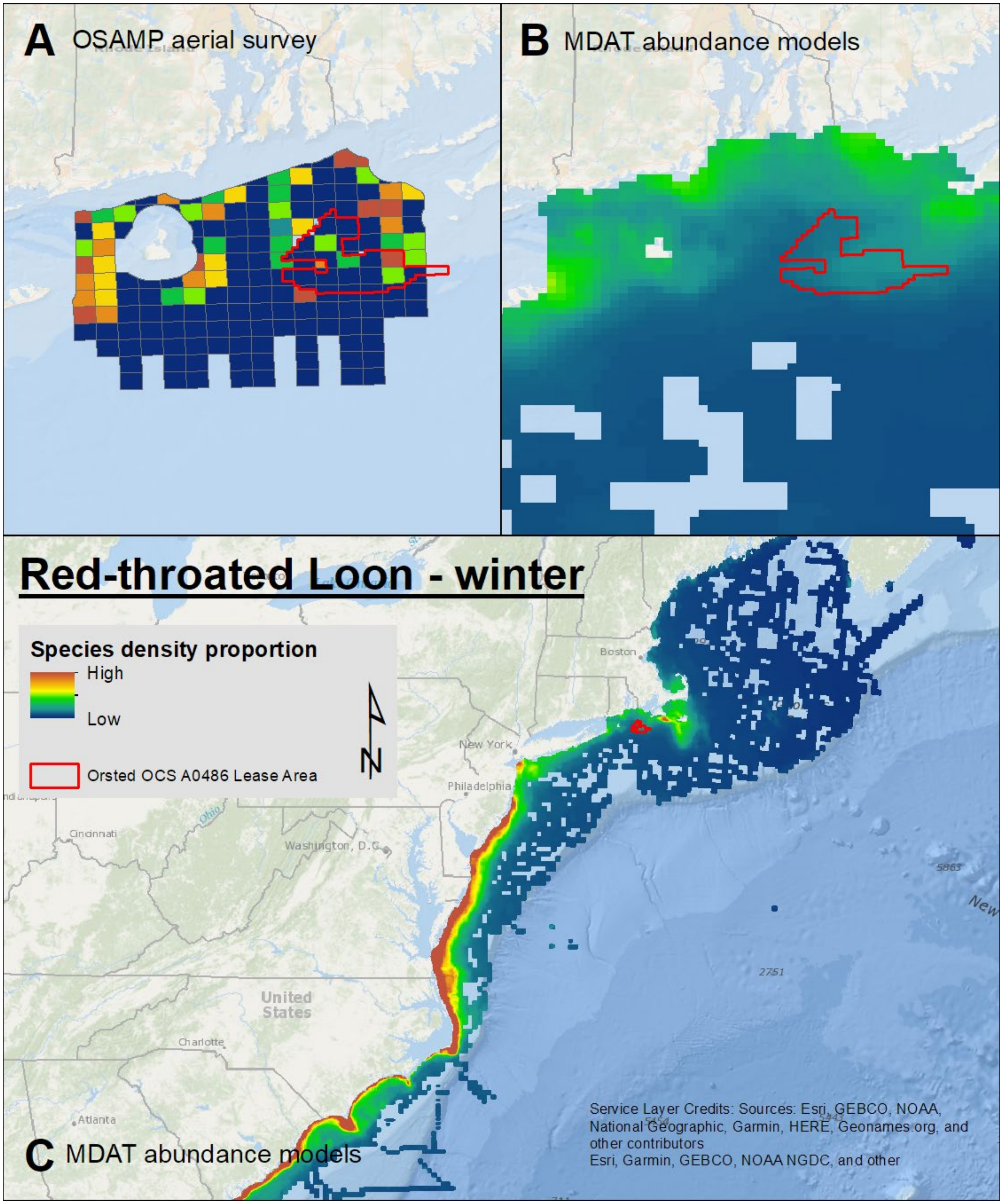
Map 48. Spring Common Loon density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



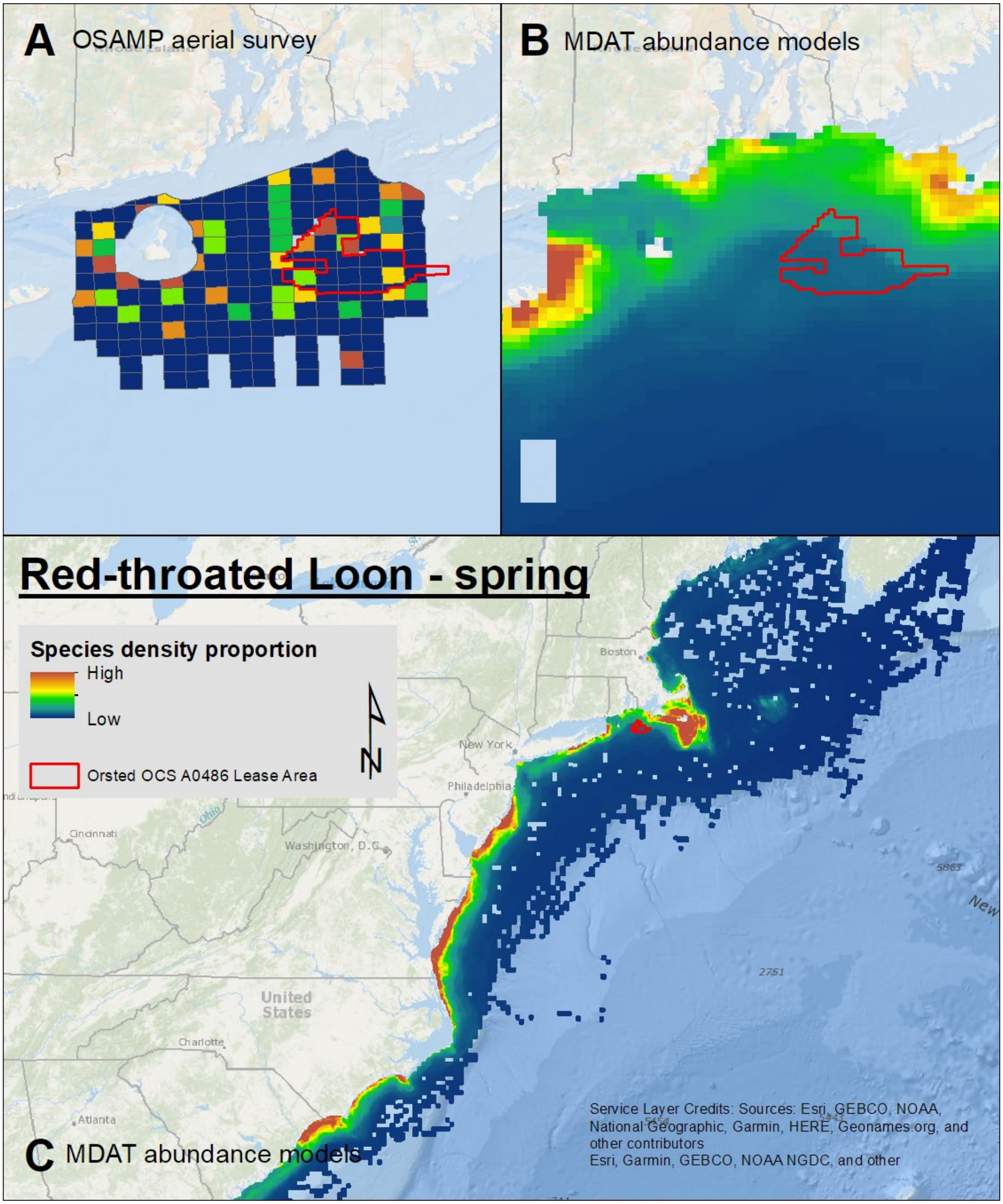
Map 49. Summer Common Loon density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



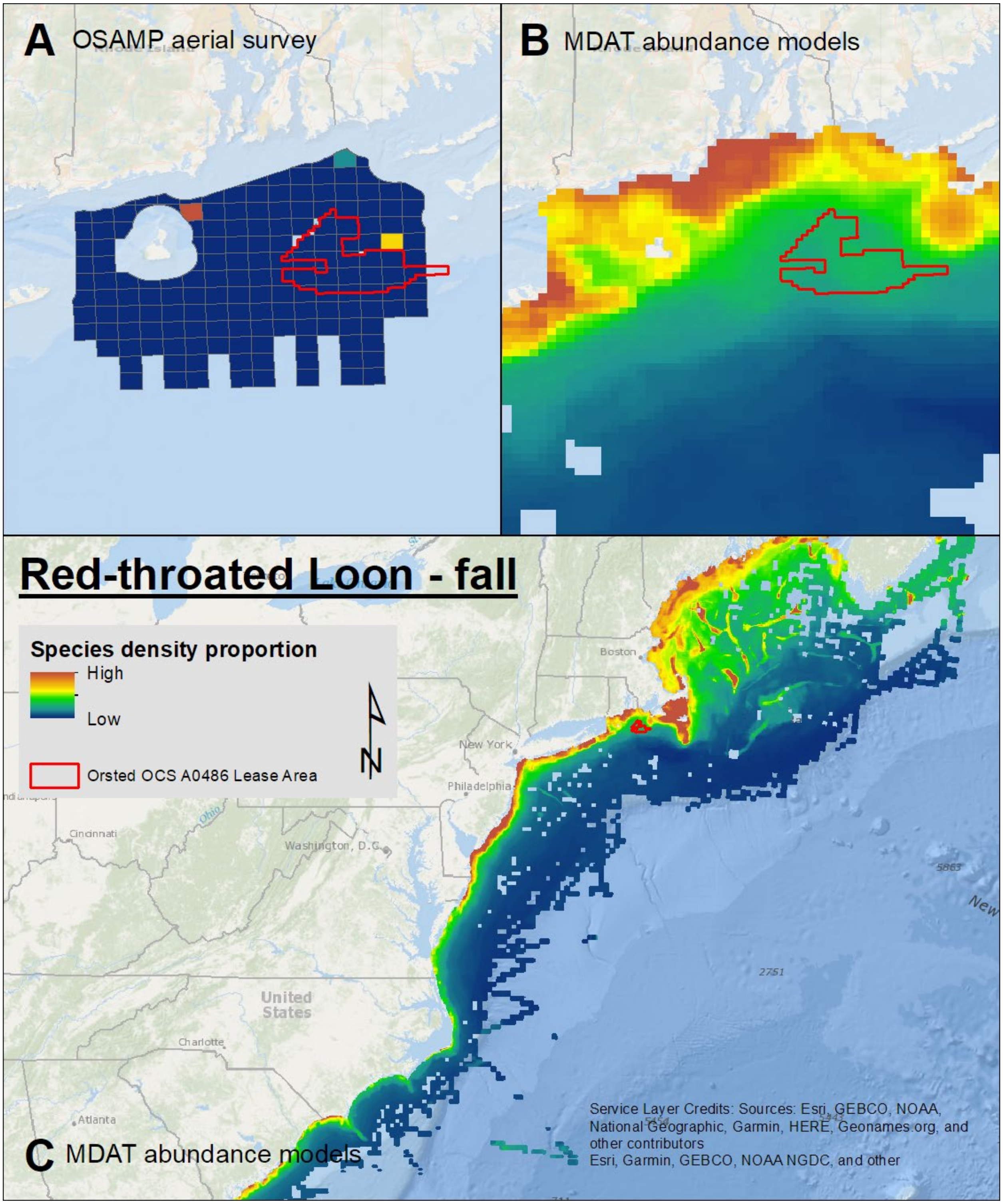
Map 50. Fall Common Loon density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



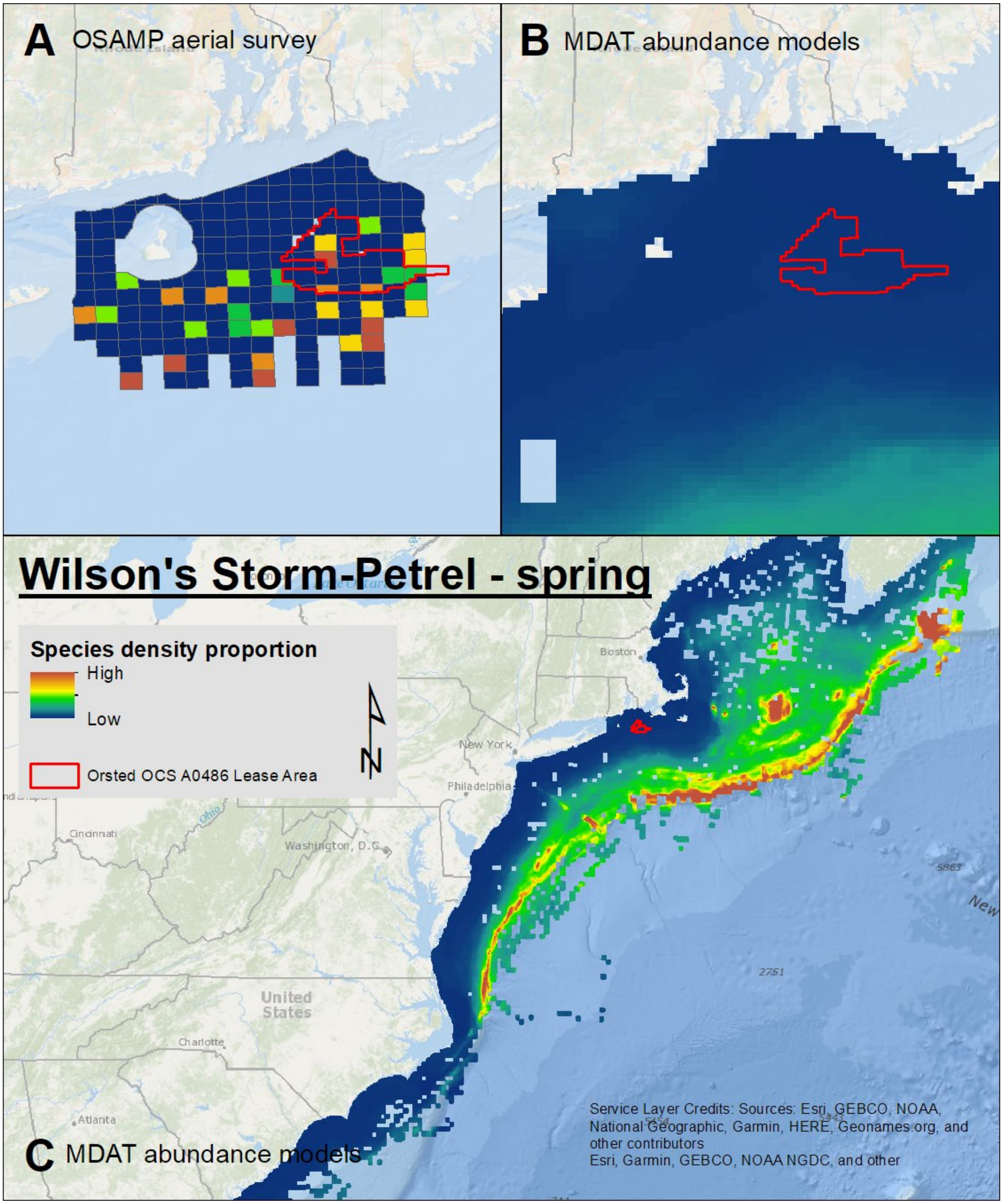
Map 51. Winter Red-throated Loon density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



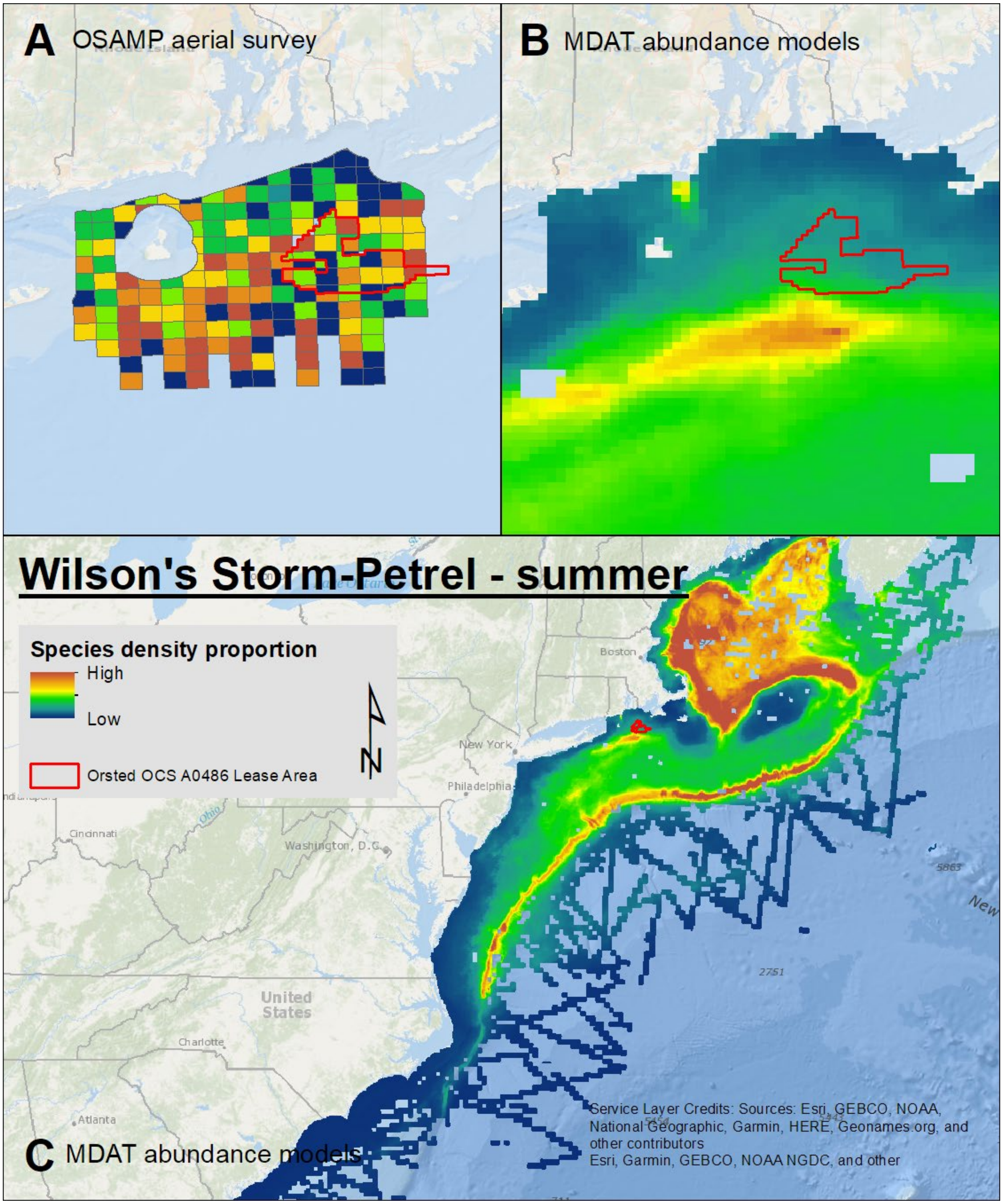
Map 52. Spring Red-throated Loon density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



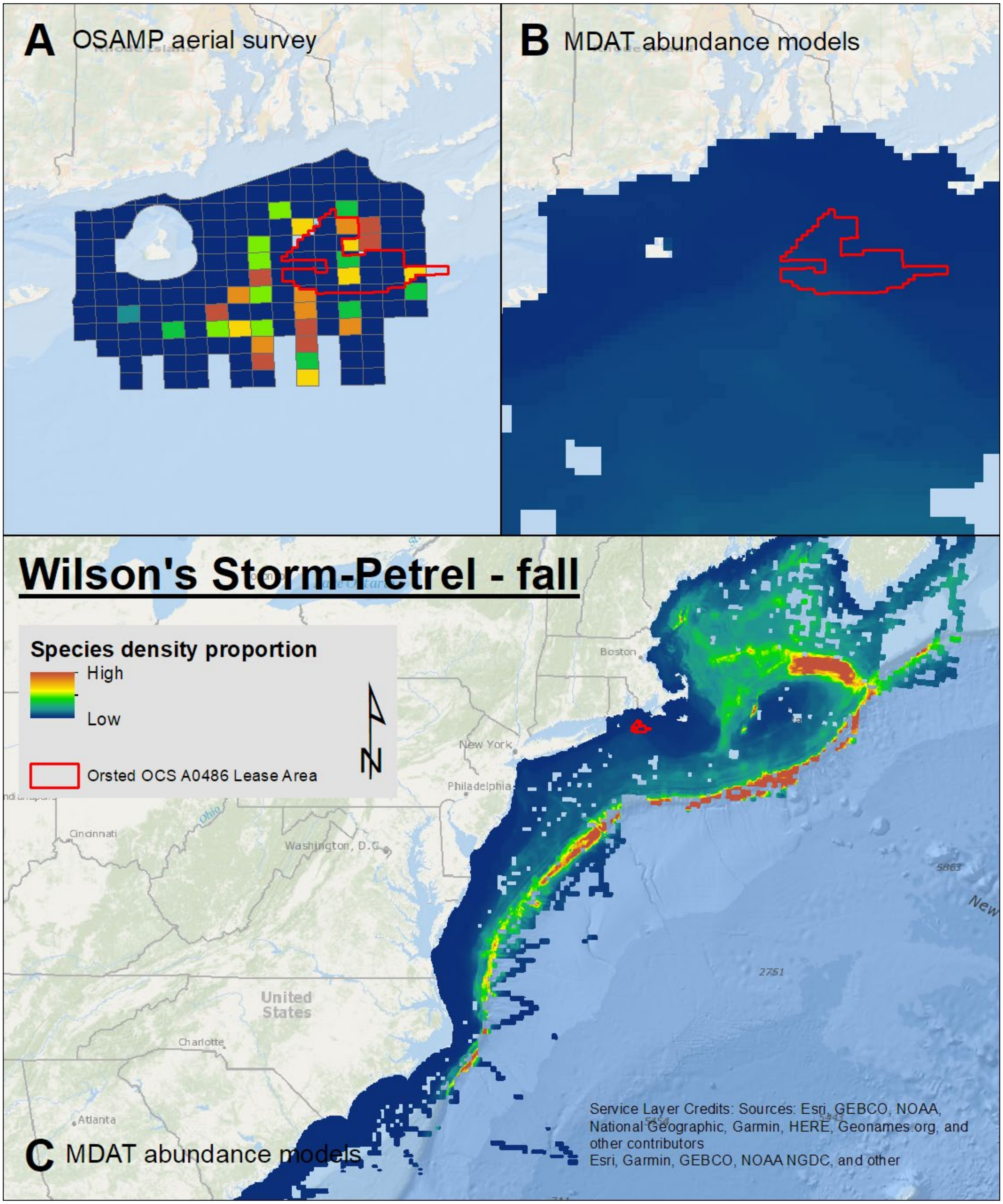
Map 53. Fall Red-throated Loon density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



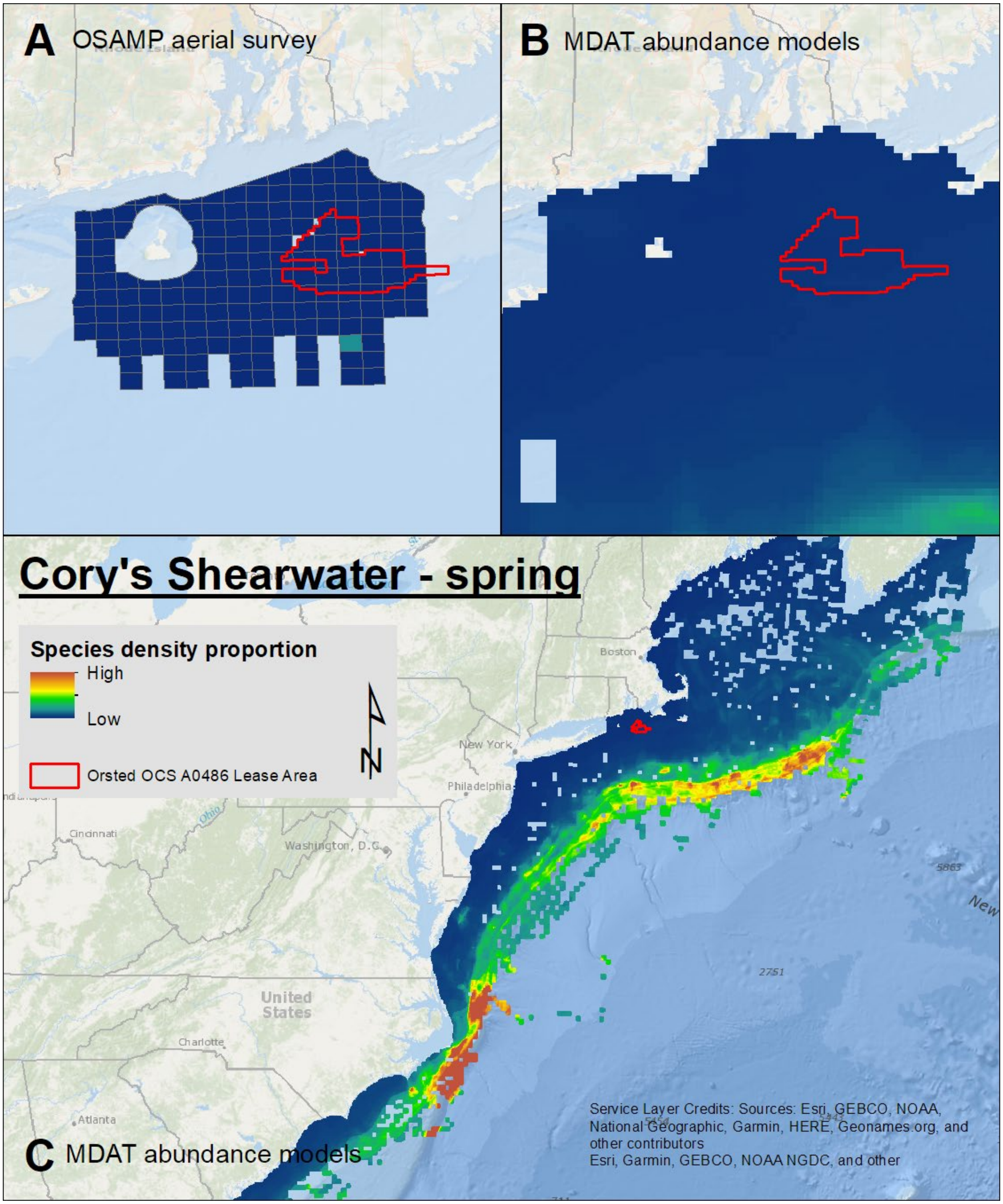
Map 54. Spring Wilson's Storm-Petrel density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



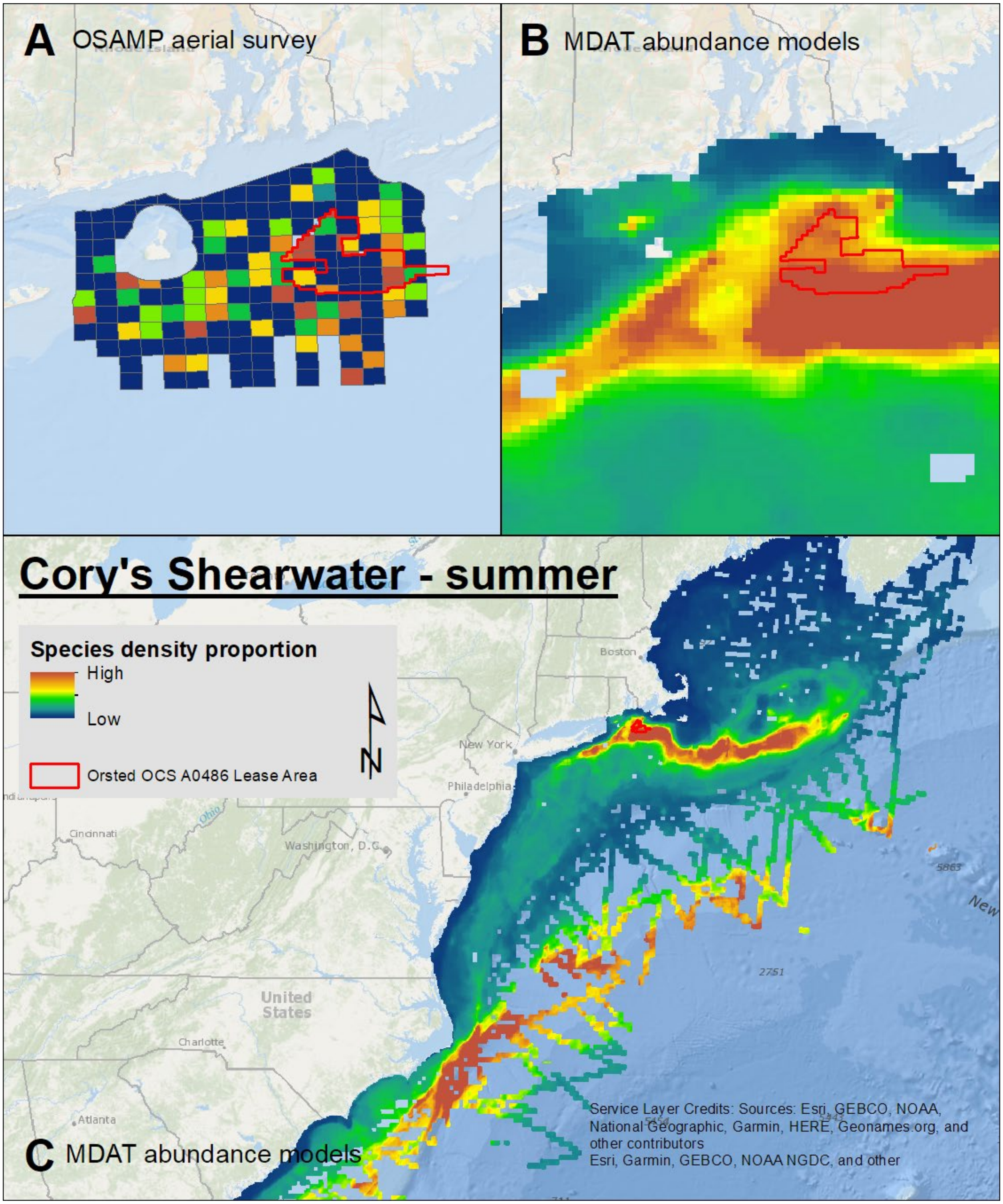
Map 55. Summer Wilson's Storm-Petrel density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



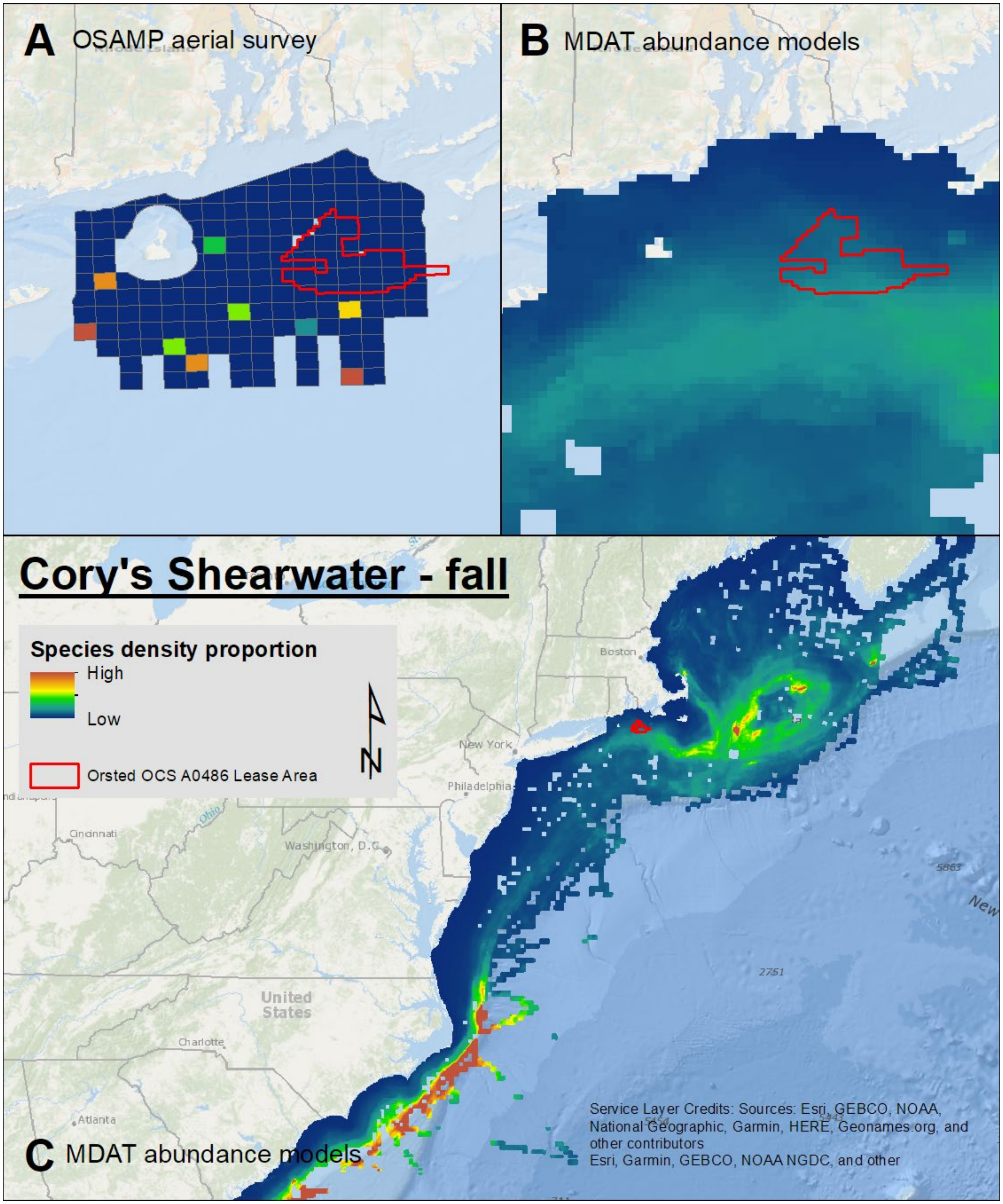
Map 56. Fall Wilson's Storm-Petrel density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



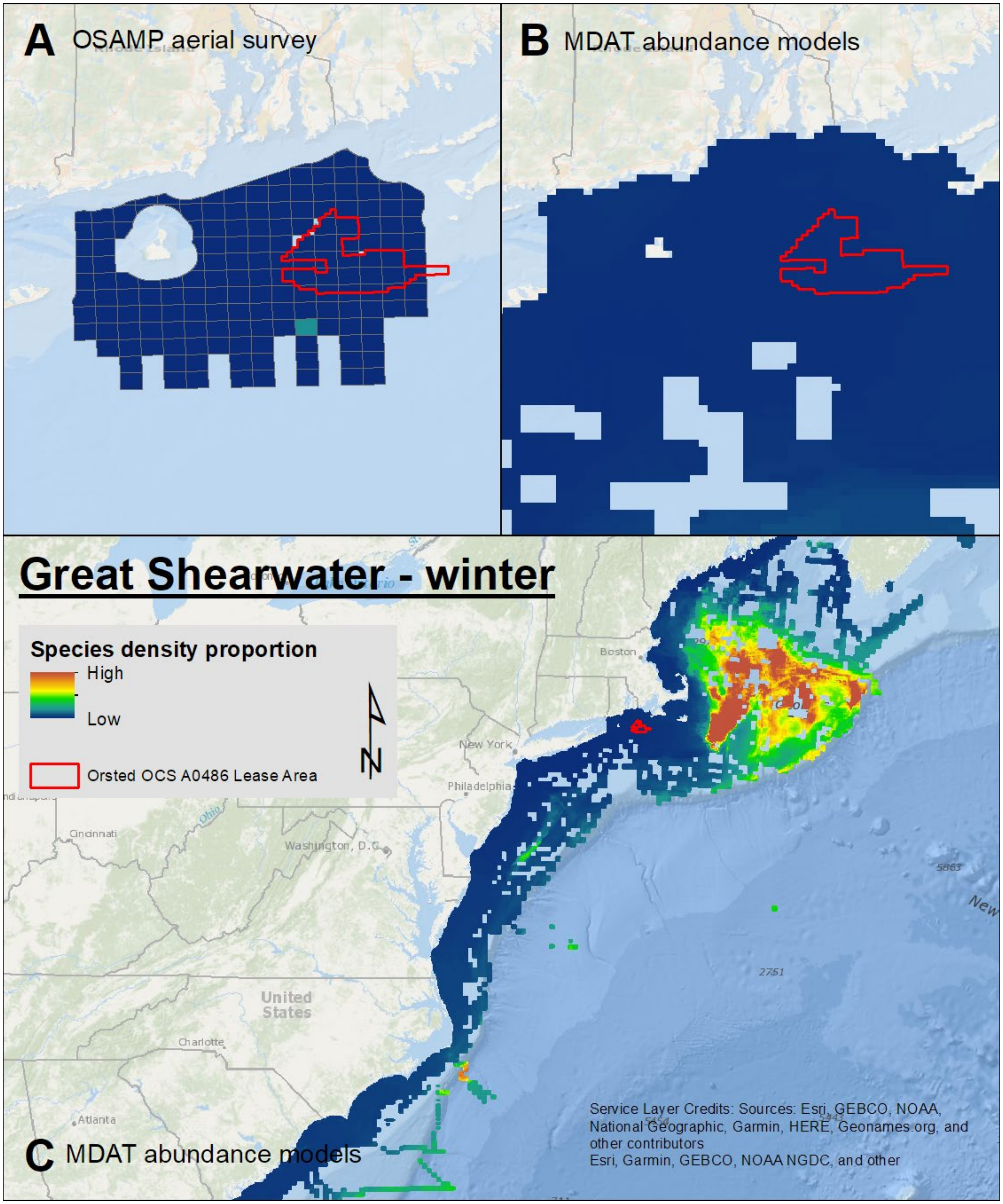
Map 57. Spring Cory's Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



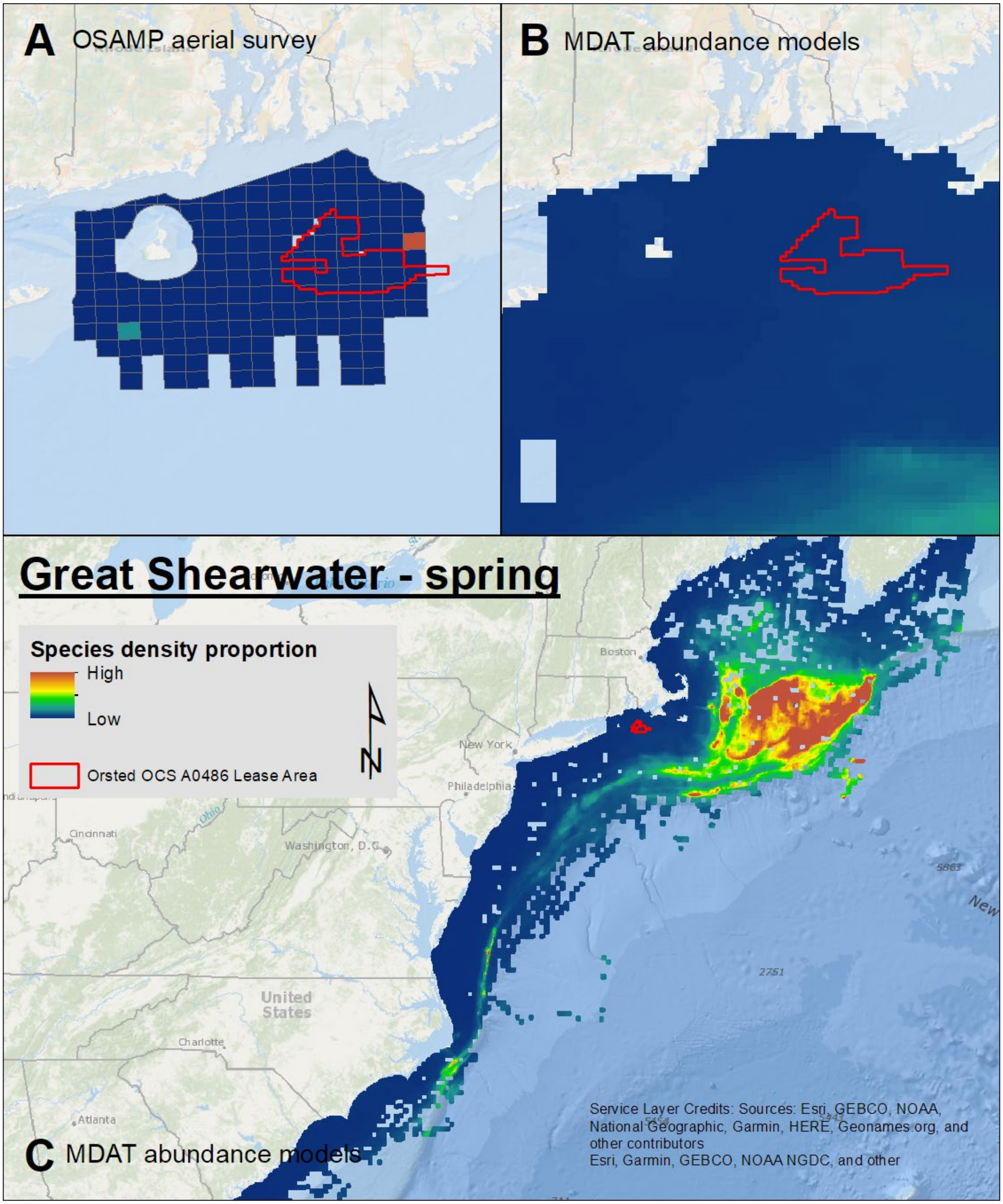
Map 58. Summer Cory's Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



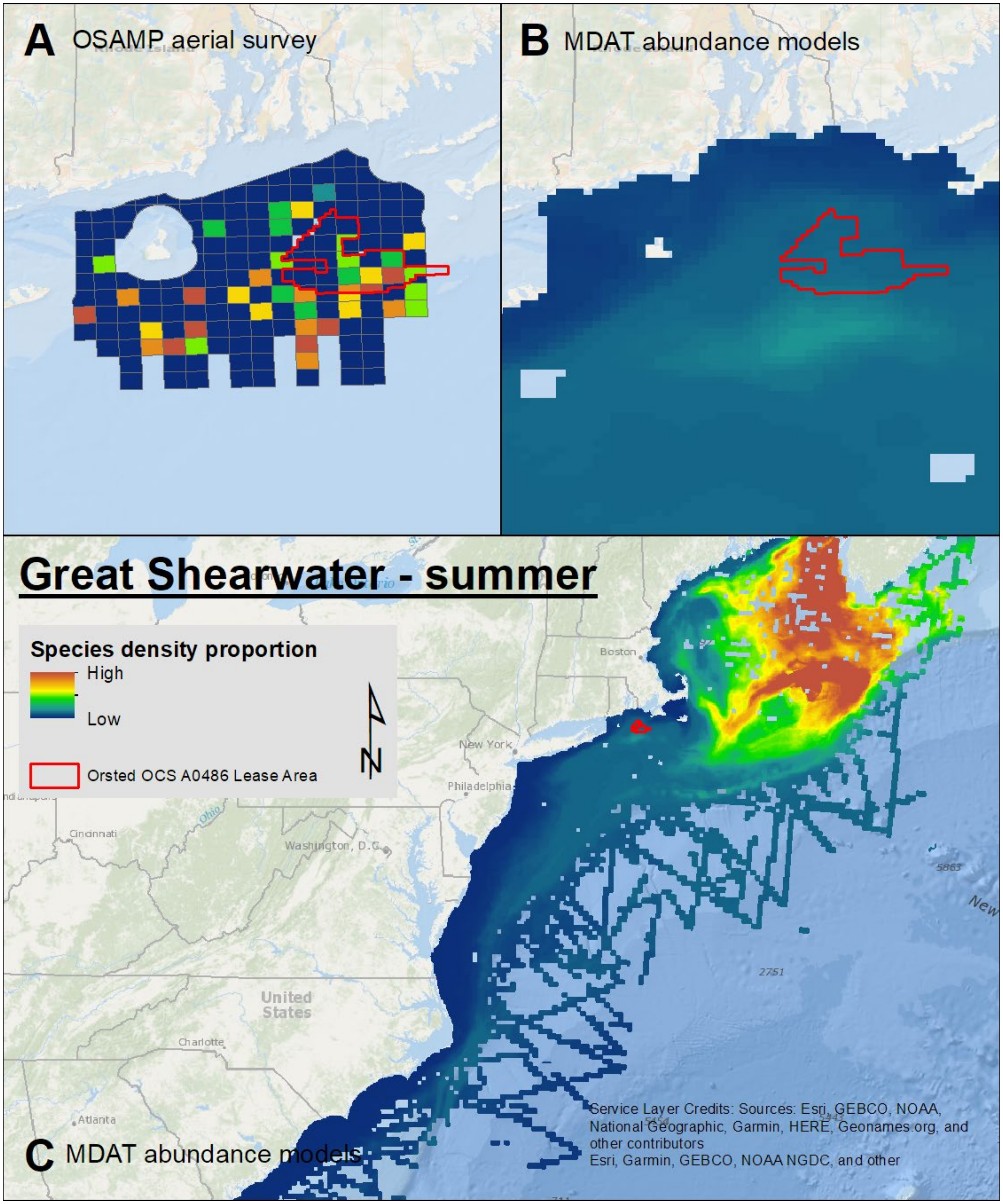
Map 59. Fall Cory's Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



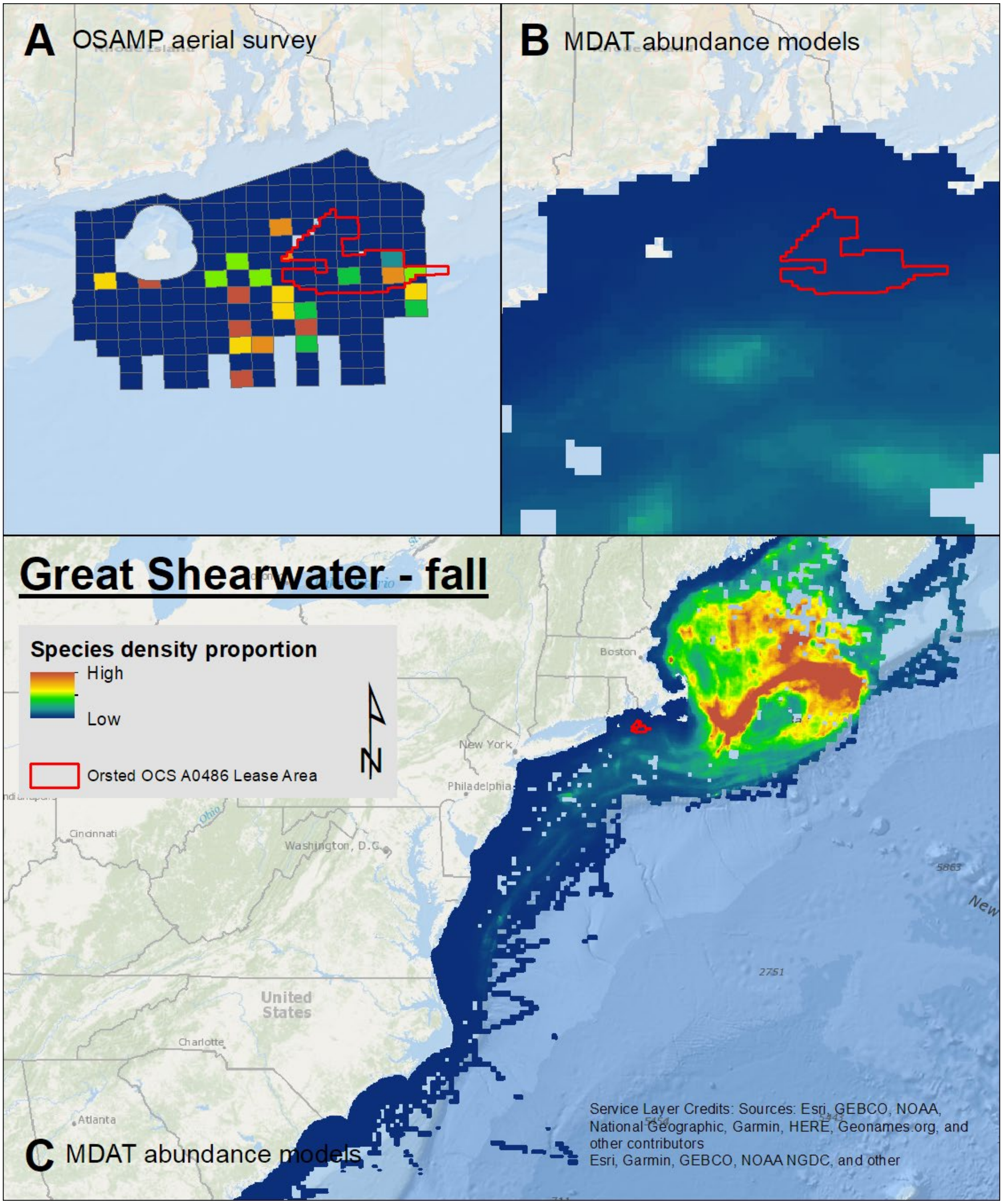
Map 60. Winter Great Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



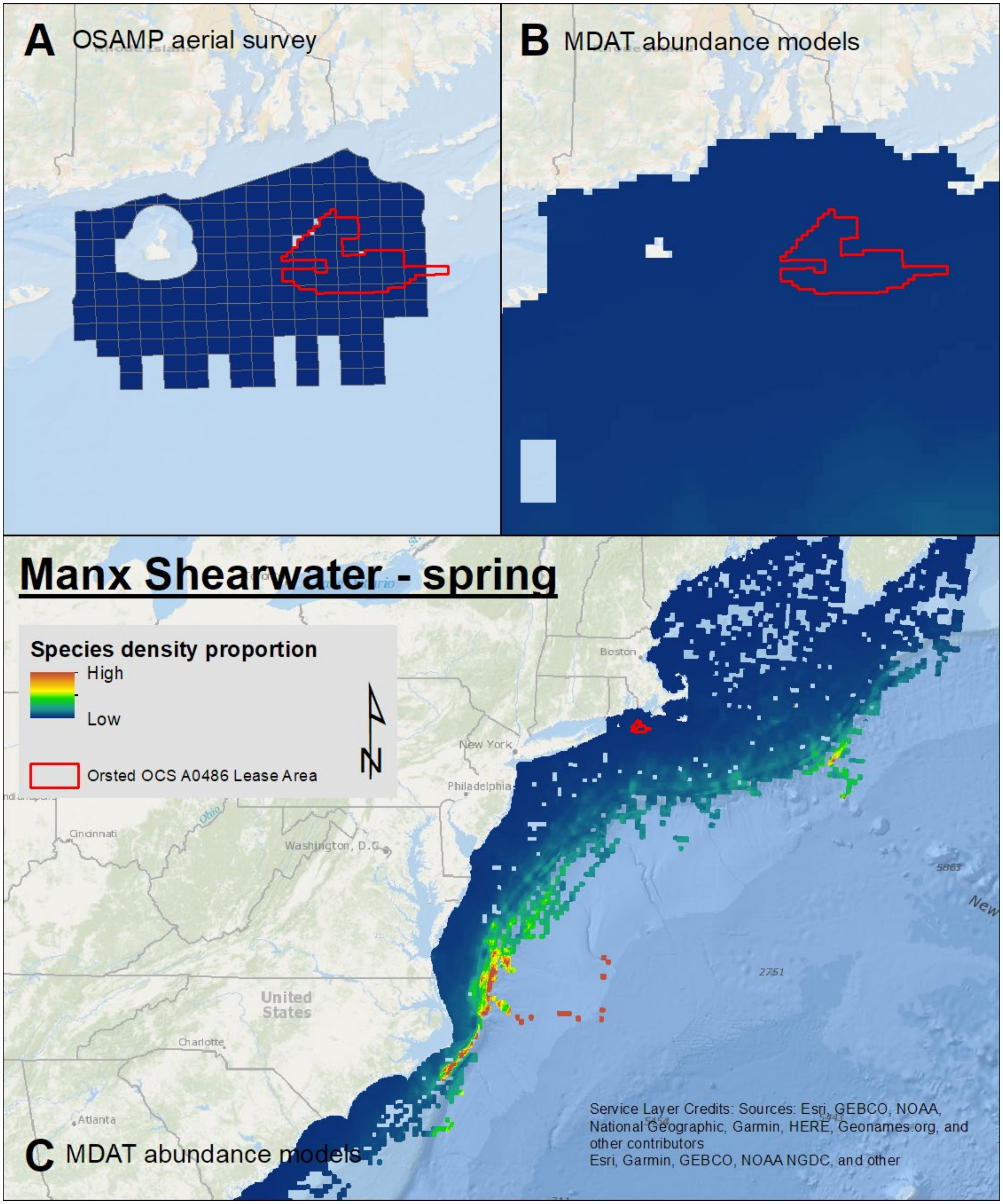
Map 61. Spring Great Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



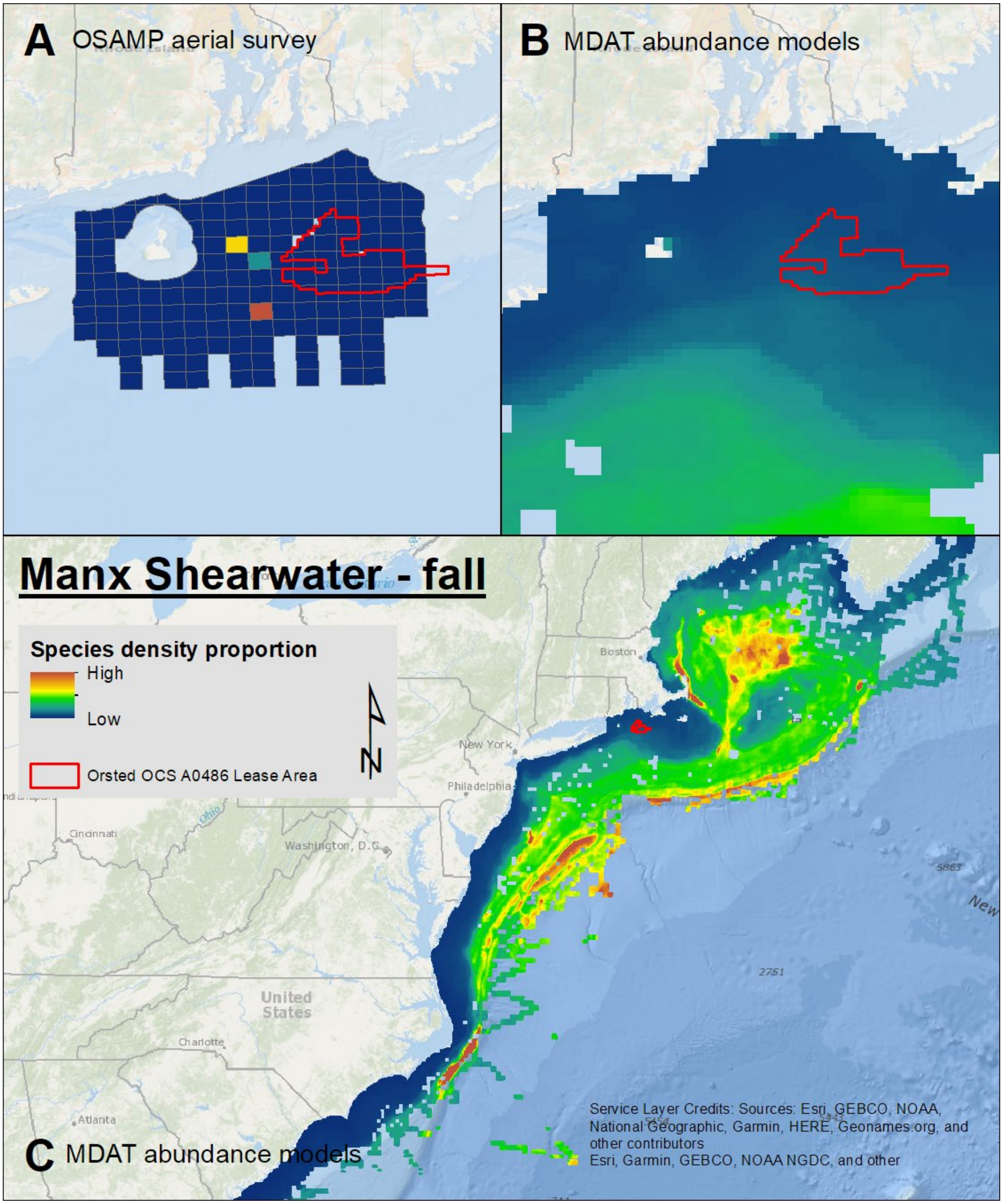
Map 62. Summer Great Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



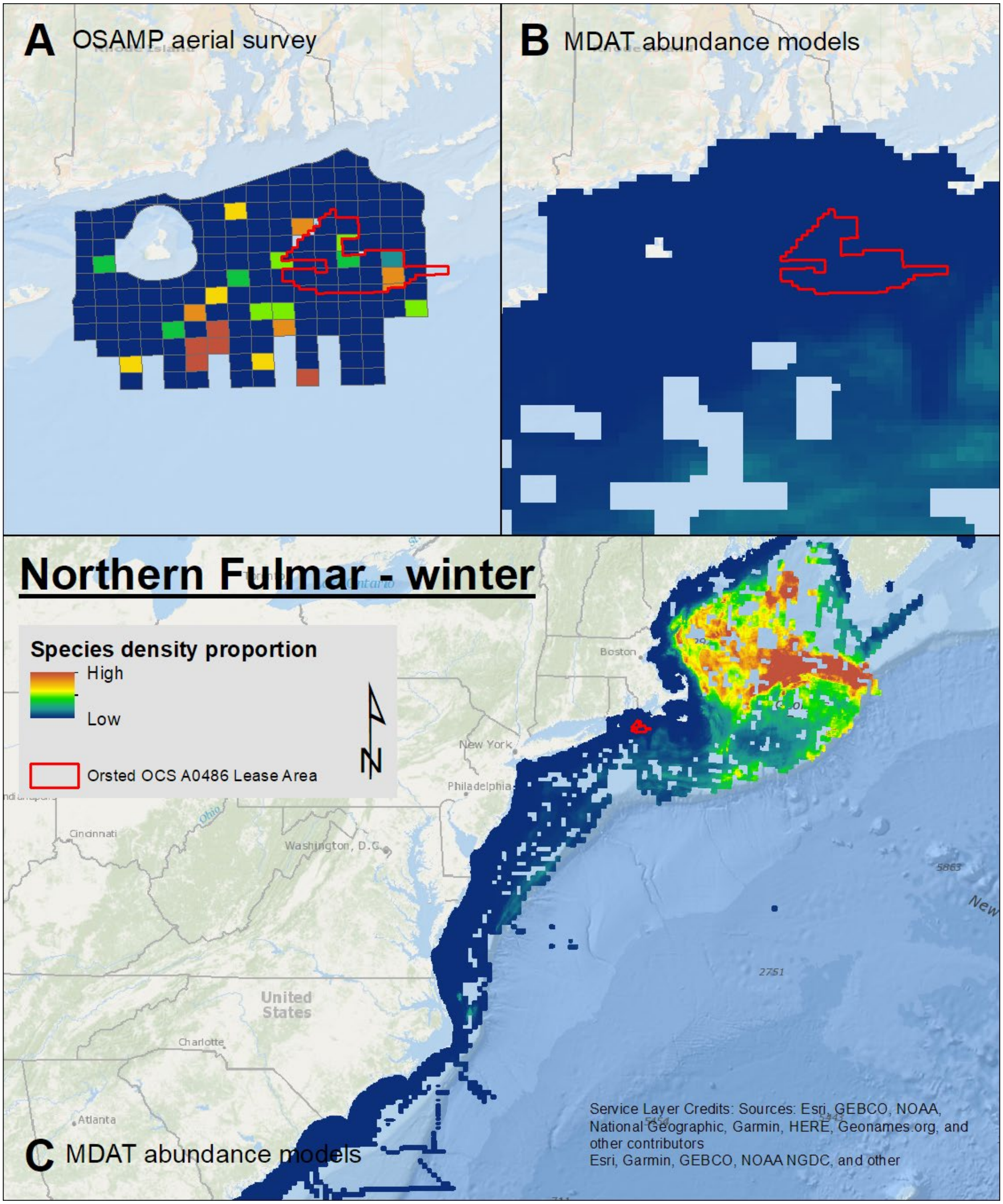
Map 63. Fall Great Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



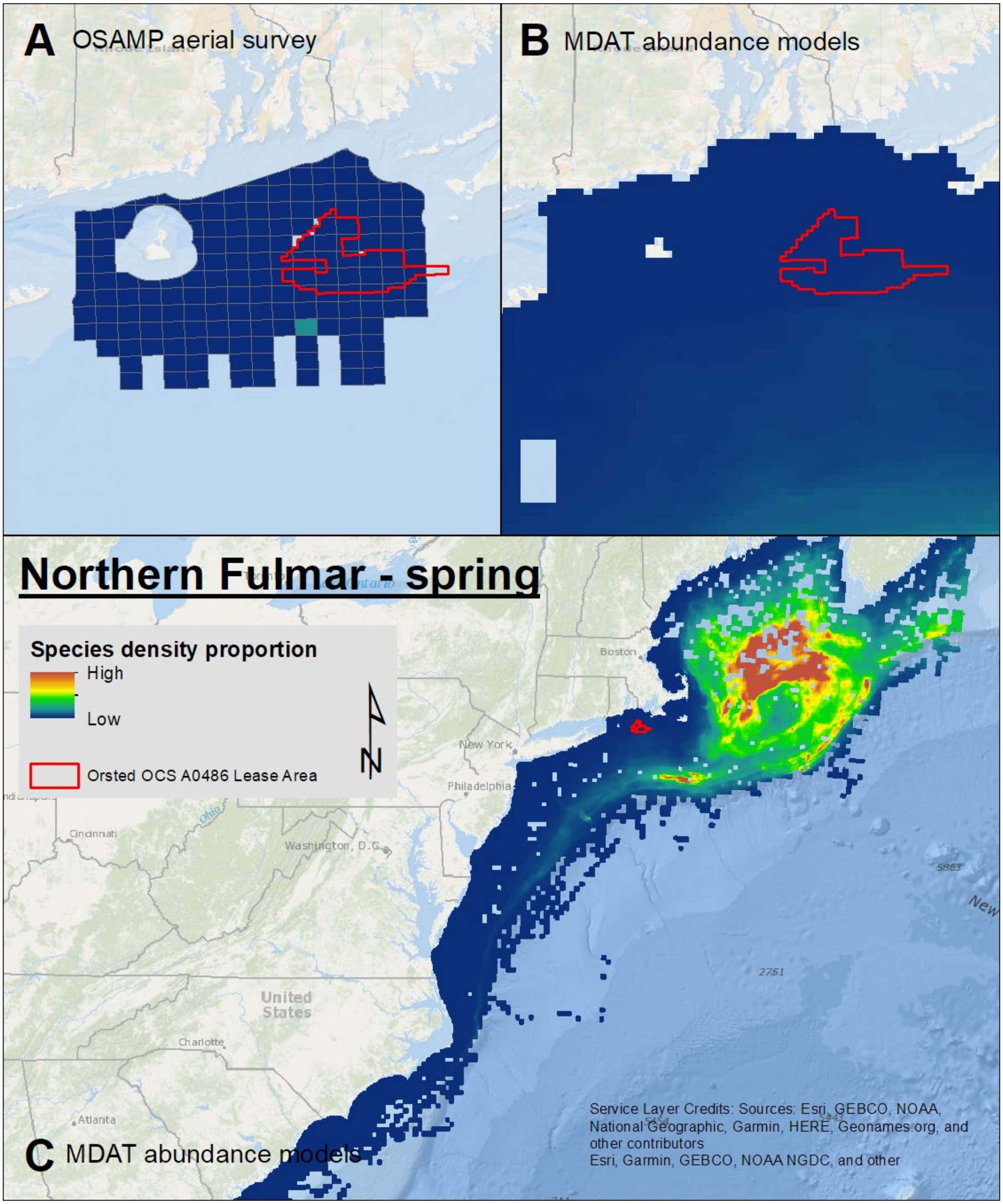
Map 64. Spring Manx Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



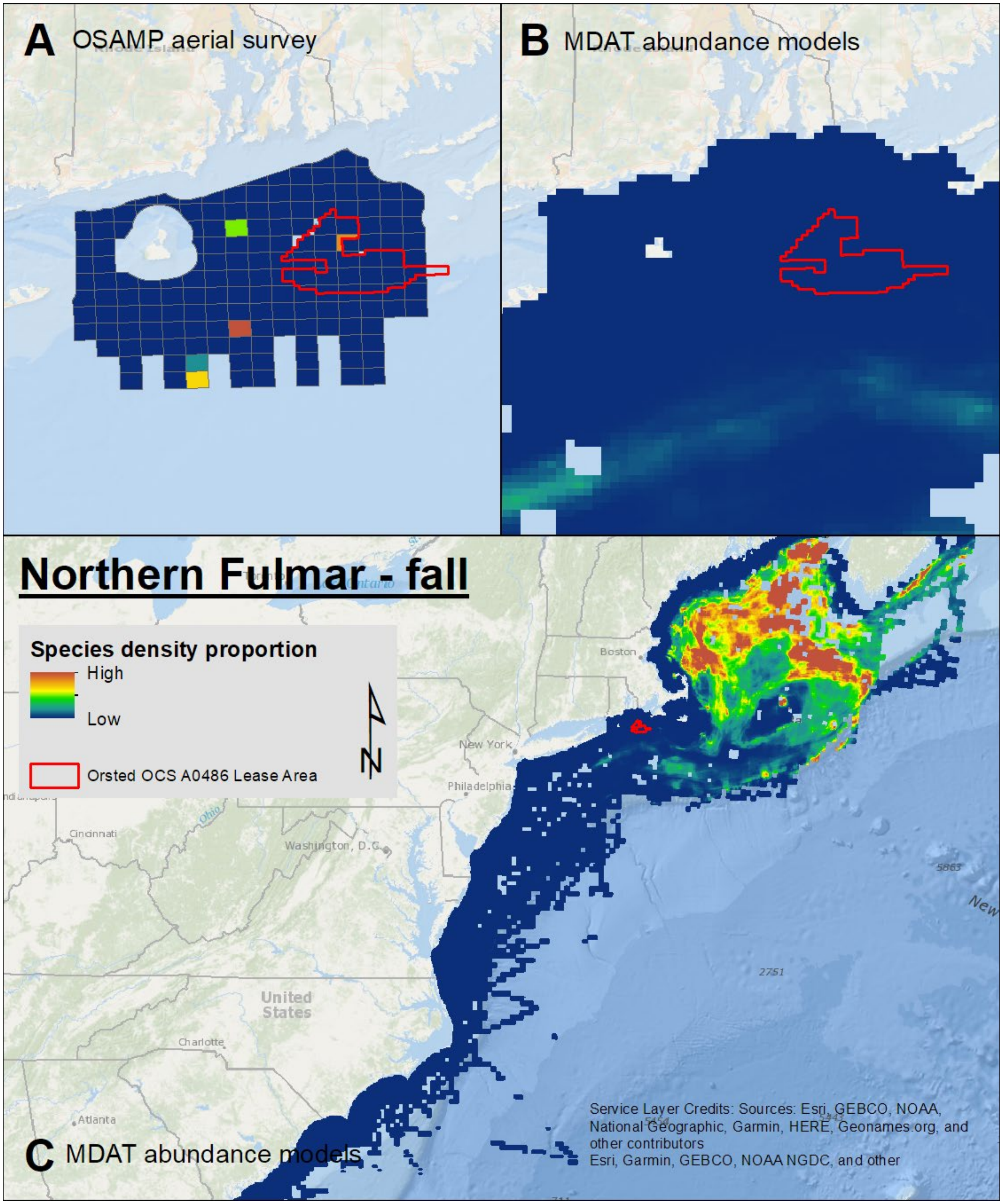
Map 65. Fall Manx Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



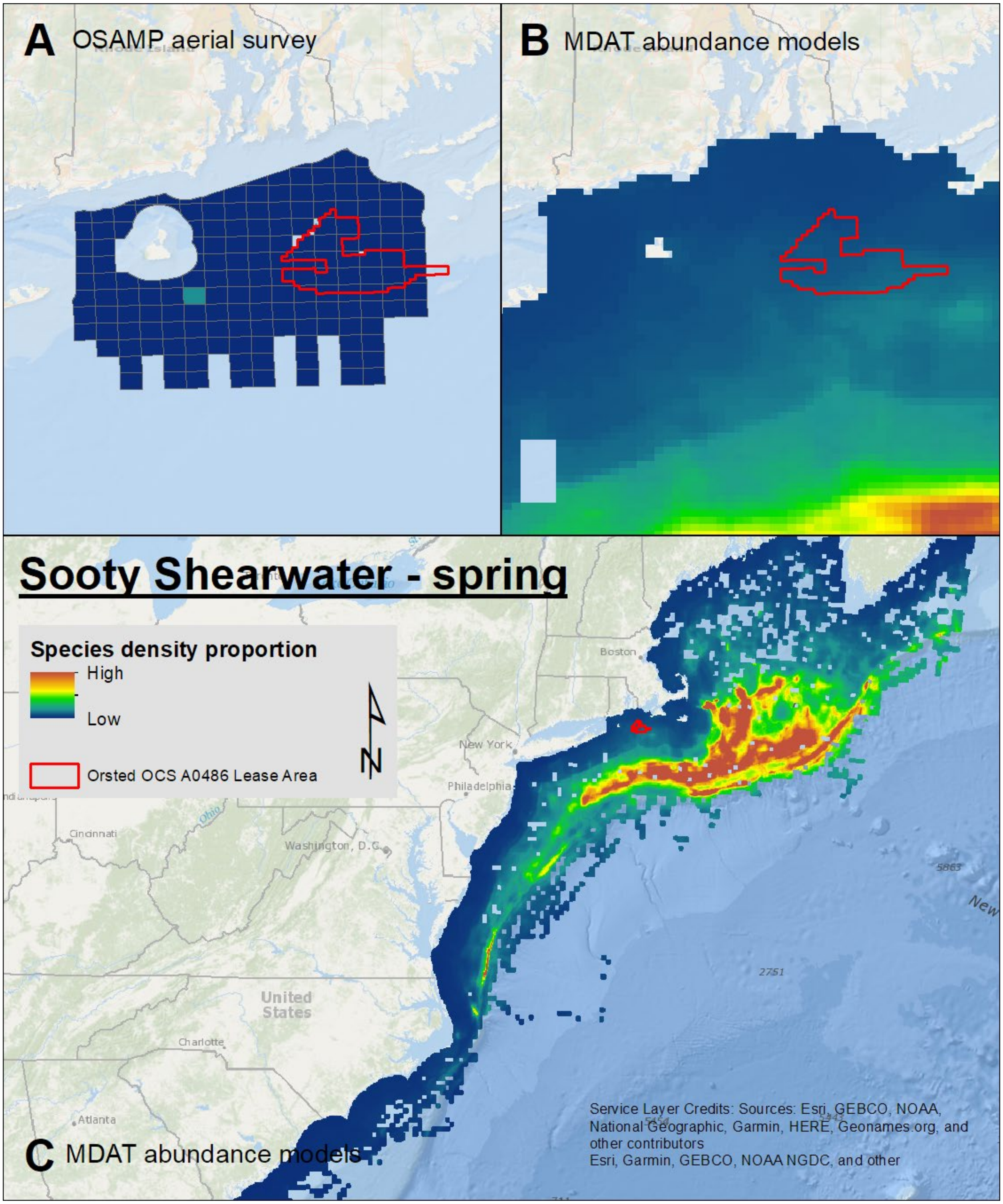
Map 66. Winter Northern Fulmar density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



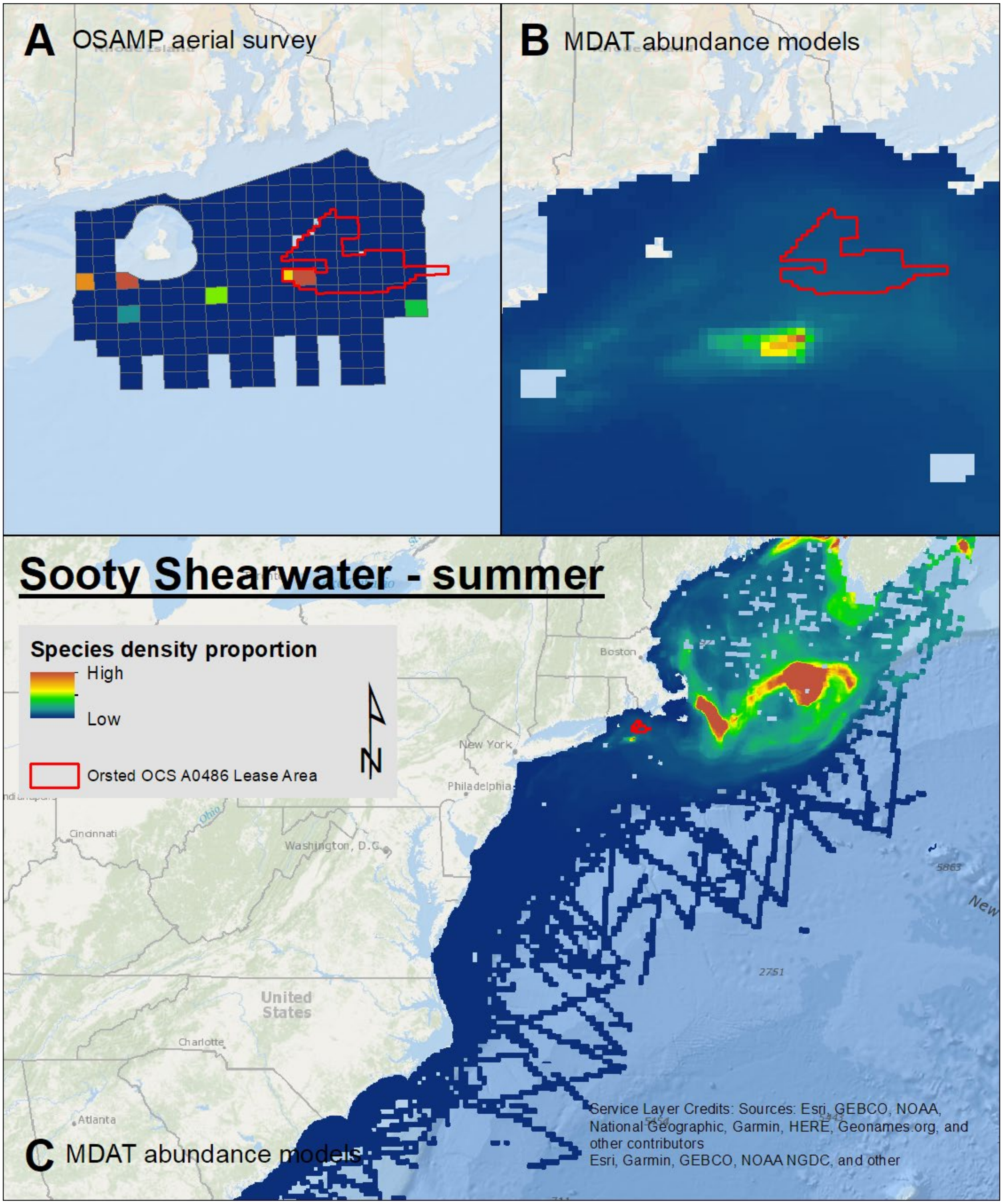
Map 67. Spring Northern Fulmar density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



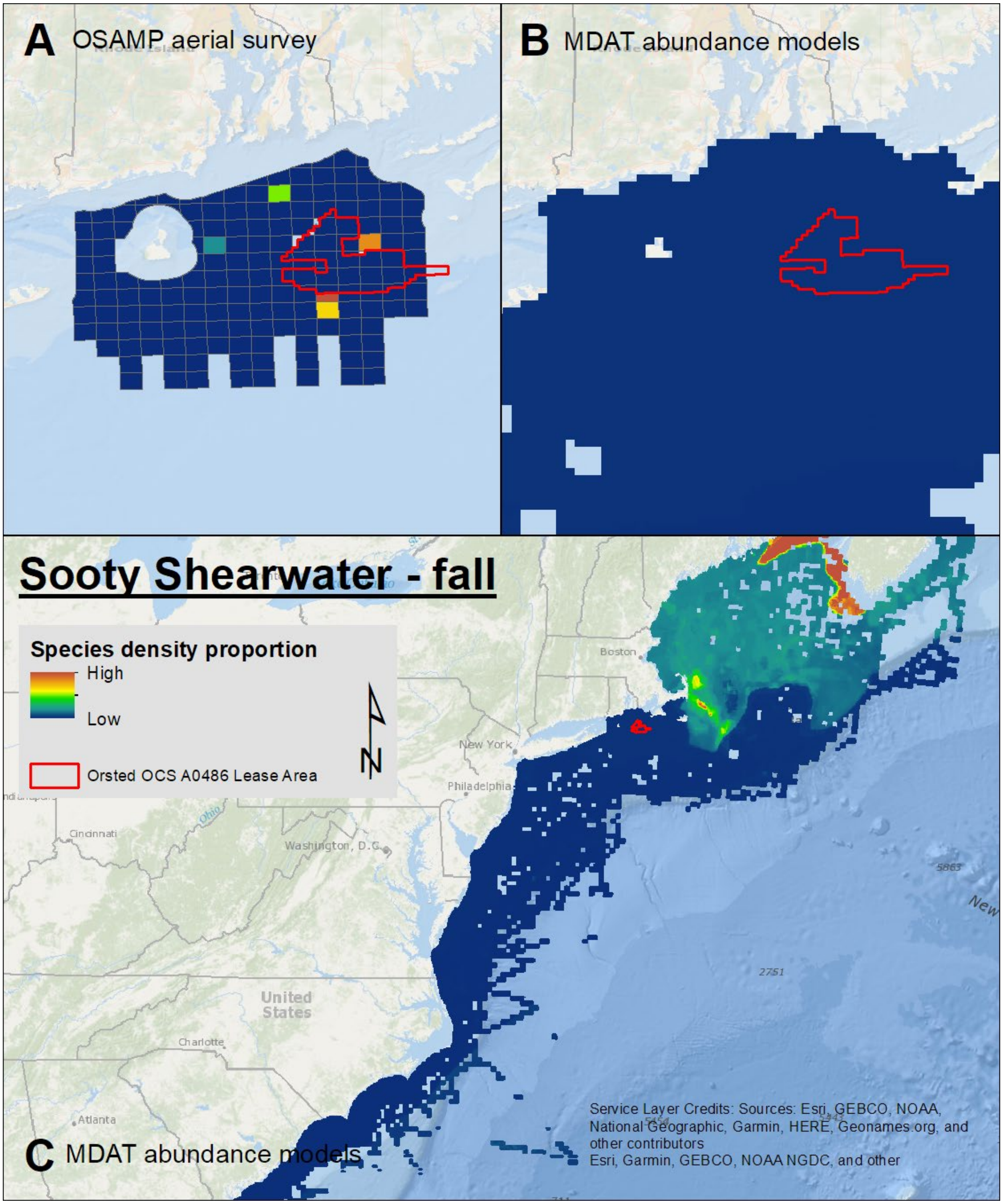
Map 68. Fall Northern Fulmar density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



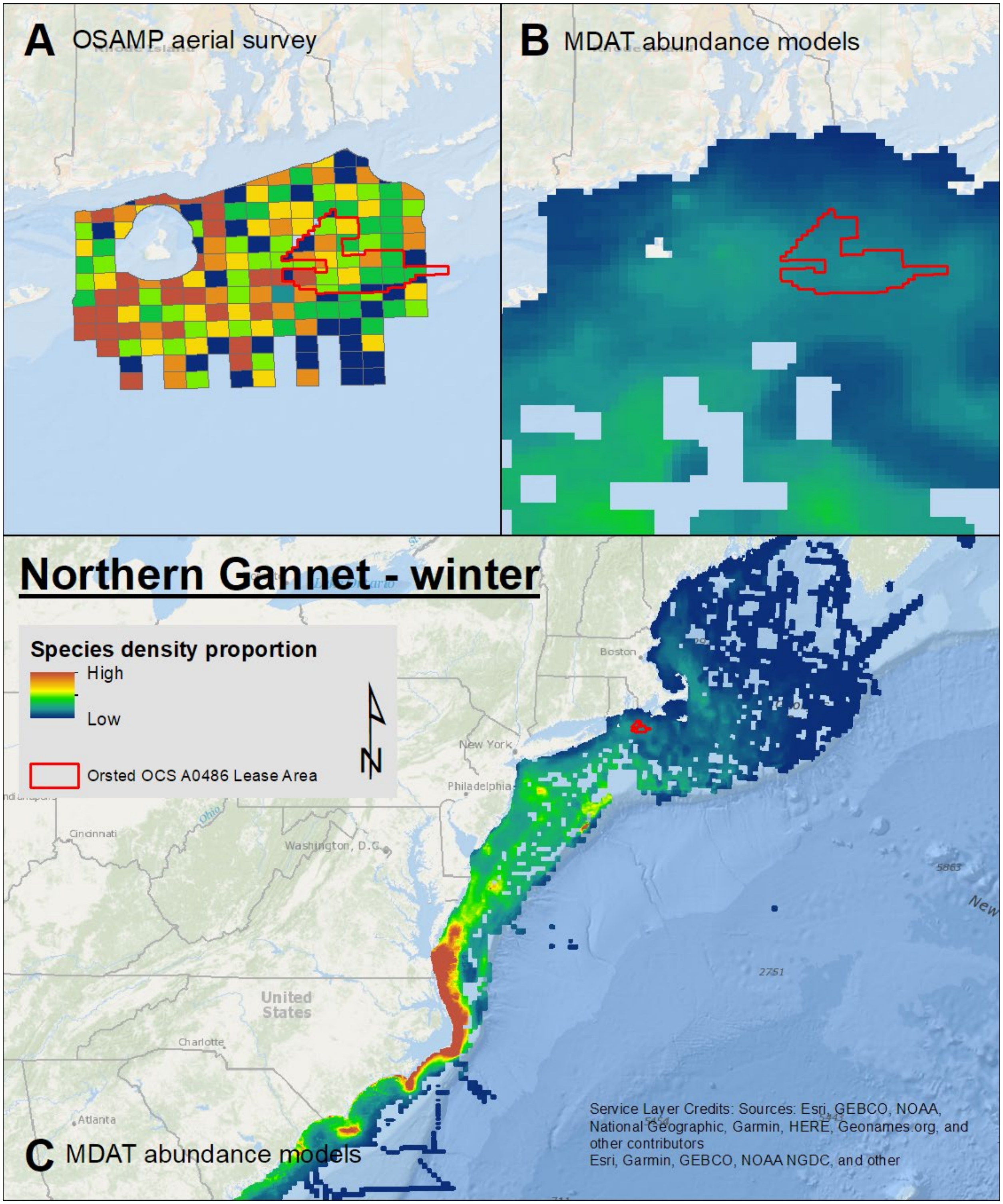
Map 69. Spring Sooty Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



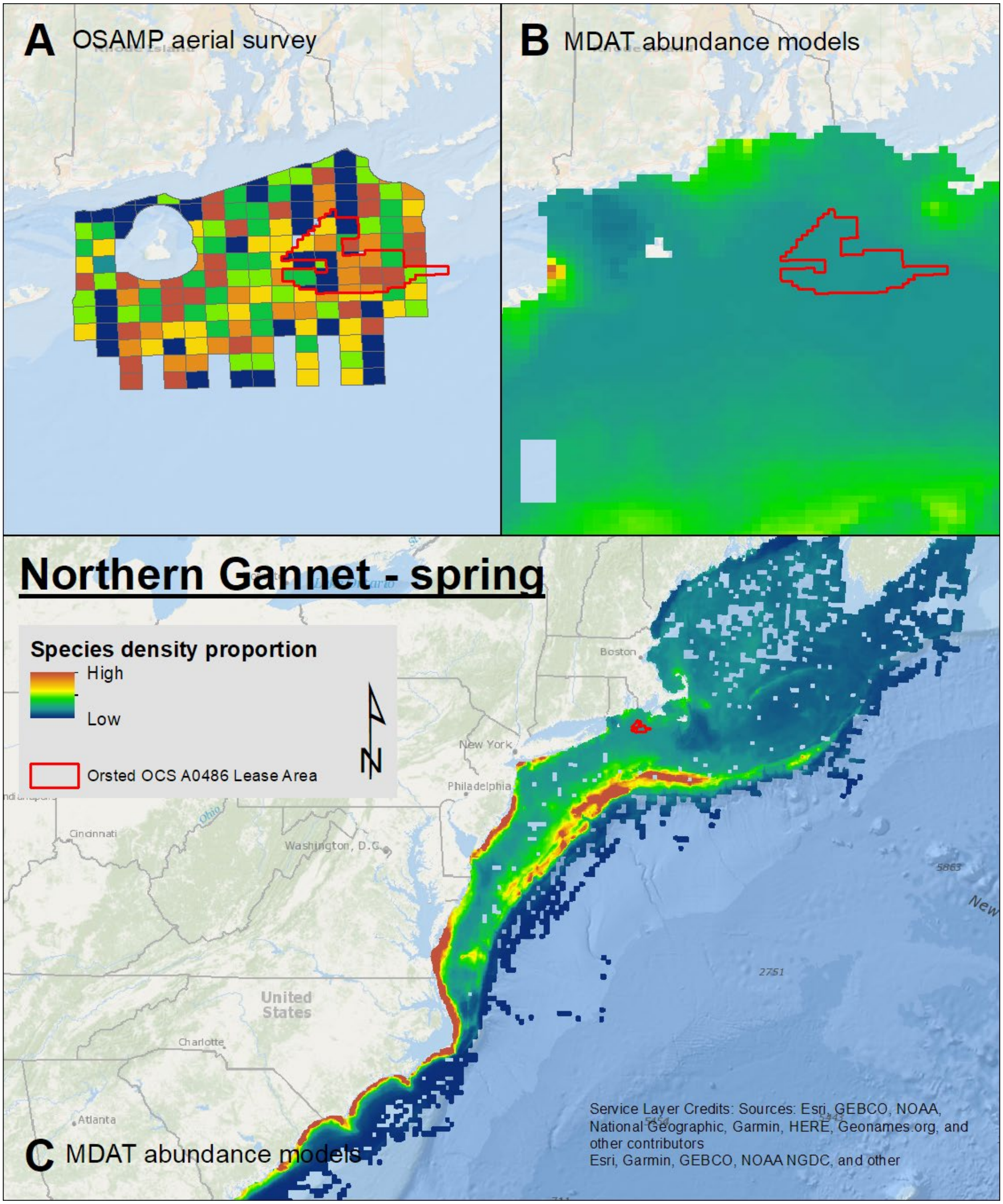
Map 70. Summer Sooty Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



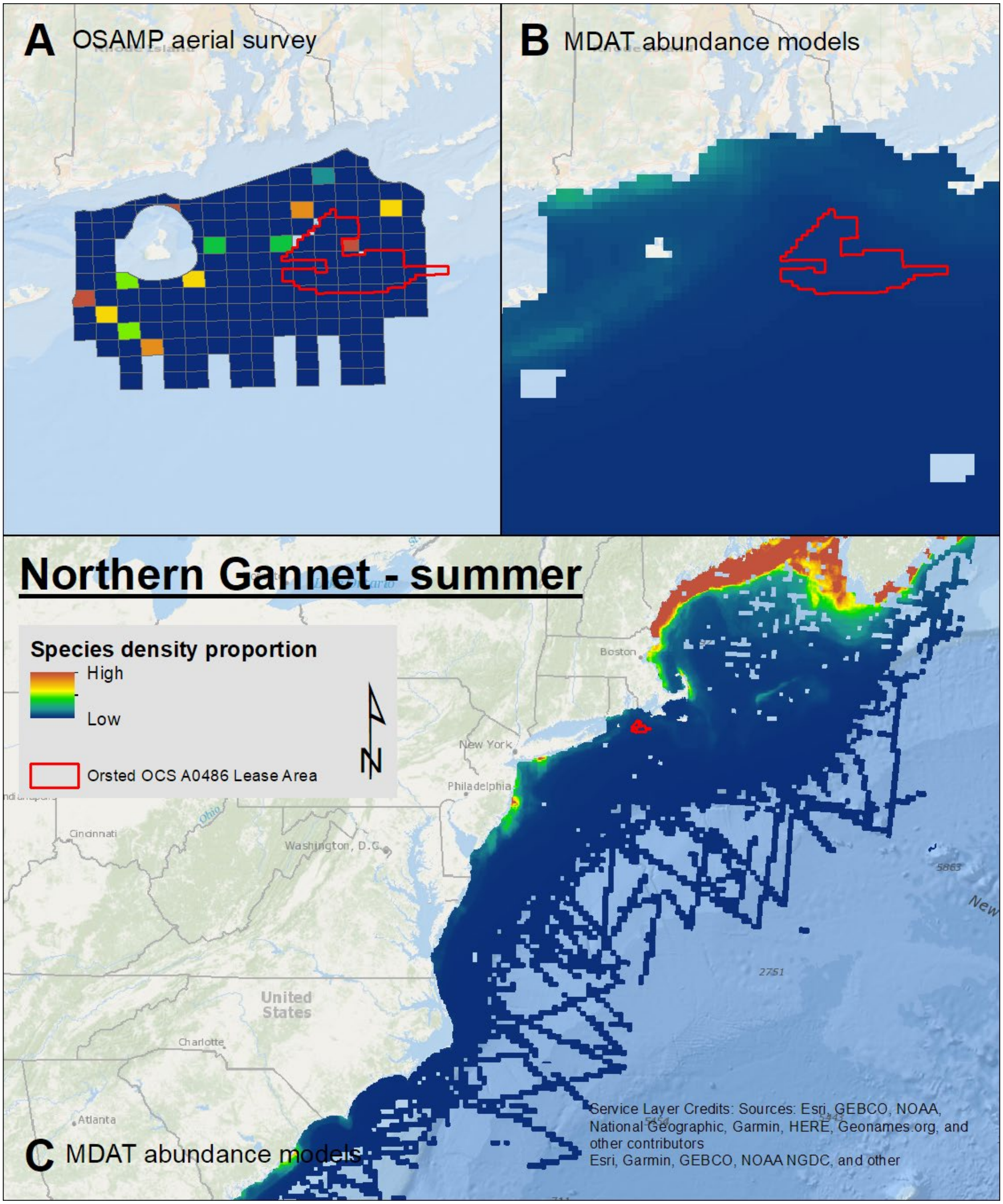
Map 71. Fall Sooty Shearwater density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



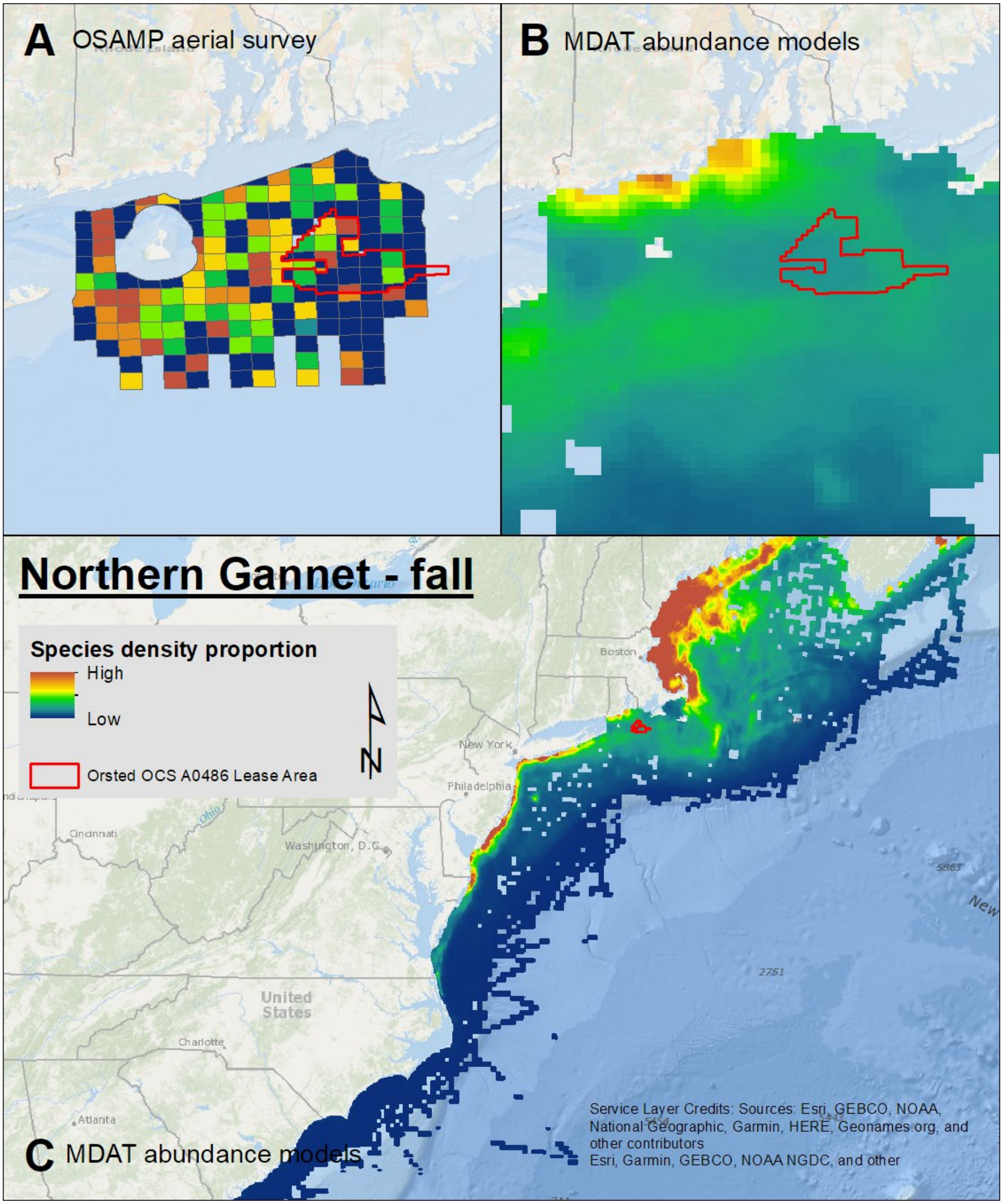
Map 72. Winter Northern Gannet density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



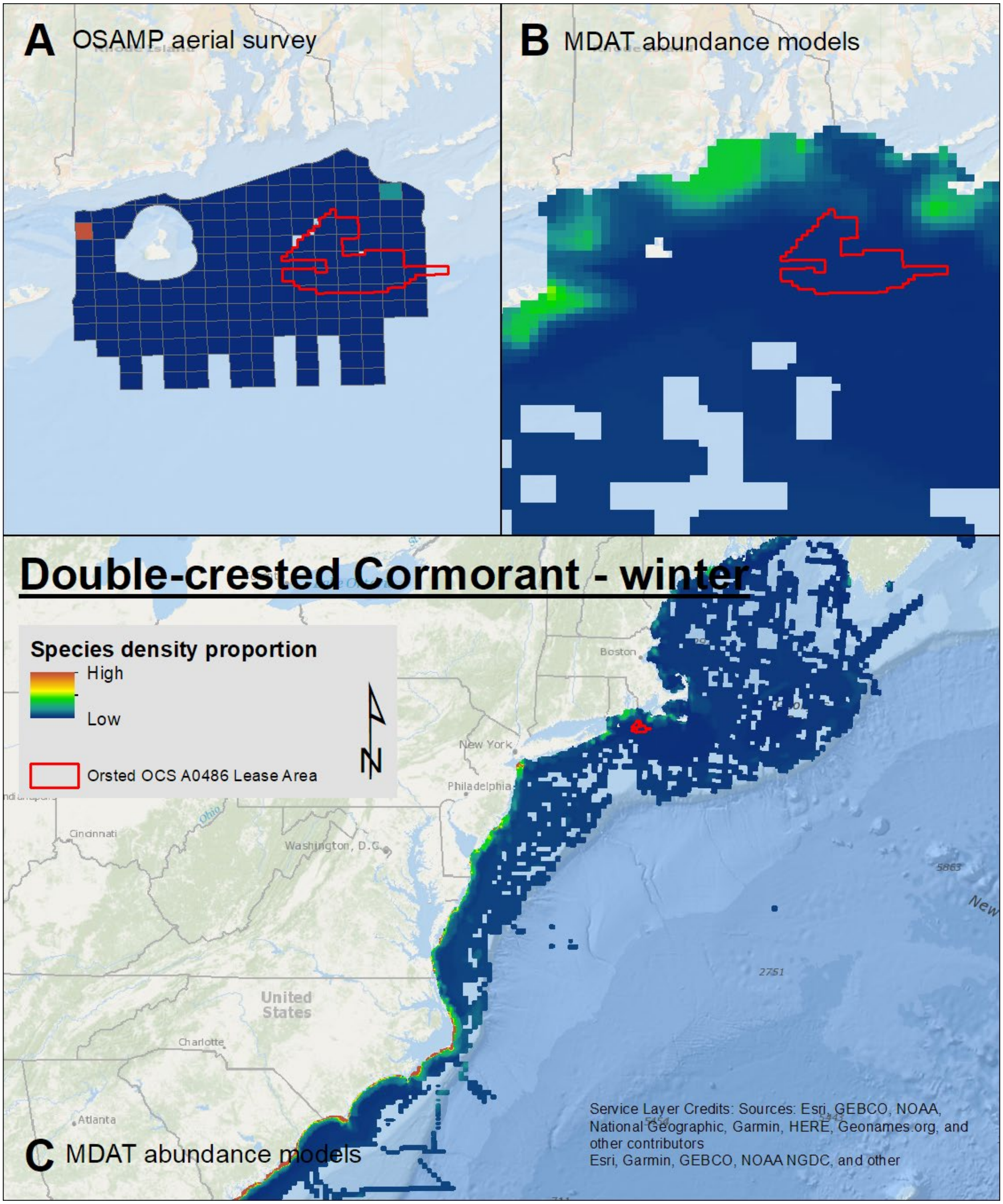
Map 73. Spring Northern Gannet density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



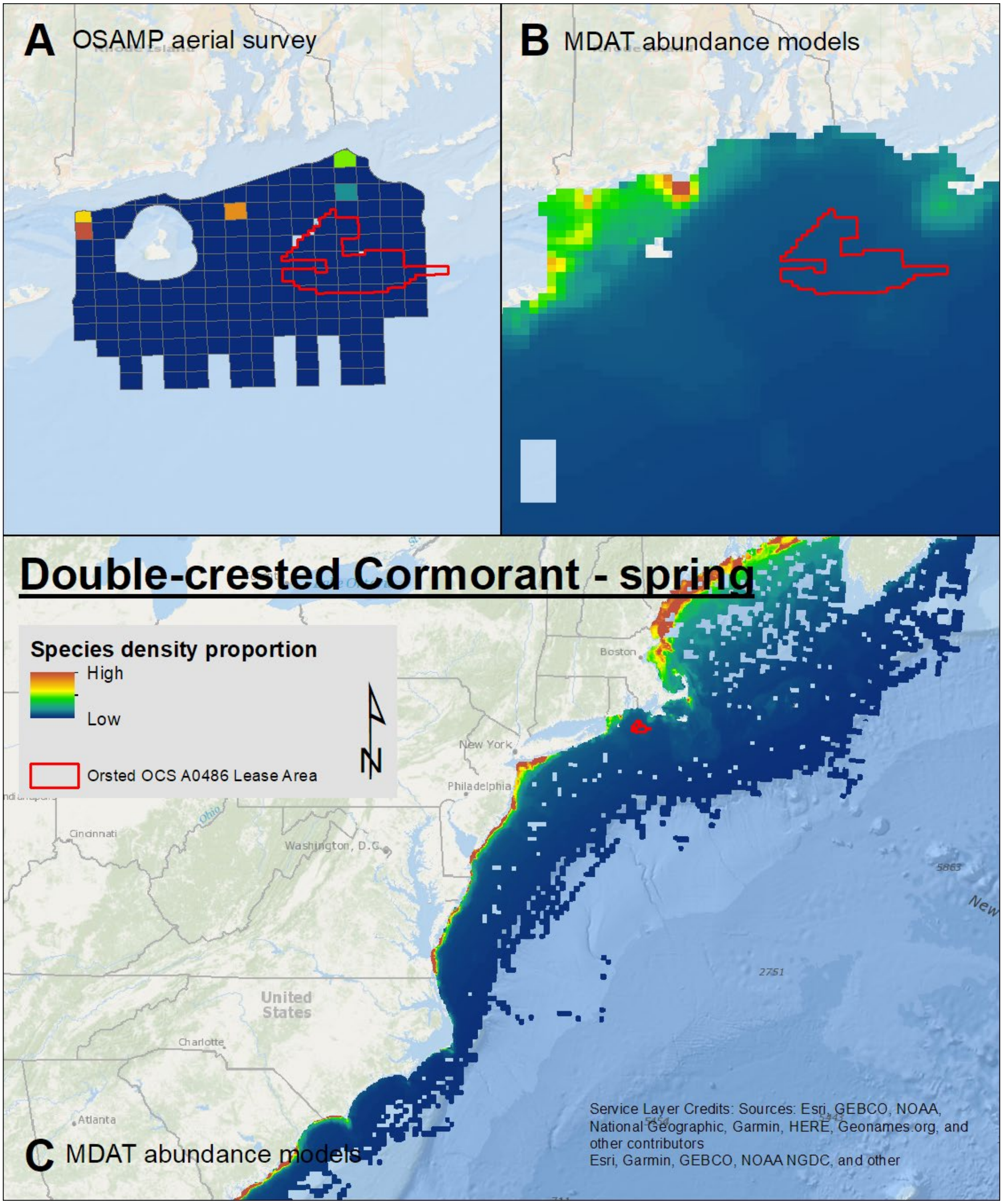
Map 74. Summer Northern Gannet density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



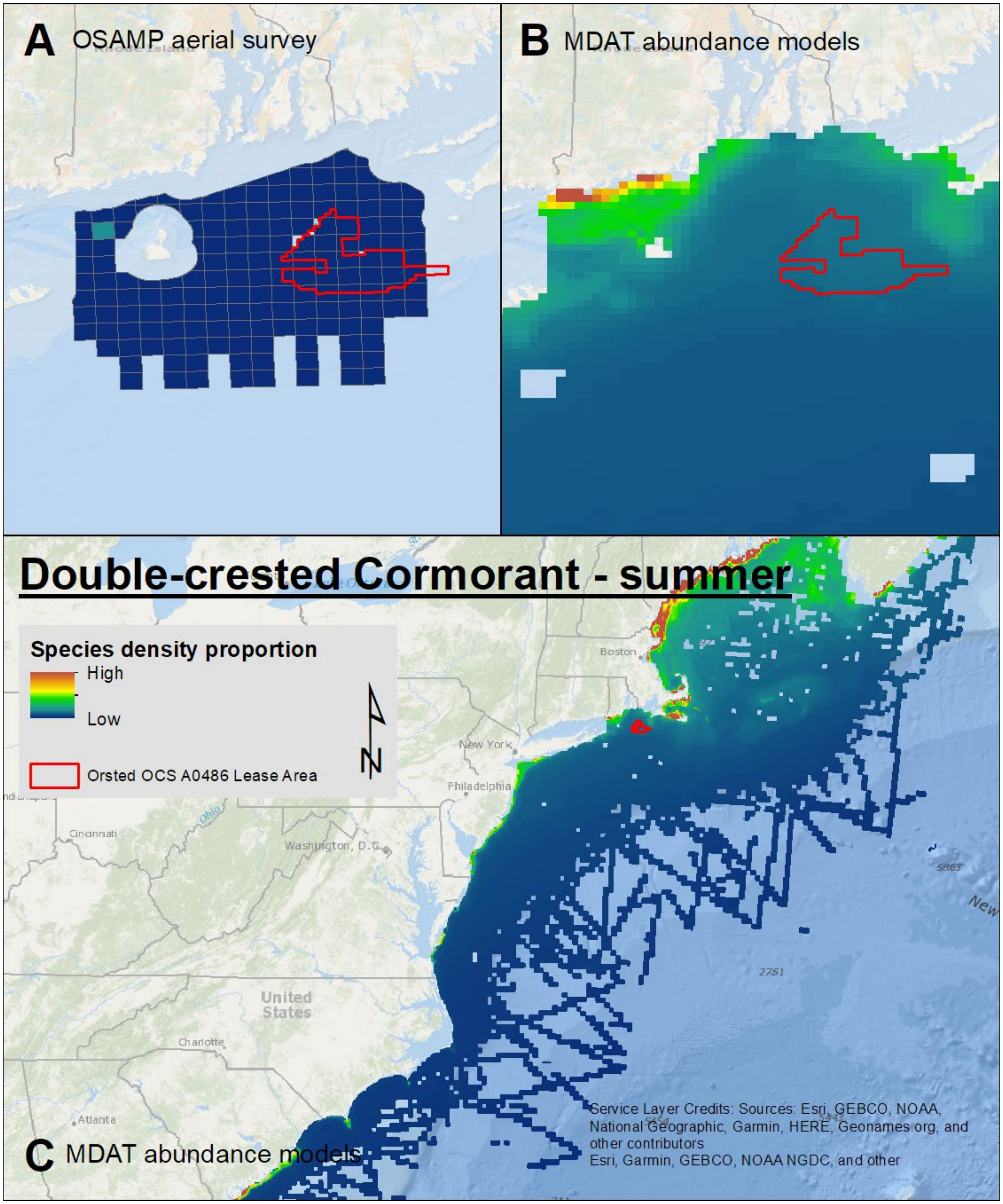
Map 75. Fall Northern Gannet density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



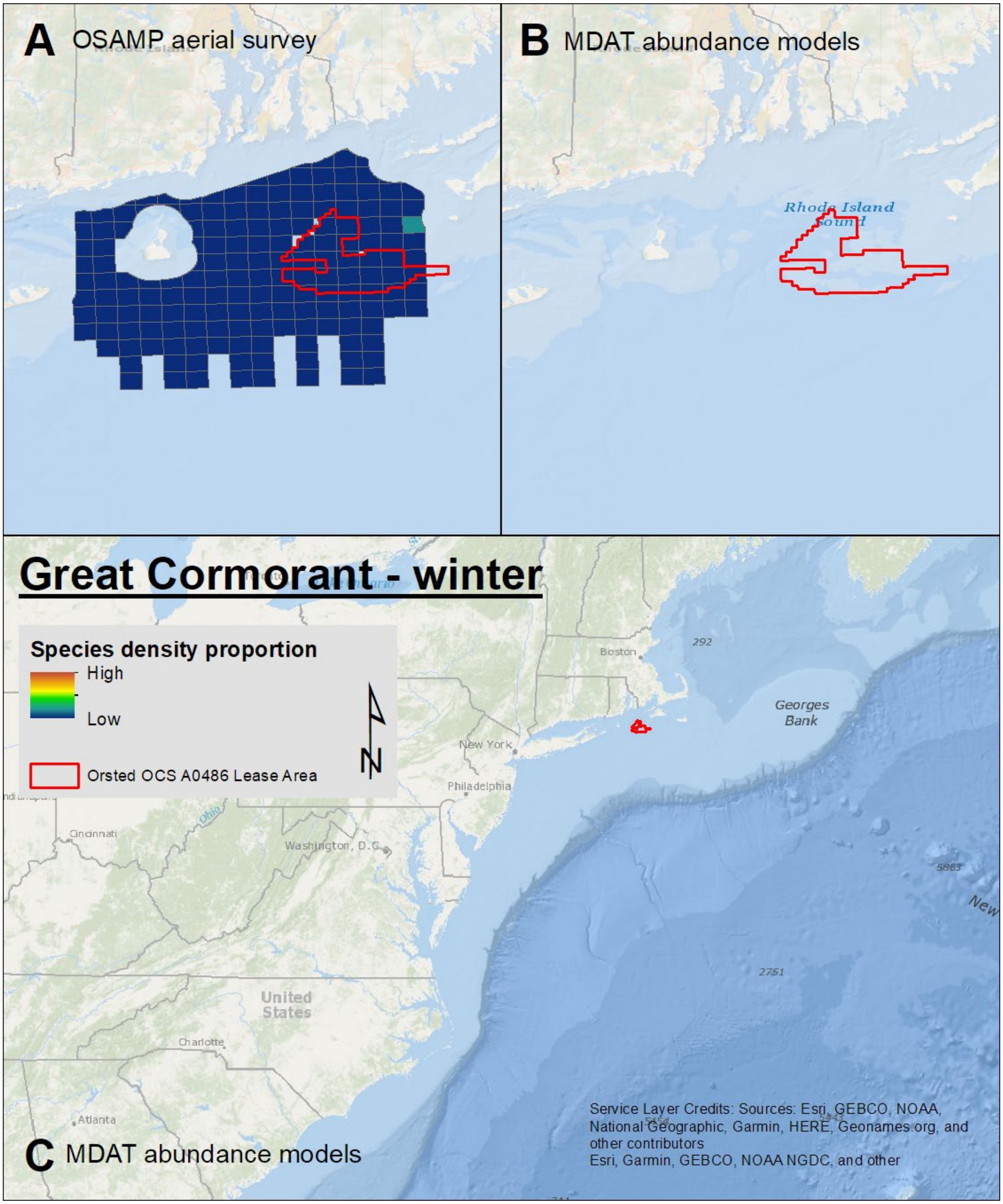
Map 76. Winter Double-crested Cormorant density proportions in the OSAMP aerial baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



Map 77. Spring Double-crested Cormorant density proportions in the OSAMP aerial baseline survey data (A) and the 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.



Map 78. Summer Double-crested Cormorant density proportions in the OSAMP aerial baseline survey data (A) and the 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.



Map 79. Winter Great Cormorant density proportions in the OSAMP aerial baseline survey data (A) and the 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.

7 Part VII: Post-Construction Monitoring Framework

Revolution Wind Avian and Bat Post-Construction Monitoring Framework

Submitted by:
M. Wing Goodale, Andrew T. Gilbert, Iain J. Stenhouse
Biodiversity Research Institute

Introduction

Revolution Wind LLC (Revolution Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (Eversource), proposes to construct and operate the Revolution Wind Farm (RWF) and the Revolution Wind Export Cable (RWEC), collectively the Revolution Wind Farm Project (hereinafter referred to as the Project). The wind farm portion of the Project will be in Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0486 (Lease Area), southeast of Point Judith, Rhode Island, and east of Block Island, Rhode Island. The Project's generating capacity will range between 704 megawatts (MW) and 880 MW. This *RWF Avian and Bat Post-Construction Monitoring Framework* (hereafter the "Framework") focuses solely on the offshore footprint of the Project within the Lease Area, and does not apply to the offshore export cable, cable landfall, or onshore portions of the Project.

Revolution Wind has developed this Framework to outline an approach to post-construction monitoring that supports advancement of the understanding of bird and bat interactions with offshore wind farms, and other areas of uncertainty, such as the potential influence of weather conditions. The scope of monitoring is designed to meet federal requirements [30 CFR 585.626(b)(15) and 585.633(b)] and is scaled to the size and risk profile of the Project with a focus on species of conservation concern.

The intent of the Framework is to outline overarching monitoring objectives, monitoring questions, proposed monitoring elements, and reporting requirements. A detailed *Avian and Bat Post-Construction Monitoring Plan* (Monitoring Plan), based on this Framework, will be developed in coordination with BOEM, U.S. Fish and Wildlife Service (USFWS), and other relevant regulatory agencies prior to beginning monitoring. Where feasible, monitoring conducted at the RWF will be coordinated with monitoring at neighboring Orsted/Eversource offshore wind projects—South Fork Wind Farm (SFWF) and Sunrise Wind Farm (SRWF)—to facilitate integrated analyses across a broader geographic area.

Monitoring objectives, questions, and associated methods are summarized in Table 1. Technical approaches were selected based on offshore logistical constraints, their ability to address monitoring objectives, and their effectiveness in the marine environment. Emerging technologies, such as multi-sensor radar/camera collision detection systems, are not proposed under this Framework because they have not yet been broadly deployed offshore or demonstrated to effectively reduce uncertainties related to potential impacts on birds and bats.

Table 1. Monitoring objectives, questions, general approaches to be used, and duration.

Taxa	Monitoring Objective	Primary Questions	Approach	Duration
Bats	Monitor occurrence of bats	What times of year and under what environmental conditions are bats detected in the wind farm?	Acoustics	2 years
Birds	Monitor use by ESA listed birds	What times of year and under what environmental conditions are ESA birds present in the wind farm?	Radio-tags	up to 3 years
Birds	Monitor use by nocturnal migratory birds	What are the flux rates and flight heights of nocturnally migrating birds?	Radar	1–2 years
Birds	Monitor movement of marine birds around the turbines	What are the avoidance rates of marine birds?	Radar	1–2 years
Both	Document mortality	What dead or injured species are found incidentally?	Incidental observations	Project lifetime

Bat Acoustic Monitoring

The presence of bats in the marine environment has been documented in the U.S. (Hatch et al. 2013, Solick and Newman 2021). However, there remains uncertainty regarding the extent to which bats occur offshore, particularly within offshore wind farms. Acoustic detectors are commonly used to study bat movements and migration (Johnson et al. 2011). Following the approach taken at SFWF (Final Environmental Impact Statement Appendix F[1]), Orsted/Eversource would conduct bat acoustic monitoring to assess bat activity at RWF, targeting key data gaps related to species presence/composition, temporal patterns of activity, and correlation with weather and atmospheric conditions. The primary monitoring questions are: What times of year and under what environmental conditions are bats detected in the wind farm?

Acoustic monitoring of bat presence would be conducted for two years post-construction. A detector would first be tested onsite to determine if there is any sound interference. Contingent on a successful test, ultrasonic bat detector stations would be installed on the offshore convertor station, wind turbine platforms, and/or buoys. The specific number and location of detector stations would be selected to optimize study design goals, and would be determined in cooperation with BOEM, USFWS, and other relevant regulatory agencies. While specific timing would be dictated by logistics, detectors would likely be deployed in the early spring or late winter (March), and removed in the late fall or early winter (December) after migration, or the most appropriate period as determined in cooperation with BOEM, USFWS, and other relevant regulatory agencies. The detectors would record calls of both cave-hibernating bats, including the northern long-eared bat (*Myotis septentrionalis*), and migratory tree bats; the resulting

[1] https://www.boem.gov/renewable-energy/state-activities/south-fork

information can be used to identify bats to species. All acoustic data recorded would be processed with approved software to filter out poor quality data and identify the presence of bat calls. Where information is insufficient to make a species identification, calls would be classified to one of two phonic groups: low frequency bats (LoF), or high frequency bats (HiF). The HiF group includes both migratory tree bats and cave hibernating bats. Since HiFi include the ESA-listed northern long-eared bat, they would then be manually vetted by an experienced acoustician to the highest resolution possible (e.g., species or genus).

All bat calls detected and identified would be analyzed to understand relationships with time of day, season, and weather/atmospheric conditions. The results would provide information on bat presence offshore and the conditions under which they may occur near offshore wind turbines.

Motus Tracking Network and ESA Use Study

Tracking studies indicate that at least some individual ESA-listed Piping Plovers (*Charadrius melodus*), Red Knots (*Calidris canutus rufa*), and Roseate Terns, may pass through the Rhode Island and Massachusetts lease areas (Loring et al. 2018, 2019). However, due to limited coverage of onshore automated telemetry receiving stations and low probability of detecting tags (hereafter, Motus receivers and tags) in the offshore environment (Loring et al. 2019), there remains uncertainty related to offshore movements of ESA-listed birds in New England. Revolution Wind would install offshore Motus receiver stations and contribute funding to radio-tagging efforts to address this data gap. The exact species being studied would be determined in consultation with federal agencies and would be dependent on existing, ongoing field efforts. The Motus receivers would also provide opportunistic presence/absence data on other species carrying Motus tags, such as migratory songbirds and bats. <u>The primary monitoring questions are: What times of year and under what environmental conditions are ESA birds present in the wind farm?</u>

Movements of radio-tagged ESA-listed birds in the vicinity of the RWF would be monitored for up to three years post-construction, during the spring, summer, and fall. Motus receivers would be installed within the wind farm to determine the presence/absence of ESA-listed species. The specific number and location of offshore receiver stations would be selected to optimize study design goals, and would be determined using a design tool currently being developed through a New York State Energy Research and Development Authority (NYSERDA) funded project[2]. If there is a need identified by USFWS and in coordination with efforts at SFWF and RWF, existing Motus receiver stations at up to two onshore locations near the RWF would be refurbished or maintained to confirm the presence and movements of radio-tagged ESA-species in areas adjacent to RWF. Funding for up to 150 Motus tags per year would be provided to researchers working with ESA-listed birds for up to three consecutive years.

ESA-listed bird presence/absence in the wind farm would be analyzed by comparing detections within the wind farm to coastal receiver towers. All detections would be analyzed to understand relationships with time of day, season, and weather.

[2] https://www.briloon.org/renewable/automatedvhfguidance

Radar Monitoring: Nocturnal Migrants Flux and Flight Heights

Nocturnal migrants, including songbirds and shorebirds, are documented to fly offshore (Adams et al. 2015, Loring et al. 2020). Since nocturnal migration events are episodic and cannot be detected during daytime surveys, there is uncertainty on the timing and intensity of migration offshore. Radar, oriented vertically, has been used at offshore wind farms in Europe to study nocturnal migration events (Hill et al. 2014). Orsted/Eversource is considering conducting a one-to-two-year radar study across SRWF, SFWF, and RWF to record the passage rates (flux) of migrants and flight heights. <u>The primary monitoring questions are: What are the flux rates and flight heights of nocturnally migrating birds?</u>

Since radar approaches to monitoring birds are actively evolving and feasibility would need to be determined, a specific system and methods would be identified closer to when the projects begin operating. The results would be related to time of year and weather conditions, to increase the understanding on when nocturnal migrants may have higher collision risk.

Radar Monitoring: Marine Bird Avoidance

Marine birds, particularly loons, sea ducks, auks, and the Northern Gannet (*Morus bassanus*), have been documented to avoid offshore wind farms, potentially leading to displacement from habitat (Goodale and Milman 2016). However, there remains uncertainty on how birds would respond to Orsted/Eversource's large turbines that would be spaced one nautical mile apart. Based on methods used by Desholm and Kahlert (2005), Skov et al. (2018), and others, Orsted/Eversource is considering conducting a one-to-two-year cross-project (SRWF, SFWF, and RWF) radar study to collect data on macro (and potentially meso—i.e., flying between turbines) avoidance rates. These data on avoidance would support understanding of both displacement and collision vulnerability, and how this may be correlated with weather conditions. <u>The primary monitoring questions is: What are the avoidance rates of marine birds?</u>

Documentation of Dead and Injured Birds and Bats

Revolution Wind, or its designated operator, would implement a reporting system to document dead or injured birds or bats found incidentally on vessels and project structures during construction, operation, and decommissioning. The location would be marked using GPS, an Incident Reporting Form would be filled out, and digital photographs taken. Any animals detected that could be ESA-listed, would have their identity confirmed by consulting biologists, and a report would be submitted to the designated staff at Revolution Wind who would then report it to BOEM, USFWS, and other relevant regulatory agencies. Carcasses with federal or research bands or tags would be reported to the U.S. Geological Survey (USGS) Bird Band Laboratory, BOEM, and USFWS.

Adaptive Monitoring

Adaptive monitoring is an important principle underlying Revolution Wind's post-construction monitoring Framework. Over the course of monitoring, Revolution Wind would work with BOEM, USFWS, and other relevant regulatory agencies, to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring, based on an ongoing assessment of monitoring results. Potential triggers for adaptive monitoring may include, but not be limited to, equipment failure, an unexpected impact to birds or bats identified through monitoring, or new opportunities to collaborate with other projects in the region. The Monitoring Plan would include a series of potential adaptive monitoring actions, developed in coordination with BOEM, USFWS, and other relevant regulatory agencies, to be considered as appropriate.

Reporting

Revolution Wind would submit an annual report to BOEM and USFWS summarizing post-construction monitoring activities, preliminary results as available, and any proposed changes in the monitoring program. Revolution Wind would participate in an annual meeting with BOEM and USFWS to discuss the report.

Data from these monitoring studies will ultimately be submitted to relevant regional databases and archives (e.g., NABat), as feasible and appropriate.

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8 Part VIII: Wind Turbine Generator Percent Operational Estimates (Confidential)

CONFIDENTIAL/FOIA-EXEMPT

Contains trade secrets and/or privileged/confidential commercial/financial information