Ocean Wind
An Ørsted & PSEG project

Appendix H – Assessment of the Potential Effects of the Ocean Wind Offshore Wind Farm on Birds & Bats

Ocean Wind Offshore Wind Farm

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

Prepared by:
Biodiversity Research Institute
276 Canco Road, Portland, ME 04103

Executive Summary

An assessment of the potential effects on bats and birds of the onshore and offshore components of the Ocean Wind Offshore Wind Farm was conducted to support the Construction and Operation Plan (COP). The goal of the assessments is to provide a detailed analysis of the species that may be exposed to each project component to support the Affected Environment section of the COP, and those potentially affected for the Impact section. As a whole, this assessment was developed to meet COP requirements, provide information for NEPA review, and support agency consultations.

Part I of this assessment provides background information on the Project. Part II of this assessment covers potential impacts on migratory tree-bats and cave-hibernating bats for all Project components. Part III of the assessment provides a detailed examination of the potential effects of the offshore Project components on birds, including migratory shorebirds, wading birds, raptors, songbirds, coastal waterbirds, and marine birds. Marine birds were assessed by major taxonomic group and included loons, sea ducks, tube-nosed species, gannets and allies, gulls and allies, terns, and auks. Part IV of the assessment describes the bird habitat potentially disturbed by onshore project activities and the birds that may occupy the habitat. Species with greater Federal protection [Northern long-eared bat (*Myotis septentrionalis*); Bald Eagle (*Haliaeetus leucocephalus*), Golden Eagle (*Aquila chrysaetos*), Roseate Tern (*Sterna dougallii*), Piping Plover (*Charadrius melodus*), and Red Knot (*Calidris canutus*)] were individually assessed. For each section, mitigation approaches are discussed. Maps of exposure for marine birds are provided in Part V.

The assessment used a weight-of-evidence approach that included an analysis of exposure of bats and birds to each specific project hazard (i.e., impact producing factor), and behavioral vulnerability to the hazard. The primary datasets used for the offshore assessment were the New Jersey Department of Environmental Protection Ecological Baseline Studies (NJDEP EBS), NOAA Marine Bird Distribution Models, and occurrence data available in the literature. For marine birds, for which survey data was available, a semi-quantitative exposure assessment was conducted. For bats, and non-marine and migratory birds, other data sources (e.g., individual tracking data), literature, and species accounts were used to assess likely exposure. Onshore, the habitat potentially disturbed by the project was described, and the species likely to occupy the habitat were identified.

Offshore, bats are not expected to regularly forage in the Wind Farm Area, but tree bats may be present during migration. Impacts to bats during construction are limited because, while bats may be attracted to vessels, stationary objects are not generally considered a collision risk. During operation, individual tree-bats, particularly eastern red bats (*Lasiurus borealis*), may pass through the array during fall migration. Potential effects during all construction phases will be reduced by minimizing lighting. Although uncertainty remains on the extent to which bats use the offshore environment, the Project is unlikely to have a population level impact for any species of bat. Onshore, cave-hibernating bats—including the northern long-eared bat—and

migratory tree bats may be present in the area; however, since most Project activities are co-located with existing disturbed areas, there is expected to be limited disruption of bat habitat. Therefore, individual impacts to northern long-eared bats from the onshore components of the project are expected to be minimal to low; and the likelihood of population level impacts for non-listed species are expected to be minimal to low. To further avoid potential effects to bats from onshore Project development, Ocean Wind will implement the proposed measures for avoiding, minimizing, and monitoring environmental impacts for the Project presented in Volume II of the COP, Table 1.1-2.

Overall, construction, operation, and decommissioning activities occurring in the Wind Farm Area are not expected to result in population-level effects to migratory, coastal, or marine birds. While some non-marine birds have the potential to be exposed to the Wind Farm Area, the wind farm is far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species. During migration, falcons and songbirds may pass through the Wind Farm Area. Of the ~40 species of marine birds that use the mid-Atlantic marine environment, the Northern Gannet and loons had the highest potential exposure. Potential exposure of marine and coastal birds listed under the Endangered Species Act (Roseate Tern, Piping Plover, and Red Knot) will be limited to a short period during migration and these species have not been observed in the Wind Farm Area; thus, since these birds are not considered to have high collision risk, individual impacts are unlikely. Eagle exposure to the Wind Farm Area is considered 'minimal' because these species are rarely detected in the offshore environment. The proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts for the Project are presented in Volume II of the COP, Table 1.1-2.

Onshore, Project activities are expected to have little impact on birds because nearly all development will be co-located with existing areas of development. With the proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts for the Project, onshore construction, operation, and decommissioning activities are not expected to affect the populations of breeding or migratory birds.

Table of Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

AC	alternating current
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
CFA	Conservation focal area
CFR	Code of Federal Regulations
CWF	Conserve Wildlife Foundation of New Jersey
COP	Construction and Operations Plan
CSV	comma-separated value
EBS	Ecological Baseline Studies
ENSP	New Jersey Endangered and Nongame Species Program
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
MW	megawatt
MMS	Minerals Management Service
NEPA	National Environmental Policy Act
NE RPB	Northeast Regional Planning Body
NCCOS	National Centers for Coastal Ocean Science
NJDEP	New Jersey Department of Environmental Protection
NJWAP	New Jersey Wildlife Action Plan
NLEB	northern long-eared bats
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

The Biodiversity Research Institute (BRI) was contracted by HDR to support a bat and avian assessment for the onshore and offshore components of the Ocean Wind Offshore Wind Farm (hereafter referred to as the “Project”). Ocean Wind LLC (Ocean Wind), an affiliate of Orsted Wind Power North America LLC (Orsted; formerly Dong Energy Wind Power [U.S.] Inc.) is developing the Project pursuant to the Bureau of Ocean Energy Management (BOEM) requirements for the commercial lease (Lease Area OCS-A-0498) of submerged lands for renewable energy development on the outer continental shelf (OCS). The purpose of the assessment was to evaluate the potential effects on bats, migratory shorebirds, wading birds, raptors, songbirds, coastal waterbirds, and marine birds from the proposed development of the Project as part of the Construction and Operation Plan (COP) for the Project.

Overall, the Project consists of three major components (Figure 1-1). The first component, the Wind Farm Area, is where the offshore wind farm will be located, which will include the turbines, array cables, offshore substation(s), substation interconnector cables, and portions of the offshore export cables. The second component, the Offshore Cable Corridor, will include the portion of the offshore export cables from the Wind Farm Area to the cable landfall. The third component, the Onshore Cable Corridor, is where the permanent onshore electrical infrastructure will be located, which will include onshore export cables, onshore AC substation, and connections to the grid. For the purposes of this assessment we limit our consideration to the Wind Farm Array, the Offshore Cable Corridor, and the Onshore Cable Corridor. Ocean Wind will use existing port and onshore office, warehouse, and workshop facilities to the extent practicable.

Offshore, the overall Lease Area is approximately 160,480 acres (64,944 ha) and is located approximately 9 nautical miles (17 km) southeast of Atlantic City. The Lease Area runs roughly parallel to the coast for approximately 52 nm (96 km) along Ocean, Atlantic and Cape May counties, New Jersey, and is approximately 13 nm (24 km) from west to east. The offshore infrastructure including turbines, offshore substation(s), and array cables will be located within the Lease Area. Water depths within the offshore Lease Area range from 49–118 ft (16–36 m) below mean lower low water (MLLW) with the seafloor sloping generally offshore toward the southeast at less than 1°. The project would be located in the northeastern portion of the lease area referred to as the Phase 1 area. Ocean Wind will construct 98 turbines. Indicative turbine dimensions are provided in Figure 1-2.

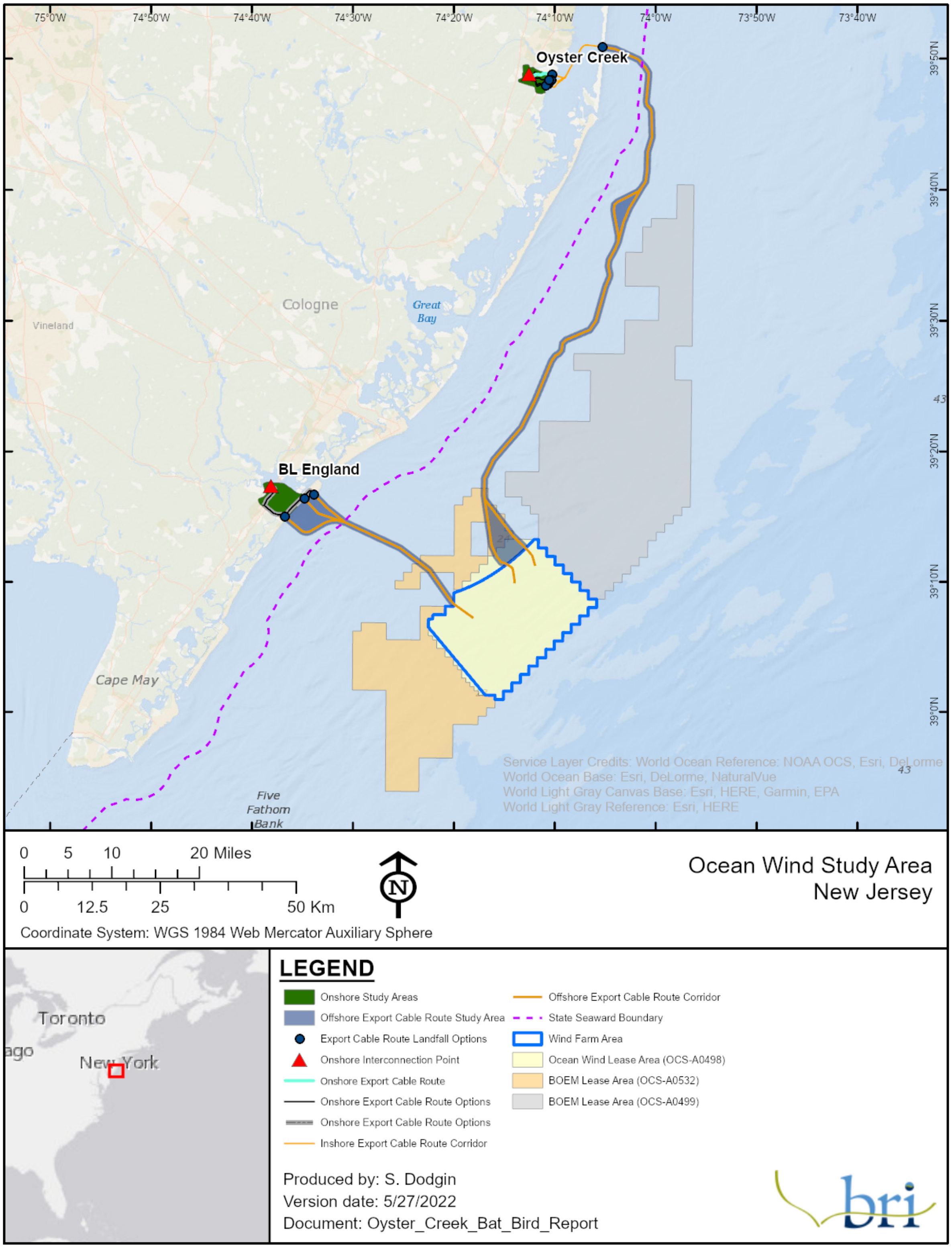


Figure 1-1. Overview of the Project, including the Wind Farm Array, Export Cable corridor, and Onshore Cable Corridor.

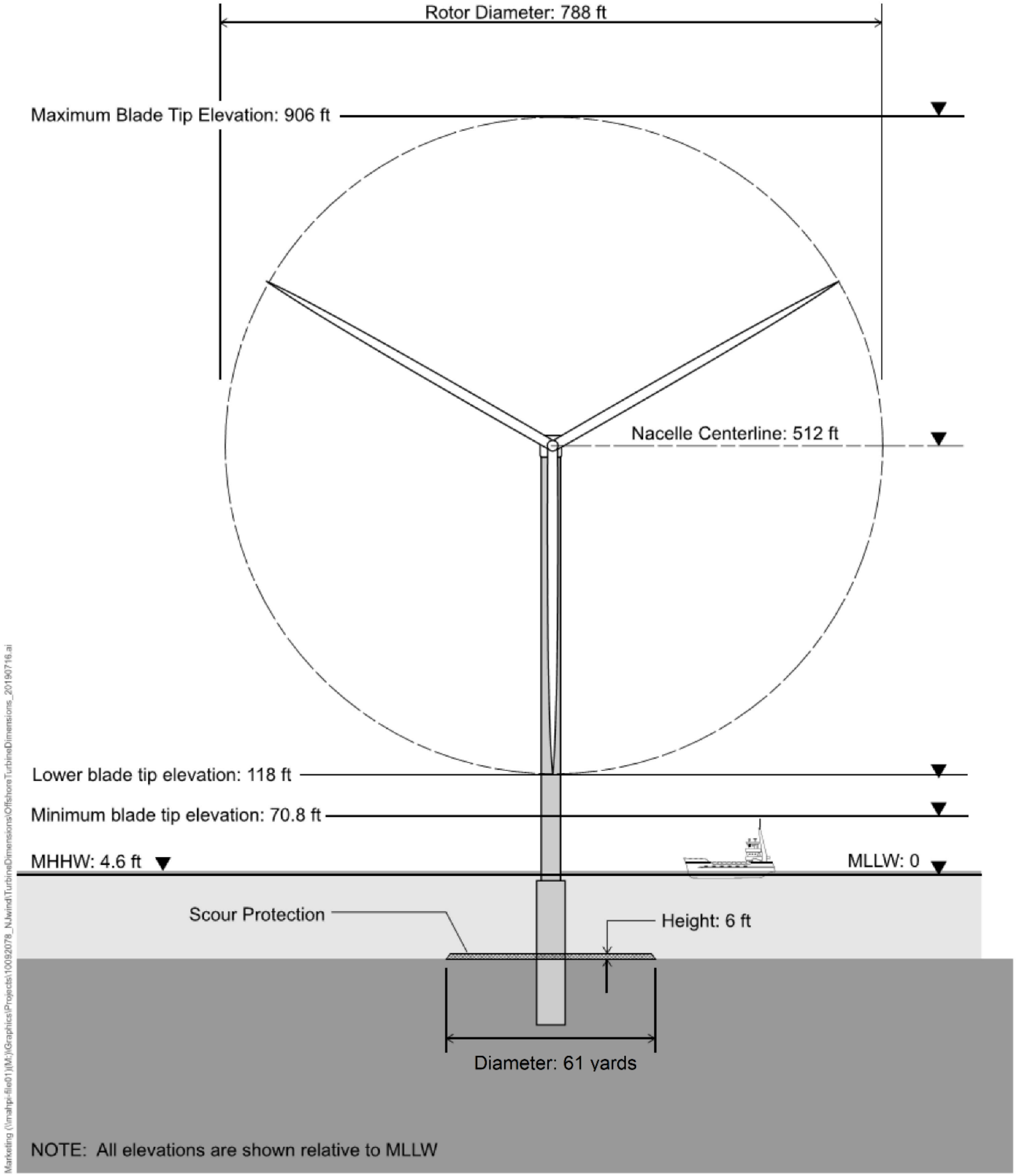


Figure 1-2. Maximum design scenario for wind turbines.

Onshore, construction activities will be focused on two locations: BL England and Oyster Creek. Each onshore AC substation would require a permanent site, including area for the substation equipment and buildings, energy storage, and stormwater management and landscaping. During construction, additional areas will be required for temporary workspace at each substation. The cables will be installed within a permanent right-of-way and an additional parallel temporary construction corridor will be required. See Volume I, Section 6, of the COP for details on project dimensions and timing of construction activities.

The focus of this assessment is on the offshore wind turbines within the Wind Farm Area and onshore (above high tide line) components of the Project. Bat and avian impacts from the offshore portions of proposed submarine cables and offshore sub-stations are not expected (Epsilon Associates Inc. 2018) and, therefore, are not discussed in detail. Potential nearshore impacts are discussed in the onshore bird section.

1.2 Scope and Approach of Assessment

Impacts to birds are regulated under three federal laws: 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 environmental review process. This assessment was developed to provide adequate data and analysis to BOEM and other federal and state agencies for NEPA review.

Specifically, this bat and avian assessment provides an overview of the species that have the potential to be affected by the proposed onshore and offshore Project activities, with separate sections on federally listed species. To do so, the potential direct and indirect impacts were evaluated for each phase of the Project including habitat conversion, collision, and displacement (Table 1-1). For the onshore component of the project, the assessment focused on the habitats that would potentially be disturbed and the bat and bird species that may occupy each major habitat type.

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

- *Impact-producing Factors* – The first step in the assessment was to describe the impact-producing factors, which are the Project activities or components 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. For species where site-specific data was available, a semi-quantitative exposure assessment was conducted. The exposure of birds to the Project was assessed using three datasets, species accounts, and the literature. This assessment of exposure was focused exclusively on the horizontal, or two-dimensional, likelihood that a bird would use the Project Area.

- *Vulnerability* – Potential effects are then assessed qualitatively by combining the exposure assessment with the best information available on behavioral vulnerability to offshore wind. For the purposes of this analysis, 'behavioral vulnerability' is defined as the degree to which a species is expected to be affected by the Project based on known effects at similar offshore developments. This assessment of behavioral vulnerability focused on documented avoidance behaviors, estimated flight heights, and estimated collision risks published in the literature.

- *Risk* – The likelihood that the Project would impacts bats/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 WEAs ([BOEM] Bureau of Ocean Energy Management 2016a) and project specific EISs ([BOEM] 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 non-listed species.

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

Project Component	Potential Effect	Description	Construction	Operation
Onshore	Habitat Conversion (Temporary)	Temporary disturbance of habitat by Project activities	✓	✓
Onshore	Habitat Conversion (Permanent)	Permanent disturbance of habitat by Project activities	✓	✓
Offshore	Collision	Mortality and injury caused by collision with Project structures	✓	✓
Offshore	Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	✓	
Offshore	Displacement (Permanent)	Permanent avoidance and/or displacement from habitat		✓

1.3 Agency Coordination

Prior to beginning the assessment, Ocean Wind met with BOEM on July 11, 2018 to discuss the overall approach for assessment. At the meeting, available data on bird and bat use of the Project Area was presented along with an overview of the assessment approach. At the conclusion of the meeting, BOEM determined that the existing data were sufficient to conduct the assessment.

1.4 Assessment Structure

Part I of the assessment is the introduction and background to the Project and assessment of effects (this section). Part II of the assessment is focused on bats. First, a general description of bats present in New Jersey is provided, followed by specific assessments for the offshore and onshore project components. Part III of the assessment is focused on birds in the offshore component of the Project. Part IV is focused on birds in the onshore Project component. Finally, Part V includes supplemental maps for Part III, which includes a map for each of the marine birds for each season they may be present in the Wind Farm Area. The entire report is provided as Appendix H of the COP and was used to support the Affected Environment and Impact sections of the COP.

2 Part II: Bats

This bat assessment provides an overview of the bat community that has the potential to be exposed to the proposed offshore and onshore Project activities, with separate sections on federally listed species.

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; critical habitat has not been designated for bats in the Project Area).

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 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) ([BOEM] Bureau of Ocean Energy Management 2012, Goodale and Milman 2016).

Offshore bats may be exposed to the following hazards: construction and maintenance vessels and the wind turbines (Table 2-1). Except for vessel activities during construction, the offshore export cable route is not considered a hazard for bats and therefore no impact analysis was conducted. For the analysis below, the full range of turbine sizes that may be used by the Project are considered and it is also assumed that foundation type will not significantly change the hazards during construction.

Onshore, the primary hazard is temporary and/or permanent habitat conversion (e.g., tree clearing, vegetation clearing, and soil disturbance) during construction. During operation, maintenance activities have the potential to cause temporary habitat conversion (e.g., ground disturbance), but the disturbance would generally be similar or less than the construction of the onshore export cables, impact smaller areas, and is expected to be of shorter duration. Thus, operation of onshore facilities is not expected to have any specific long-term hazards associated with habitat conversion. Noise and vibration generated by construction and maintenance equipment may temporarily disturb some bats within nearby habitat, but these bats are expected to return once the activity is complete. Since noise and vibration are impact-producing factors that are limited, temporary, and indirect, they will not be discussed further.

Table 2-1: Potential effects on bats and the Project phases for which they are assessed. Effects of decommissioning are expected to be less than or equal to construction activities.

Impact-producing Factor(s)	Potential Effect	Project Component	Description	Construction	Operation
Land disturbances	Habitat Conversion (Temporary)	Coastal and Upland	Temporary disturbance of upland habitat by Project activities	✓	✓
Land disturbances	Habitat Conversion (Permanent)	Coastal and Upland	Permanent disturbance of upland habitat by Project activities	✓	✓
Vessels, lighting, wind turbines, substations	Collision	Offshore	Mortality and injury caused by collision with Project structures	✓	✓

2.1.2 Assessment Methods

The impact assessment was conducted by evaluating the *exposure* of bats to the offshore and onshore project components within the context of the known *vulnerability* of bats to collisions with wind turbines (offshore) and habitat conversion (onshore). This is similar to the approach taken for birds. Bat exposure was assessed using the best available data. Descriptions of these data are provided below. Given the general data gaps of 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 impact assessment.

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

- Minimal: Not likely to be present, and little to no evidence of use of the offshore/onshore environment for breeding, or wintering, and low predicted use during migration.
- Low: Little evidence of the use of the offshore/onshore environment and a low proportion of the population exposed.
- Medium: Moderate evidence of the use of the offshore/onshore environment and a moderate proportion of the population is exposed.
- High: Strong evidence of the use of the offshore/onshore environment, the 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 in the literature.
- Low: Little evidence of collisions in the literature.

- Medium: Moderate evidence of collisions in the literature.
- High: Significant evidence of collisions 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 or medium/high ranking or high/medium in exposure and vulnerability.
- High: High/high ranking in exposure and vulnerability.

Other factors, such as broad population trends or general habitat use, were then considered in assigning a ***final*** risk category – *individual risk for listed species or population risk for non-listed species* (Table 2-2).

Table 2-2. Matrix used for risk determination. The "Other" category represents that risk levels could be adjusted (up or down) when other critical information is incorporated into the evaluation using expert opinion. If a final risk assessment was adjusted, justification is provided in the species group risk text and then highlighted in either green (down) or orange (up) in the final summary table (2-2).

	Vulnerability				
Exposure	*Minimal*	*Low*	*Medium*	*High*	*Other*
Minimal	Minimal	Minimal	Minimal	Minimal	↑
Low	Minimal	Low	Low	Low	↕
Medium	Minimal	Low	Medium	Medium	↕
High	Minimal	Low	Medium	High	↓
Other	←	↔	↔	→	

2.1.3 Data Sources

2.1.3.1 *USFWS Indiana and Northern Long Eared Bat Municipalities List* (USFWS New Jersey Field Office 2017)

The USFWS has completed telemetry studies throughout the state and has developed a list of municipalities in which species listed under the ESA (Indiana and northern long-eared bats [NLEB]) are found to have known roost trees and summer maternity colonies, as well as those within 0.25 mi (0.4 km) of a known hibernaculum. These data are available at the county and township level and were used to determine the potential presence for these bat species in the onshore study area.

2.1.3.2 *Conserve Wildlife Foundation of New Jersey Northern Long-eared Bats Mist Netting and Radio Telemetry Study*

The Conserve Wildlife Foundation of New Jersey (CWF) conducted a NLEB mist net and acoustic monitoring study beginning in 2015 (CWF 2018). The NLEB mist netting and telemetry project is a state-wide project aimed at determining the distribution and habitat selection of NLEB. Netting is conducted from June through August. Morphometrics are measured and recorded for all bats caught in the nets during the survey. Each captured bat is tagged with a uniquely identifiable metal band in case of future recapture. Bats of interest (any bat in the *Myotis* genus) are fitted with radio transmitters for tracking purposes. Tracking occurs the following day after the transmitter is placed on the bat and continues until the transmitter falls off. The NLEB mist net and radio telemetry study is ongoing and data from the survey has not yet been published. Information on the location of these sites is available through consultation with NJDEP Natural Heritage Program. The information in this study is sufficient in spatial and temporal extent to describe the existing conditions of bat distributions in the vicinity of the Study Corridors to support the COP.

2.1.3.3 *Conserve Wildlife Foundation of New Jersey Acoustic Bat Monitoring*

The CWF has conducted acoustic bat monitoring across New Jersey since 2010 and has published two reports based on this work (CWF 2012, 2014). In 2012 both cave-hibernating and migratory tree bats were detected in Ocean and Atlantic Counties. The 2014 acoustic survey report indicates that the most common bats identified in Monmouth County, the county sampled that year closest to the onshore Project Area, were eastern red bats and big brown bats. The information in this study is sufficient in spatial and temporal extent to describe the existing conditions of bat distributions in the vicinity of the Study Corridors to support the COP.

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

Aerial and boat-based surveys of wildlife in the Mid-Atlantic detected a possible migration event of eastern red bats in September 2012 (Hatch et al. 2013). Eleven bats were observed between 10.5 mi (16.9 km) and 25.9 mi (41.8 km) east of New Jersey. The information in this study provides additional information about bat distributions in the vicinity of the Study Corridors to support the COP.

2.1.3.5 *Offshore Activity of Bats along the Mid-Atlantic Coast*

Monthly shipboard surveys were conducted coastally and further offshore of New Jersey for NJDEP Ocean/Wind Power EBS (NJDEP 2010). During the March-October 2009 shipboard surveys, bat surveys using Anabat II detectors, were conducted by Angela Sjollema of the University of Maryland Center for Environmental Science (Sjollema et al. 2014). The goal of this project was to study offshore occurrence of bats along the Delmarva Peninsula. Acoustic monitoring of bats off the Atlantic Coast (from Massachusetts to North Carolina) was conducted for 86 nights from March 2009 to August 2010 in spring (March-beginning of June) and fall (August-October). One hundred and sixty-six bat detections were recorded over 898 hours of recording time. Maximum detection distance from shore was 13.6 mi (21.9 km) and mean distance was 5.2 mi (8.4 km). The information in this study is sufficient in spatial and temporal extent to describe the existing conditions of bat distribution in the vicinity of the Study Corridors to support the COP.

2.1.3.6 Federal Aviation Administration (FAA) Bat Monitoring Report at the FAA Technical Center Property

Mist net surveys were completed as part of a long-term study by the FAA at the William J. Hughes Training Center (Risley 2015) in Atlantic County. Surveys were completed from June through July since 2001 and provide a unique view of the local bat community. The data collected is for Atlantic County and therefore not spatially sufficient for the project but can be used to support the CWF findings of bat species distribution in the state.

2.1.3.7 Conserve Wildlife Foundation of New Jersey Summer Bat Count

The Summer Bat Count was created in 2003 by CWF and the New Jersey's Endangered and Nongame Species Program (ENSP) to gain a better understanding of how New Jersey's bats are distributed, what conditions they choose for roosting, and how their populations may be changing over time (CWF 2014).

2.1.3.8 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 (range August-October) 2010-2012 (Smith and McWilliams 2016). These data were used to infer potential implications for wind energy development in relation to bat activity in southern New England. During 775 detector nights 47,611 bat detections were recorded. The most commonly identified calls belonged to eastern red bats and silver-haired bats. Bat activity varied with regional wind conditions, indicative of cold fronts and was strongly associated with various aspects of temperature.

2.2 Overview of Bats in New Jersey

There are nine species of bats present in the state of New Jersey, of which six are year-round residents (Table 2-3) (Maslo and Leu 2013). Bat species present in New Jersey can be broken down 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 the winter, migrate from summer habitat (specific areas dependent on species) to hibernacula in the mid-Atlantic region (Maslo and Leu 2013). Migratory tree bats fly to southern parts of the U.S. in the winter and are observed offshore during migration (Hatch et al. 2013).

Table 2-3. Bat species present in New Jersey and their conservation status (Maslo and Leu 2013).

Common Name	Scientific Name	Type	State Status	Federal Status
Eastern small-footed bat	*Myotis leibii*	Cave-Hibernating Bat		
Little brown bat	*Myotis lucifugus*	Cave-Hibernating Bat		
Northern long-eared bat	*Myotis septentrionalis*	Cave-Hibernating Bat		T
Indiana bat*	*Myotis sodalis*	Cave-Hibernating Bat	E	E
Tri-colored bat	*Perimyotis subflavus*	Cave-Hibernating Bat		
Big brown bat	*Eptesicus fuscus*	Cave-Hibernating Bat		
Eastern red bat	*Lasiurus borealis*	Migratory Tree Bat		
Hoary bat	*Lasiurus cinereus*	Migratory Tree Bat		
Silver-haired bat	*Lasionycteris noctivigans*	Migratory Tree Bat		
*Range does not indicate presence in the project area.				
"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. E=endangered; T=threatened.				

2.2.1 Federally Listed Species

Two federally listed bats are present in New Jersey: Indiana bat and northern long-eared bat, but only one, the NLEB is found in the vicinity of the Project, being recorded in Monmouth, Ocean, and Atlantic counties of New Jersey. Historical and current records of the Indiana bat demonstrate its presence only in north and west-central New Jersey (Barbour and Davis 1969, USFWS New Jersey Field Office 2018). Thus, this assessment will focus solely on the potential exposure of NLEB to the Onshore and Offshore Project Areas.

2.2.1.1 Northern long-eared bat

The NLEB is an insectivorous bat 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 United States 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 (USFWS 2016). As a result, NLEB was listed as threatened under the ESA in 2015.

The NLEB is active throughout early spring to late fall (March-November; Menzel et al. 2002, Brooks and Ford 2005). At summer roosting locations, the NLEB forms maternity colonies (aggregations of females and juveniles) where females give birth to young in mid-June. 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). 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). 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 the summer, NLEB have small home ranges (less than 25 acres [10 hectares]; Silvis et al. 2016 in Dowling et al. 2017) and migratory movements can be up to 170 mi (275 km) (Griffin 1945 in Dowling et al. 2017).

Despite severe population declines, NLEB 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 present on Nantucket and Martha's Vineyard (Dowling et al. 2017) and pre-WNS along the New Jersey shore (BRI unpublished data; USFWS New Jersey Field Office).

2.3 Offshore

2.3.1 Exposure

While there is uncertainty on the specific movements of bats offshore, bats have been documented in the marine environment in the U.S. (Grady and Olson 2006, Cryan and Brown 2007, Johnson et al. 2011b, Pelletier et al. 2013, Hatch et al. 2013, Dowling and O'Dell 2018). Bats have been observed to temporarily roost on structures on nearshore islands such as lighthouses (Dowling et al. 2017) and there is historical evidence of bats, particularly the eastern red bat, 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 0.6 mile (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, eastern red bat comprised 78% (166 bat detections during 898 monitoring hours) of all bat detections offshore and bat activity decreased as wind increased (Sjollema et al. 2014). In addition, eastern red bats were detected in the mid-Atlantic up to 27.3 mi (44 km) offshore by high resolution video aerial surveys (Hatch et al. 2013).

Cave-hibernating bats: Cave-hibernating bats hibernate regionally in caves, mines, and other structures and feed primarily on insects in terrestrial and fresh-water habitats. These species generally exhibit lower activity in the offshore environment than the migratory tree bats (Sjollema et al. 2014), with movements primarily during the fall. In the mid-Atlantic, the maximum distance *Myotis* bats were detected off shore 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 of the Gulf of Maine that indicated the greatest percentage of activity in July-October (Peterson et al. 2014). Given that the use 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 Wind Farm Area is considered “minimal” to “low” for this group. Northern-long-eared bats are discussed in greater depth below:

> *Northern long-eared bat*: Northern long-eared bats are not expected to be exposed to the Wind Farm Area, but there has been limited work studying the movements of NLEB over the ocean to provide strong evidence of a lack of movement offshore. A recent tracking study on Martha’s Vineyard (n = 8; July-October 2016) did not record any offshore movements (Dowling et al. 2017). If NLEB were to migrate over water, 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 NLEB 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 NLEB, exposure is expected to be “minimal”.

<u>Migratory tree bats</u>: Tree bats migrate south to overwinter and have been documented in the offshore environment (Hatch et al. 2013). Eastern red bats have been detected migrating from Martha’s Vineyard late in the fall and one bat tracked as far south as Maryland (Dowling et al. 2017). These results are supported by historical observations of eastern-red bats offshore and recent acoustic and survey results (Hatch et al. 2013, Peterson et al. 2014, Sjollema et al. 2014). While little local data are available, the NJDEP EBS surveys recorded several observations of bats flying over the ocean, with observations of migratory tree bats in the near-shore portion of the Wind Farm Area (Figure 2-1). Tree bats may pass through the Wind Farm Area during the migration period, because they are detected in the offshore environment. However, since bat movement offshore is generally limited to fall migration, the spatio-temporal exposure is expected to be “low”.

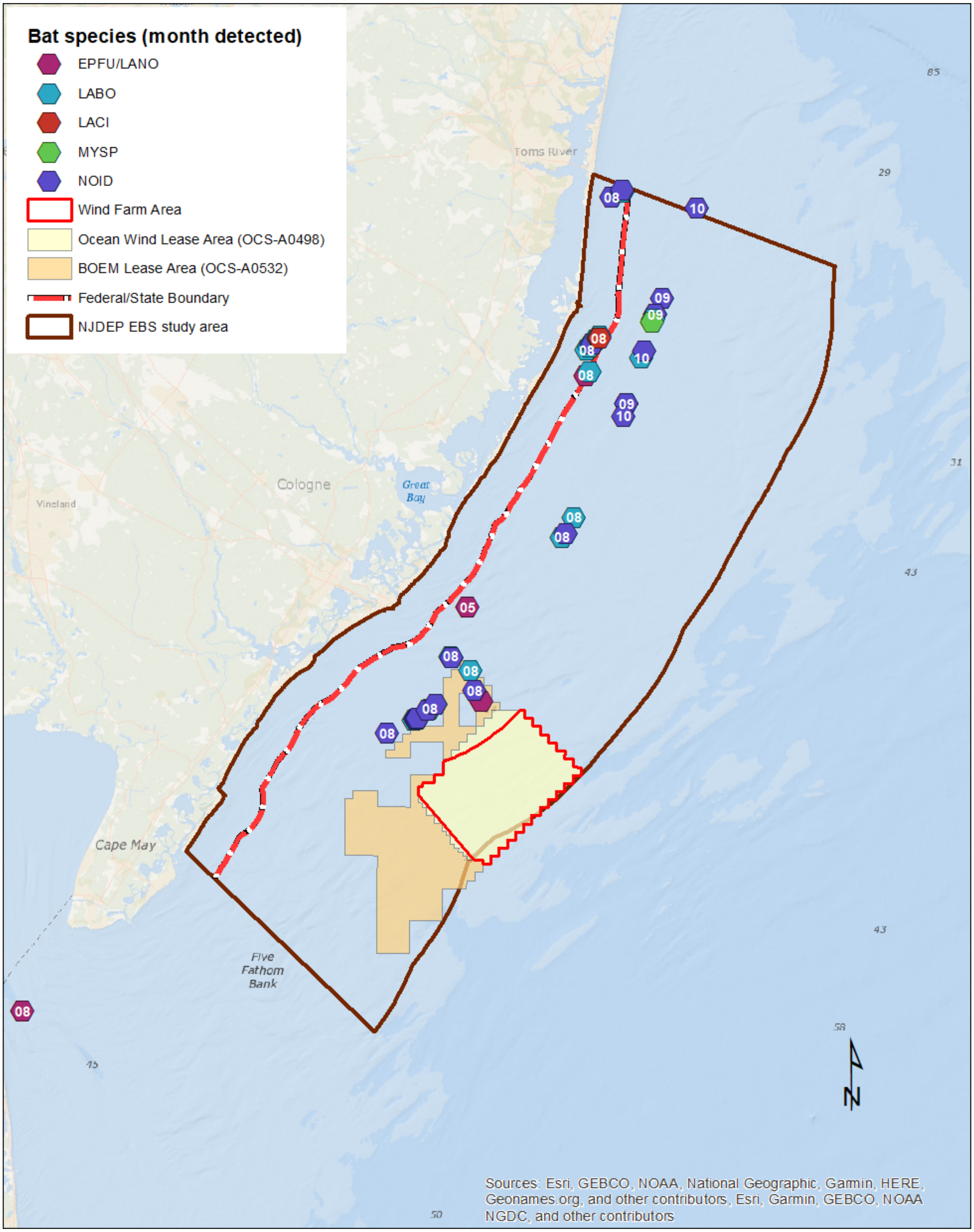


Figure 2-1: Bat occurrences in the NJDEP EBS surveys.

2.3.2 Impacts

2.3.2.1 Construction and Installation

Bats may be attracted to construction vessels installing wind turbines, sub-stations, or export cables, particularly if insects are drawn to the lights of the vessels. However, stationary objects are not generally considered a collision risk for bats ([BOEM] Bureau of Ocean Energy Management 2012) because bats are able to detect objects with echolocation (Johnson and Arnett 2004, Horn et al. 2008), though bats at onshore wind facilities have been documented showing higher attraction and more frequent approaches to turbines when the blades are not spinning (Cryan et al. 2014). Since there is little evidence to suggest that stationary objects pose significant risk to bats, behavioral vulnerability to collision with construction equipment is expected to be "minimal" to "low". Therefore, population level impacts from construction and installation to all non-listed bat species are expected to be "minimal" to "low" because of limited behavioral vulnerability and the limited temporal exposure to vessels and installation infrastructure. Impacts to NLEB are considered "minimal" because these bats are not expected to be offshore.

2.3.2.2 Operation and Maintenance

The potential impact of the operational component of the Project to bats is mortality or injury from collision with wind turbines. At terrestrial wind farms in the U.S., bat mortality has been documented (Cryan and Barclay 2009, Hayes 2013, Smallwood 2013, Martin et al. 2017, Pettit and O'Keefe 2017). These terrestrial wind farm fatalities, which affect predominantly migratory tree-roosting bats (Kunz et al. 2007), may occur when mating bats are attracted to turbines (Cryan 2008). There is some evidence in Europe to suggest that bats forage over the surface of the ocean and when foraging around obstacles (i.e., lighthouses and wind turbines) increase their altitude (Ahlén et al. 2009). Based on collision mortalities documented at terrestrial wind farms, behavioral vulnerability to collision, for all bat species, is considered "medium".

Bats are not expected to regularly forage in the Lease Area but may be present during migration ([BOEM] Bureau of Ocean Energy Management 2012). As discussed above, the exposure of cave-hibernating bats to the offshore project area is expected to be "minimal" to "low" and would only occur rarely during migration, if at all. Therefore, population level impacts are considered "minimal" to "low". Impacts to NLEB are considered "minimal" because these bats are not expected to be offshore.

Migratory tree bats have the potential to pass through the Wind Farm Area, but overall a small number of bats are expected in the Lease Area given its distance from shore ([BOEM] Bureau of Ocean Energy Management 2014). While there is evidence of bats visiting wind turbines close to shore (2.5-4.3 mi [4-7 km]) in Baltic Sea (surrounded by land) in Europe (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 Wind Farm Area because of its distance from shore. Therefore, the likelihood for population level impacts is considered 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 on bats is expected to be equal to or less than impacts from construction. The project will use best practices available at the time to minimize potential effects. Therefore, population level impacts from decommissioning to all bat non-listed species is expected to be "minimal" to "low". Impacts to NLEB are considered "minimal" because these bats are not expected to be offshore.

2.4 Onshore

This section discusses the species of bats that may be exposed to construction and operation of the project's onshore facilities (BL England and Oyster Creek), which include cable landfall sites, onshore AC substations, and onshore grid connection cables. The BL England Study Corridor is located in Atlantic and Cape May Counties NJ; the Oyster Creek Study Corridor is located in Ocean County NJ. The BL England and Oyster Creek Study Corridors contain a diverse set of habitats including coastal wetlands, forested wetlands, forested uplands, forested lowlands, barrier beaches, and bay island habitats that support a diversity of bat species. The bat species discussed below are known to commonly occur in areas that will be potentially exposed to the construction of the onshore facilities.

For all proposed Onshore Export Cable Routes, the transmission lines will be co-located with existing developed areas (i.e., roads, rail lines, and existing transmission lines) that pass through residential and commercial areas wherever possible, thereby minimizing potential impacts to terrestrial wildlife habitat. The BL England Route will terminate at the BL England substation. There are multiple proposed Onshore Export Cable Route options within the BL England and Oyster Creek study corridors. Part 4 of this assessment on birds, includes detailed descriptions of the potential Onshore Export Cable Routes for both onshore Study Corridors.

The BL England site has marsh, forest, and urban habitat (Figure 2-3). Coastal habitats within the BL England Study Corridor include areas of saline low marsh and high marsh, marsh border, intertidal flat, *Phragmites australis* community, and beach community dominated by beach grass and herbs. The variable coastal habitats within the BL England site support a diversity of bat species. Similarly, the Oyster Creek site has marsh, forest, and urban habitat (Figure 2-2). Coastal habitats within the Oyster Creek Study Corridor include saline low and high marsh, *Phragmites australis* community, scrub-shrub wetlands, vegetated dunes, and barren beach. The variable coastal habitats within the Oyster Creek site support a diversity of bat species. Below is a description of bats that may occur in both onshore project locations.

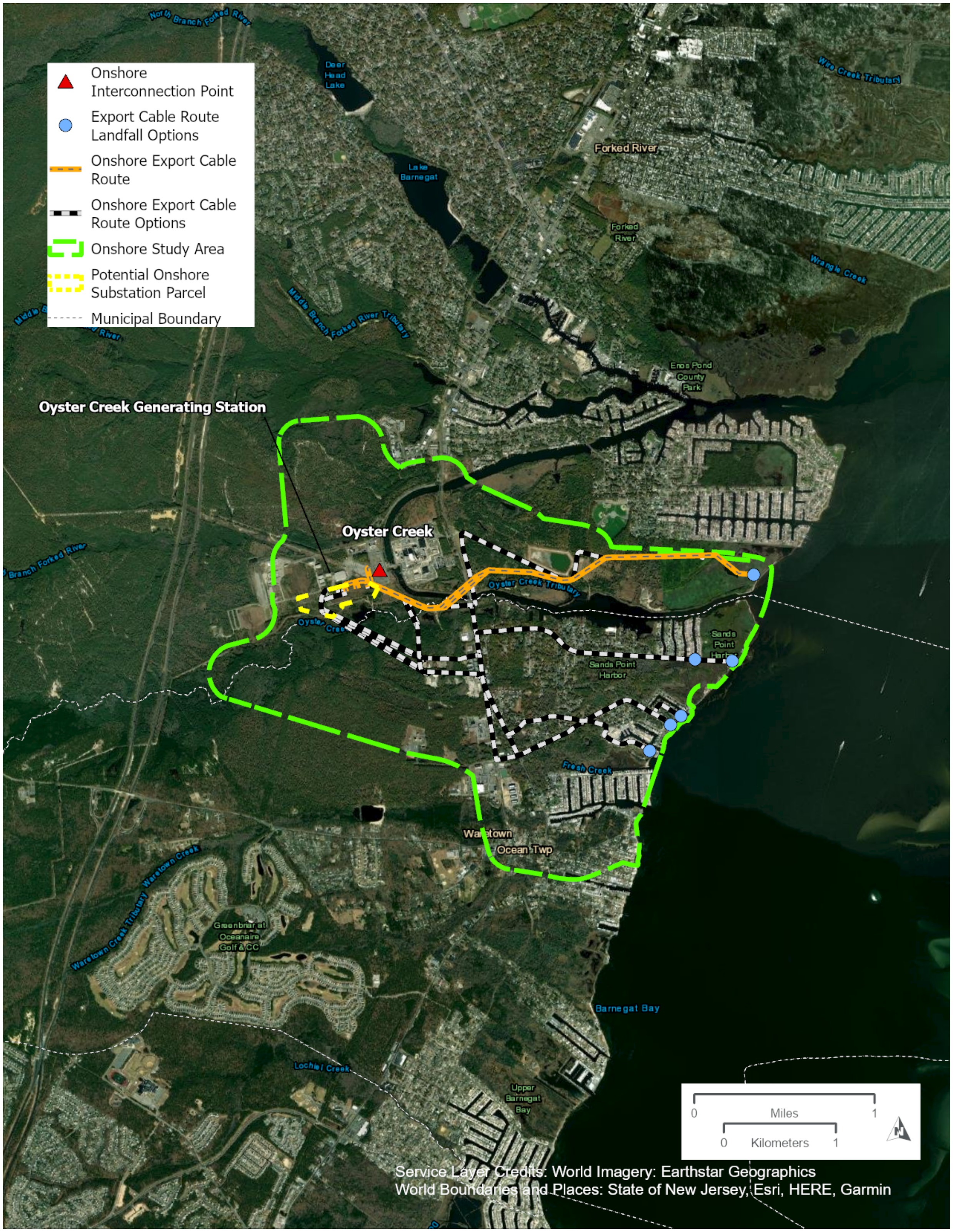


Figure 2-2: Overview of the habitat of the proposed Oyster Creek site that are primarily co-located with existing linear development (e.g. roadways).

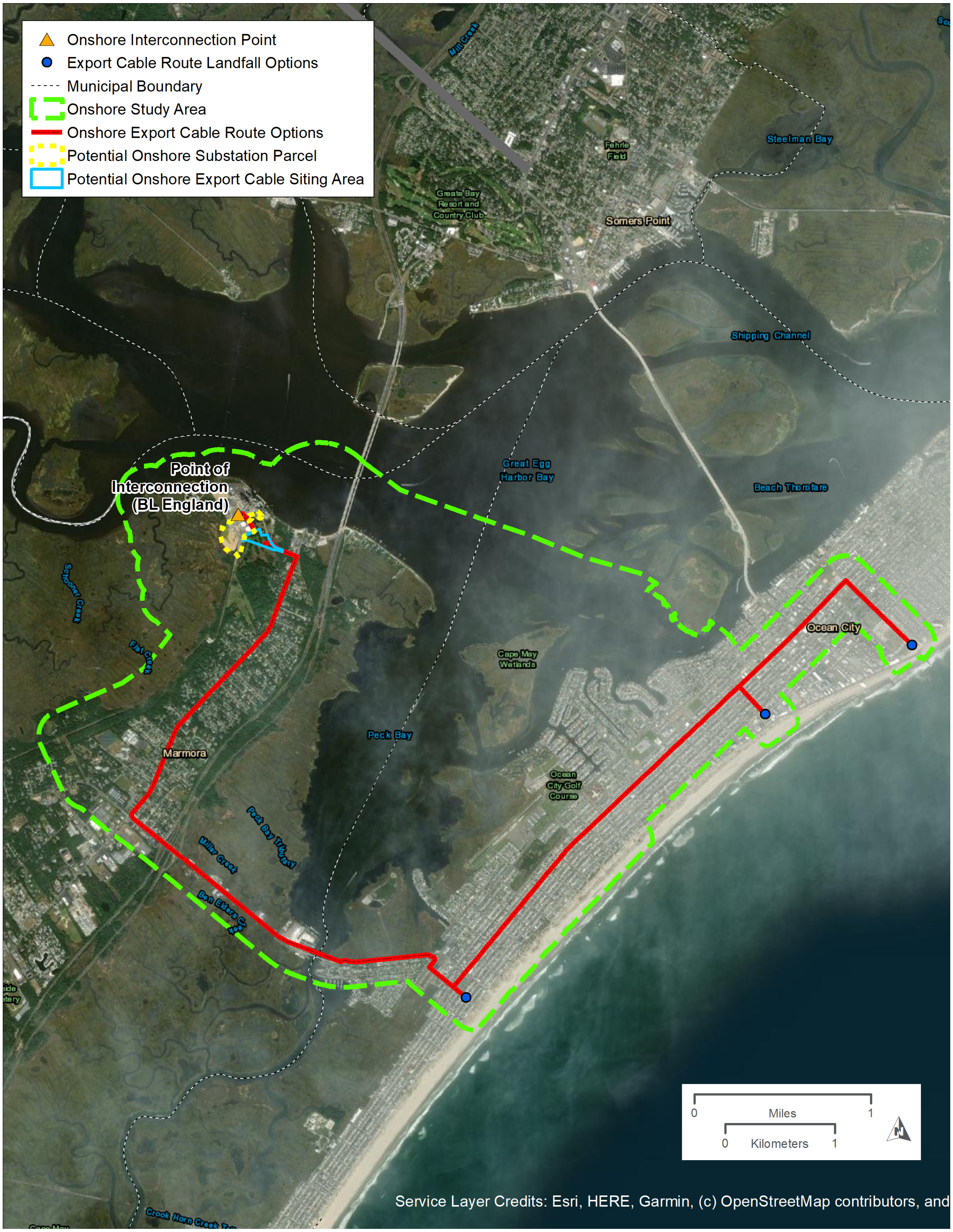


Figure 2-3: Overview of the habitat of the proposed BL England site that are primarily co-located with existing linear development (e.g. roadways).

2.4.1 Exposure

All bat species present in New Jersey are nocturnal insectivores. Preferred foraging habitats vary among species, however, and the type of foraging habitat a bat species selects may be linked to the flight capabilities, preferred diet, and echolocation capabilities of each species (Norberg and Rayner 1987). Small, maneuverable species like the NLEB and the little brown bat can forage in cluttered conditions such as the forest understory or small forest gaps. Larger, faster-flying bats, such as the hoary bat, often forage above the forest canopy or in forest gaps (Taylor 2006). Some species, such as the little brown bat and the tri-colored bats, regularly forage over water sources. The big brown bat, eastern red bat, and hoary bat are also known to use waterways as foraging areas, as well as travel corridors (Barbour and Davis 1969).

Forested habitats, such as the area adjacent to the proposed onshore export cables at BL England and Oyster Creek, can provide roosting areas for both migratory and non-migratory species. All bat species present in New Jersey (migratory and non-migratory) are known to utilize forested areas (of varying types) during summer for roosting and foraging. Some of these species roost solely in the foliage of trees, while others select dead and dying trees where they roost in peeling bark or inside crevices. Some species may select forest interior sites, while others prefer edge habitats (Barbour and Davis 1969).

Caves and mines provide key habitat for non-migratory bats. These locations serve as winter hibernacula, fall swarm locations (areas where mating takes place in the fall months), and summer roosting locations for some individuals. Four main factors are understood to determine whether a cave or mine is suitable for use as a hibernaculum: low levels of disturbance; suitable temperature; suitable humidity; and suitable airflow (Tuttle and Taylor 1998). Hibernacula are documented in New Jersey, but the numbers of individuals at the sites have declined dramatically because of white-nose syndrome (NJ Division of Fish and Wildlife 2017).

Although there are no data for non-listed species in this area, BRI has completed field work in the area at Edwin B. Forsythe National Wildlife Refuge (~6 mi [~10 km] south of Oyster Creek; and ~30 mi [48 km] north of BL England) where BRI biologists captured NLEB, Eastern red, big brown and little brown bats in 2011. No telemetry was conducted, so it is unknown if they used the refuge or surrounding areas for roosting. Since 2011, WNS has substantially reduced *Myotis* bat populations in New Jersey (NJ Division of Fish and Wildlife 2017) and generally there are fewer bats along the coast of New Jersey (Figure 2-4).

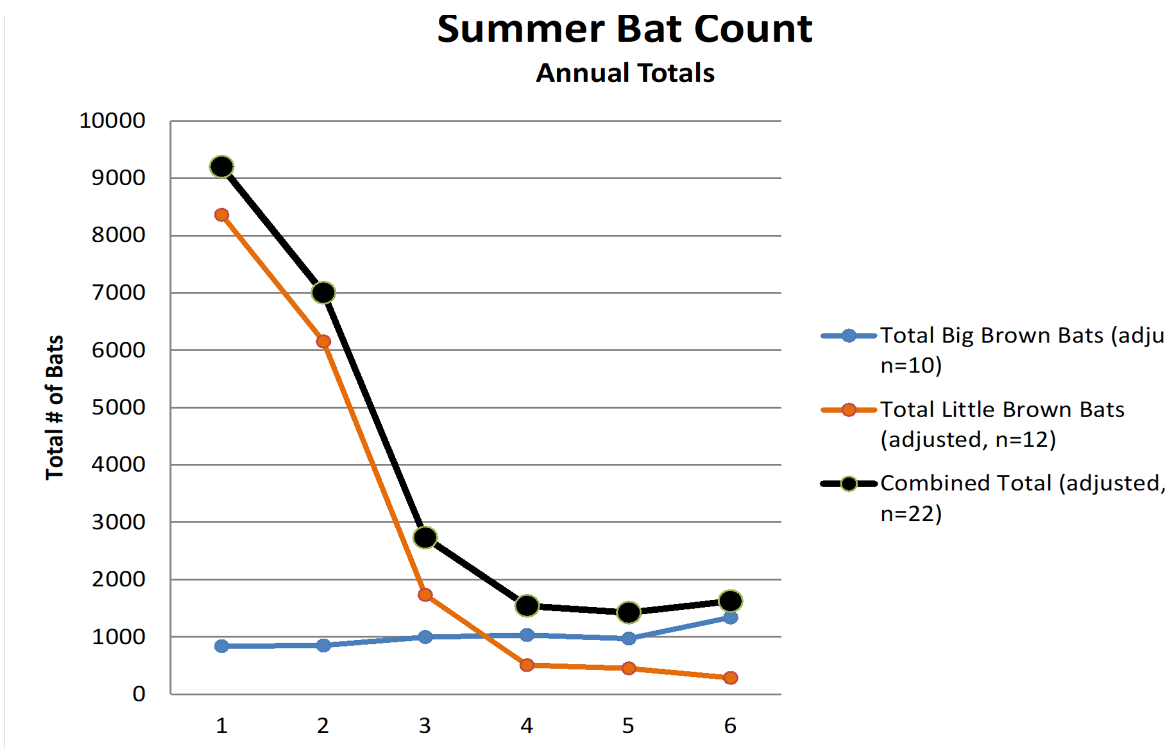


Figure 2-4: Annual summer bat count totals, from baseline (2007; pre-WNS) to 2013, corrected for sample size (n=22 sites; CWF 2014)

Overall, while both cave-hibernating and migratory tree bats may occur in the area around BL England and Oyster Creek, the Onshore Cable Corridors are not likely to provide suitable habitat because they are co-located with existing disturbed areas (e.g. roads, transmission lines). Therefore, the bat exposure to the areas directly disturbed by project activities is expected to be "low". Federally listed species are described in greater detail below:

- *Northern long-eared bat*: Northern-long eared bat maternity roosts have been detected in Atlantic County (BL England) and Ocean County (Oyster Creek; USFWS New Jersey Field Office 2017), indicating that they could be present in the areas surrounding both onshore sites but the Onshore Cable Corridors are not likely to provide suitable habitat. Therefore, the bat exposure to the areas directly disturbed by project activities is expected to be "low".

Table 2-4: Roost tree data for northern long-eared bats within townships in the Study Corridors (USFWS New Jersey Field Office 2017).

County	Municipality	Northern Long-Eared Bat	Study Corridor
Ocean	Barnegat Township	Maternity	Oyster Creek
	Long Beach Township	Maternity	Oyster Creek
	Ocean Township	Maternity	Oyster Creek
Atlantic	Absecon City	Maternity	BL England
	Egg Harbor Township	Maternity/Known Roost Trees	BL England

County	Municipality	Northern Long-Eared Bat	Study Corridor
	Galloway Township	Maternity	BL England
	Hamilton Township	Maternity	BL England
Indiana bat was not identified in any municipalities within the Study Corridors.			

2.4.2 Impacts

2.4.2.1 Construction and Installation

The primary potential effect of the onshore Project components to bats is habitat conversion. When the transmission lines are installed, up to 40 m on either side of the line may be disturbed, including limited cutting of trees. However, the majority of the proposed routes are located in already disturbed areas (e.g., roadways, transmission lines), and the cutting of trees is not expected to cause any loss of important habitat and may even increase the 'edge effect' improving foraging opportunities for bats. Cutting of any maternity roost trees will be avoided through best practices (see mitigation section). Overall, habitat loss would be limited and only be a potential indirect effect. Therefore, vulnerability to habitat loss is expected to be "minimal" to "low" for all bat species. Since exposure is also expected to be low, the overall impacts to individual NLEB, and likelihood for population level impacts for non-listed species is expected to be "minimal" to "low". As described below, any potential risk will be further reduced through mitigation measures.

2.4.2.2 Operation and Maintenance

Trees removed during construction in areas of development will be permanently lost and thus unavailable for roosting by bats during operation. This permanent habitat loss will be limited to small areas. Therefore, vulnerability to habitat loss is expected to be "minimal" to "low" for all bat species. Since exposure is also expected to be low, the overall impact to individual northern long-eared bat, and population level impact for non-listed species is expected to be "minimal' to "low" during operation and maintenance.

2.4.2.3 Decommissioning

While the specifics of decommissioning activities are not fully known at this time, the potential impact of decommissioning on bats is expected to be equal to or less than impacts from construction. The Project will use best practices available at the time to minimize potential effects. Therefore, overall risk to individual northern long-eared bat, and population level impact for non-listed species is expected to be "minimal" to "low".

2.5 Mitigation

The proposed measures for avoiding, minimizing, and monitoring environmental impacts for the Project are presented in COP, Volume II, Table 1.1-2.

2.6 Summary and Conclusions

Overall the Project is expected to have a minimal to low impacts to bats (Table 2-5) .The exposure of cave-hibernating bats to Wind Farm Area is expected to be minimal to low and would only occur rarely during migration when a small number of bats may occur in the New Jersey Wind Energy Area given its distance from shore ([BOEM] Bureau of Ocean Energy Management 2012). NLEB are not expected to be offshore and exposure is considered minimal. Migratory tree bats could pass through the Wind Farm Area, but overall small numbers of migratory bats are expected in the area given its distance from shore ([BOEM] Bureau of Ocean Energy Management 2012). Lighting during the operations and maintenance phase of the Project will be limited, which should reduce insect and potential bat attraction. Overall, bats have limited exposure to the Wind Farm Area because it is located far offshore, and bat exposure is likely limited to small numbers of migrating tree bats. Onshore, impacts are expected to be minimal to low, because Project construction activities will be co-located in existing disturbed areas. Furthermore, direct impacts will be avoided by cutting trees in the winter months to the extent practical.

Table 2-5: Overall summary of the assessment of potential impacts on bats.

Group	Exposure	Vulnerability to			Overall Risk of Impacts		
		Collision (operation)	Habitat conversion		Construction	Operation	Decommissioning
			Temporary	Permanent			
Cave-hibernating bats: Offshore	Minimal - Low	Medium	Minimal	Minimal	Minimal - Low		
Cave-hibernating bats: Onshore	Low	Minimal	Minimal - Low	Minimal - Low	Minimal - Low		
Migratory tree bats: Offshore	Low	Medium	Minimal	Minimal	Minimal - Low	Low	Minimal - Low
Migratory tree bats: Onshore	Low	Minimal	Minimal - Low	Minimal - Low	Minimal - Low		
Northern Long-eared Bat: Offshore	Minimal	Medium	Minimal	Minimal	Minimal		
Northern Long-eared Bat: Onshore	Low	Minimal	Minimal - Low	Minimal - Low	Minimal - Low		

3 Part III: Birds – Offshore

3.1 Overview of Potential Bird Exposure to the Offshore Components of the Project

A broad group of avian species may pass through the Wind Farm 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 may use the Wind Farm Area because it is located in the Mid-Atlantic Bight, which overlaps with northern and southern species assemblages.

The Mid-Atlantic Bight is an oceanic region that spans an area from Cape Cod, MA, to Cape Hatteras, NC, 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 200 m (650 ft) deep. Beyond the shelf edge, the continental slope descends rapidly to around 3,000 m (1,000 ft). Most of this mid-Atlantic coastal region is bathed in cool Arctic waters introduced by the Labrador Current. At the southern end of this region, around Cape Hatteras, these cool waters collide with the warmer waters of the Gulf Stream. The mid-Atlantic region exhibits a strong seasonal cycle in temperature, with sea surface temperatures spanning 37-86 °F (3-30 °C; Williams et al. 2015b).

Migrant terrestrial species 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 mid-Atlantic 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 mid-Atlantic 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 mid-Atlantic.

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*). Piping Plovers nest along New Jersey beaches, and will also migrate (spring and fall) through the area to and from northern breeding sites. Red Knots pass through the region during migration in transit to far northern breeding sites. Importantly, Delaware Bay is a critical staging area for Red Knots. Roseate Terns also fly through the mid-Atlantic on their way north to breeding sites in New York and New England. 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. Bird species potentially exposed to the offshore components of the Project identified through USFWS IPaC database (https://ecos.fws.gov/ipac/) and New Jersey baseline studies. E = endangered; T = threatened, SC = special concern, BR = breeding, NB = non-breeding.

Common Name	Scientific Name	Federal Status	NJ Status	
			BR	NB
WATERBIRDS				
Waterfowl	*Anatidae*			
Geese				
Snow Goose	*Anser caerulescens*			
Brant	*Branta bernicla*			
Canada Goose	*Branta canadensis*			
Swans				
Tundra Swan	*Cygnus columbianus*			
Dabbling Ducks				
Wood Duck	*Aix sponsa*			
Northern Shoveler	*Spatula clypeata*			
Gadwall	*Mareca strepera*			
American Wigeon	*Mareca americana*			
Mallard	*Anas platyrhynchos*			
American Black Duck	*Anas rubripes*			
Northern Pintail	*Anas acuta*			
Green-winged Teal	*Anas crecca*			
Diving Ducks				
Greater Scaup	*Aythya marila*			
Lesser Scaup	*Aythya affinis*			
Seaducks				
Common Eider	*Somateria mollissima*			
Harlequin Duck	*Histrionicus histrionicus*			
Surf Scoter	*Melanitta perspicillata*			
White-winged Scoter	*Melanitta fusca*			
Black Scoter	*Melanitta americana*			
Long-tailed Duck	*Clangula hyemalis*			
Diving Ducks				
Bufflehead	*Bucephala albeola*			
Common Goldeneye	*Bucephala clangula*			
Mergansers				
Hooded Merganser	*Lophodytes cucullatus*			
Red-breasted Merganser	*Mergus serrator*			
Stiff-tailed Ducks				
Ruddy Duck	*Oxyura jamaicensis*			
Loons	*Gaviidae*			
Red-throated Loon	*Gavia stellata*			
Common Loon	*Gavia immer*			
Grebes	*Podicipedidae*			
Pied-billed Grebe	*Podilymbus podiceps*		E	SC
Horned Grebe	*Podiceps auritus*			
Red-necked Grebe	*Podiceps grisegena*			
Herons & Egrets	*Ardeidae*			

Common Name	Scientific Name	Federal Status	NJ Status	
			BR	NB
Great Blue Heron	*Ardea herodias*		SC	
Great Egret	*Ardea alba*			
Snowy Egret	*Egretta thula*		SC	
Green Heron	*Butorides virescens*			
Black-crowned Night-Heron	*Nycticorax nycticorax*		T	SC
Yellow-crowned Night-Heron	*Nyctanassa violacea*		T	
Coots & Rails	*Rallidae*			
American Coot	*Fulica americana*			
SEABIRDS				
Shearwaters & Petrels	*Procellariidae*			
Northern Fulmar	*Fulmarus glacialis*			
Cory's Shearwater	*Calonectris diomedea*			
Sooty Shearwater	*Ardenna grisea*			
Great Shearwater	*Ardenna gravis*			
Manx Shearwater	*Puffinus puffinus*			
Audubon's Shearwater	*Puffinus lherminieri*			
Storm-Petrels	*Hydrobatidae*			
Wilson's Storm-Petrel	*Oceanites oceanicus*			
Leach's Storm-Petrel	*Oceanodroma leucorhoa*			
Gannets	*Sulidae*			
Northern Gannet	*Morus bassanus*			
Pelicans	*Pelecanidae*			
Brown Pelican	*Pelecanus occidentalis*			
Cormorants	*Phalacrocoracidae*			
Double-crested Cormorant	*Phalacrocorax auritus*			
Great Cormorant	*Phalacrocorax carbo*			
Gulls & Terns	*Laridae*			
Gulls				
Black-legged Kittiwake	*Rissa tridactyla*			
Sabine's Gull	*Xema sabini*			
Bonaparte's Gull	*Chroicocephalus philadelphia*			
Little Gull	*Hydrocoloeus minutus*			
Laughing Gull	*Leucophaeus atricilla*			
Ring-billed Gull	*Larus delawarensis*			
Herring Gull	*Larus argentatus*			
Iceland Gull	*Larus glaucoides*			
Lesser Black-backed Gull	*Larus fuscus*			
Great Black-backed Gull	*Larus marinus*			
Terns				
Least Tern	*Sternula antillarum*		E	E
Caspian Tern	*Hydroprogne caspia*		SC	
Black Tern	*Chlidonias niger*			
Roseate Tern	*Sterna dougallii*	E	E	E
Common Tern	*Sterna hirundo*		SC	
Forster's Tern	*Sterna forsteri*			
Royal Tern	*Thalasseus maximus*			

Common Name	Scientific Name	Federal Status	NJ Status	
			BR	NB
Sandwich Tern	*Thalasseus sandvicensis*			
Skuas & Jaegers	*Stercorariidae*			
Great Skua	*Stercorarius skua*			
South Polar Skua	*Stercorarius maccormicki*			
Pomarine Jaeger	*Stercorarius pomarinus*			
Parasitic Jaeger	*Stercorarius parasiticus*			
Auks	*Alcidae*			
Dovekie	*Alle alle*			
Common Murre	*Uria aalge*			
Thick-billed Murre	*Uria lomvia*			
Razorbill	*Alca torda*			
Black Guillemot	*Cepphus grylle*			
Atlantic Puffin	*Fratercula arctica*			
SHOREBIRDS				
Plovers	*Charadriidae*			
Black-bellied Plover	*Pluvialis squatarola*			
Semipalmated Plover	*Charadrius semipalmatus*			
Piping Plover	*Charadrius melodus*	T	E	E
Oystercatchers	*Haematopodidae*			
American Oystercatcher	*Haematopus palliatus*		SC	SC
Sandpipers & Phalaropes	*Scolopacidae*			
Whimbrel	*Numenius phaeopus*			SC
Marbled Godwit	*Limosa fedoa*			
Ruddy Turnstone	*Arenaria interpres*			
Red Knot	*Calidris canutus*	T	E	E
Sanderling	*Calidris alba*			SC
Dunlin	*Calidris alpina*			
Purple Sandpiper	*Calidris maritima*			
Least Sandpiper	*Calidris minutilla*			
White-rumped Sandpiper	*Calidris fuscicollis*			
Pectoral Sandpiper	*Calidris melanotos*			
Semipalmated Sandpiper	*Calidris pusilla*			SC
Short-billed Dowitcher	*Limnodromus griseus*			
American Woodcock	*Scolopax minor*			
Lesser Yellowlegs	*Tringa flavipes*			
Willet	*Tringa semipalmata*			
Greater Yellowlegs	*Tringa melanoleuca*			
Red-necked Phalarope	*Phalaropus lobatus*			
Red Phalarope	*Phalaropus fulicarius*			
RAPTORS				
Vultures	*Cathartidae*			
Turkey Vulture	*Cathartes aura*			
Hawks & Eagles	*Accipitridae*			
Osprey	*Pandion haliaetus*		T	
Northern Harrier	*Circus hudsonius*		E	SC
Bald Eagle	*Haliaeetus leucocephalus*		E	T

Common Name	Scientific Name	Federal Status	NJ Status BR	NJ Status NB
Falcons	*Falconidae*			
Merlin	*Falco columbarius*			
Peregrine Falcon	*Falco peregrinus*		E	SC
SONGBIRDS				
Pigeons & Doves	*Columbidae*			
Rock Pigeon	*Columba livia*			
Mourning Dove	*Zenaida macroura*			
Humming birds	*Trochilidae*			
Ruby-throated Hummingbird	*Archilochus colubris*			
Swifts	*Apodidae*			
Chimney Swift	*Chaetura pelagica*			
Woodpeckers	*Picidae*			
Northern Flicker	*Colaptes auratus*			
Crows	*Corvidae*			
American Crow	*Corvus brachyrhynchos*			
Fish Crow	*Corvus ossifragus*			
Swallows	*Hirundinidae*			
Purple Martin	*Progne subis*			
Tree Swallow	*Tachycineta bicolor*			
Bank Swallow	*Riparia riparia*			
Barn Swallow	*Hirundo rustica*			
Creepers	*Certhiidae*			
Brown Creeper	*Certhia americana*			
Wrens	*Troglodytidae*			
Winter Wren	*Troglodytes hiemalis*		SC	
Marsh Wren	*Cistothorus palustris*			
Kinglets	*Regulidae*			
Golden-crowned Kinglet	*Regulus satrapa*			
Thrushes	*Turdidae*			
Wood Thrush	*Hylocichla mustelina*		SC	
American Robin	*Turdus migratorius*			
Mockingbirds & Thrashers	*Mimidae*			
Gray Catbird	*Dumetella carolinensis*			
Brown Thrasher	*Toxostoma rufum*		SC	
Northern Mockingbird	*Mimus polyglottos*			
Starlings	*Sturnidae*			
European Starling	*Sturnus vulgaris*			
Wood-Warblers	*Parulidae*			
Yellow-breasted Chat	*Icteria virens*			
Ovenbird	*Seiurus aurocapilla*			
Northern Waterthrush	*Parkesia noveboracensis*			
Prothonotary Warbler	*Protonotaria citrea*			
Mourning Warbler	*Geothlypis philadelphia*			
Common Yellowthroat	*Geothlypis trichas*			
American Redstart	*Setophaga ruticilla*			
Northern Parula	*Setophaga americana*		SC	

Common Name	Scientific Name	Federal Status	NJ Status	
			BR	NB
Magnolia Warbler	*Setophaga magnolia*			
Yellow Warbler	*Setophaga petechia*			
Blackpoll Warbler	*Setophaga striata*			
Palm Warbler	*Setophaga palmarum*			
Yellow-rumped Warbler	*Setophaga coronata*			
Black-throated Green Warbler	*Setophaga virens*		SC	
Tanagers	*Thraupidae*			
Scarlet Tanager	*Piranga olivacea*			
Sparrows	*Emberizidae*			
Eastern Towhee	*Pipilo erythrophthalmus*			
Field Sparrow	*Spizella pusilla*			
Vesper Sparrow	*Pooecetes gramineus*		E	SC
Song Sparrow	*Melospiza melodia*			
Swamp Sparrow	*Melospiza georgiana*			
White-throated Sparrow	*Zonotrichia albicollis*			
Dark-eyed Junco	*Junco hyemalis*			
Buntings	*Cardinalidae*			
Rose-breasted Grosbeak	*Pheucticus ludovicianus*			
Indigo Bunting	*Passerina cyanea*			
Blackbirds	*Icteridae*			
Eastern Meadowlark	*Sturnella magna*		SC	SC
Orchard Oriole	*Icterus spurius*			
Baltimore Oriole	*Icterus galbula*			
Red-winged Blackbird	*Agelaius phoeniceus*			
Brown-headed Cowbird	*Molothrus ater*			
Boat-tailed Grackle	*Quiscalus major*			
Finches	*Fringillidae*			
House Finch	*Haemorhous mexicanus*			
Pine Siskin	*Spinus pinus*			
American Goldfinch	*Spinus tristis*			

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 ([BOEM] Bureau of Ocean Energy Management 2012, Goodale and Milman 2016). For birds the primary impact-producing factors for the offshore component of the project are above water and include vessels, lighting, wind turbines, and sub-substations (Table 3-3-2). Sub-stations are not analyzed independently because they pose a lesser, but similar hazards to birds, as the turbines. Below water Project activities, including but not limited to foundation and cable installation, are not expected to be a long-term hazard for birds ([BOEM] Bureau of Ocean Energy Management 2018) and are not discussed in detail. Low probability events, such as spills, are discussed in the body of the COP.

Table 3-3-2 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	Operation
Vessels, lighting, wind turbines, sub-stations	Collision	Mortality and injury caused by collision with Project structures	✓	✓
Vessels, noise from pile-driving, wind turbines, sub-stations	Displacement (Temporary)	Temporary disturbance by Project activities resulting in effective habitat loss	✓	
Wind turbines, sub-stations	Displacement (Permanent)	Permanent avoidance and/or displacement from habitat		✓
Effects of decommissioning are expected to be less than or equal to construction activities.				

3.2.2 Overview of Potential Effects by Project Phase

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

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 associated with wind turbines and the 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 such as minimizing lighting when applicable and/or using downward-facing lights, 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 ([BOEM] Bureau of Ocean Energy Management 2018). In addition, the operation of the interconnect cable does not pose a particular hazard to birds (Epsilon Associates Inc. 2018), and will not be discussed in detail.

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).

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 the 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 offshore wind developments were evaluated qualitatively using a risk assessment framework. The framework uses a weight-of-evidence approach and combines 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 rather than to a specific number of turbines. There are many species- and site-specific factors that contribute 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. 2014a). Consequently, this analysis is scaled to the Project's overall size (i.e., area) to be inclusive of the evolving size and design of offshore wind turbines.

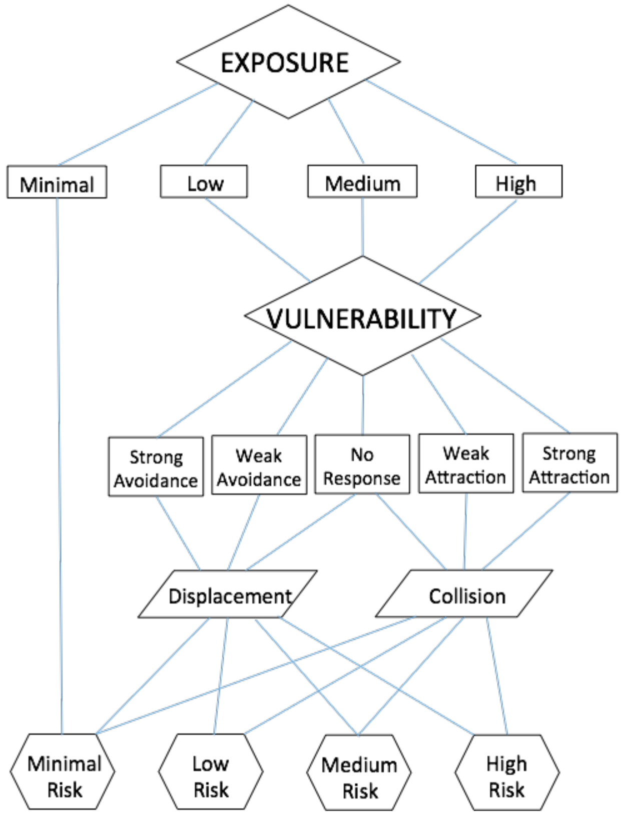


Figure 3-1: Risk assessment framework. First exposure was assessed, second vulnerability was assessed, and then, using a weight of evidence approach, the risk was evaluated.

Exposure was evaluated based on boat-based surveys conducted in New Jersey (NJDEP 2010), individual tracking data for species of special interest, and regional distribution models (Winship et al. 2018), while behavioral vulnerability was evaluated based on local flight height data and literature (Furness et al. 2013, Wade et al. 2016). 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 or medium/high ranking or high/medium in exposure and vulnerability.
- High: High/high ranking in exposure and vulnerability.

Other factors, such as broad population trends or general habitat use, were then considered in assigning a ***final*** risk category – *individual risk for listed species or population risk for non-listed species* (Table 3-3). A detailed description of data sets used in the assessment and the exposure assessment methods are detailed below as well as the vulnerability criteria.

Table 3-3. Matrix used for risk determination. The "Other" category represents that risk levels could be adjusted (up or down) when other critical information is incorporated into the evaluation using expert opinion. If a final risk assessment was adjusted, justification is provided in the species group risk text and then highlighted in either green (down) or orange (up) in the final summary table (3-4).

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

3.2.4 Exposure Framework

Exposure has both a horizontal and vertical component. This assessment 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 Wind Farm 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 Wind Farm Area, two data sources were used to evaluate local and regional marine bird use: (1) the NJDEP Ocean/Wind Power EBS avian surveys, and (2) version 2 of the Marine-life Data and Analysis Team (MDAT) marine bird relative density and distribution models. The NJDEP EBS surveys provide local coverage of the Lease Area and surrounding New Jersey 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 NJDEP 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 NJDEP Ocean/Wind Power EBS Avian Surveys

Monthly shipboard surveys were conducted coastally and further offshore of New Jersey for NJDEP Ocean/Wind Power EBS (NJDEP 2010). Coastal surveys did not enter the Lease Area, staying between shore and the 32-foot (10 m) isobath. One aerial survey was conducted in the same study area on 16 April 2008, but was not deemed beneficial enough to continue. The offshore study area covered from approximately the 32-foot (10 m) isobath to an outer boundary at 20 nm (~37 km) from shore, and extended from Hereford Inlet, just north of Cape May, north to the Route 37 bridge at Seaside Heights (Figure 3-2; Figure 3-3). Shipboard surveys were conducted between January of 2008 and December of 2009. Due to weather, February 2008 and December 2009 survey effort was less than typical, but all other surveys were conducted in a double saw-tooth design covering NJDEP EBS study area. Offshore saw-tooth surveys totaled 10,112 mi ([16,273 km] 1,414 mi [2,276 km) in the Lease Area, and 8,700 [13,997 km] outside of the Lease Area). In addition, supplemental offshore saw-tooth surveys were conducted between August and December 2009, and 6 days of offshore surveys were conducted in concert with sea watches (land-based seaward counts) at Barnegat Light and north end of Avalon. The supplemental surveys were meant to determine if increased survey effort had an effect on abundance estimates, and the sea watch surveys were meant to understand offshore migration relative to distance to shore. Supplemental surveys covered 144 mi (231 km) in the Lease Area and 719 mi (1,157 km) outside, and sea watch surveys covered 65 mi (104 km) within the Lease Area and 390 mi (629 km) outside it. Small-boat coastal surveys were conducted between January 2008 and December 2009 and totaled 1,798 mi (2,894 km).[1] These surveys were conducted after the monthly offshore surveys were completed.

Offshore and coastal surveys were conducted using a hybrid distance sampling/strip transect method, while the boat was traveling at 10 knots during daylight hours, and visibility was at least 4.3 mi (7 km). Observers recorded distance and angle to all animals focusing effort within 984 ft (300 m) of the survey vessel (948 ft [300 m] ahead and to the side). Observers viewed within a 90-degree bow-to-beam arc of either side of the vessel. During offshore saw-tooth surveys, a closing method for marine mammals was used where the vessel went off transect when marine mammals were sighted to investigate the animal and accurately identify the species present as well as the group size (if more than one was present). During these off-transect periods, observations were designated as “off” until they returned to the original transect line, when they were designated as “on”. This is not an ideal approach for seabird surveys as it increases the chances of double-counting, but should improve estimates of marine mammal group size and identification rates. Flight height data was also recorded during surveys (as 1 ft [0.3 m], 25 ft [7.6 m], 50 ft [15.2 m], 100 ft [30.5 m], 200 ft [70 m], 300 ft [91 m], 500 ft [152 m], and 1,000+ ft [305 m] above sea-level) as well as behavioral code.

[1] Note that all transect lengths were calculated in R version 3.4.2 and are slightly different from that shown in the NJDEP report.

During both coastal and shipboard surveys, a total of 176,217 birds was recorded, consisting of 153 species, including many migrant land birds. The addition of non-target taxa (e.g., bats, butterflies, marine mammals) resulted in 201 identification codes, some of which are not identified to species (e.g., unknown small tern). The overall patterns indicate higher species densities closer to shore, although spring and summer appear to show higher relative densities offshore. No federally threatened or endangered species were detected during these surveys.

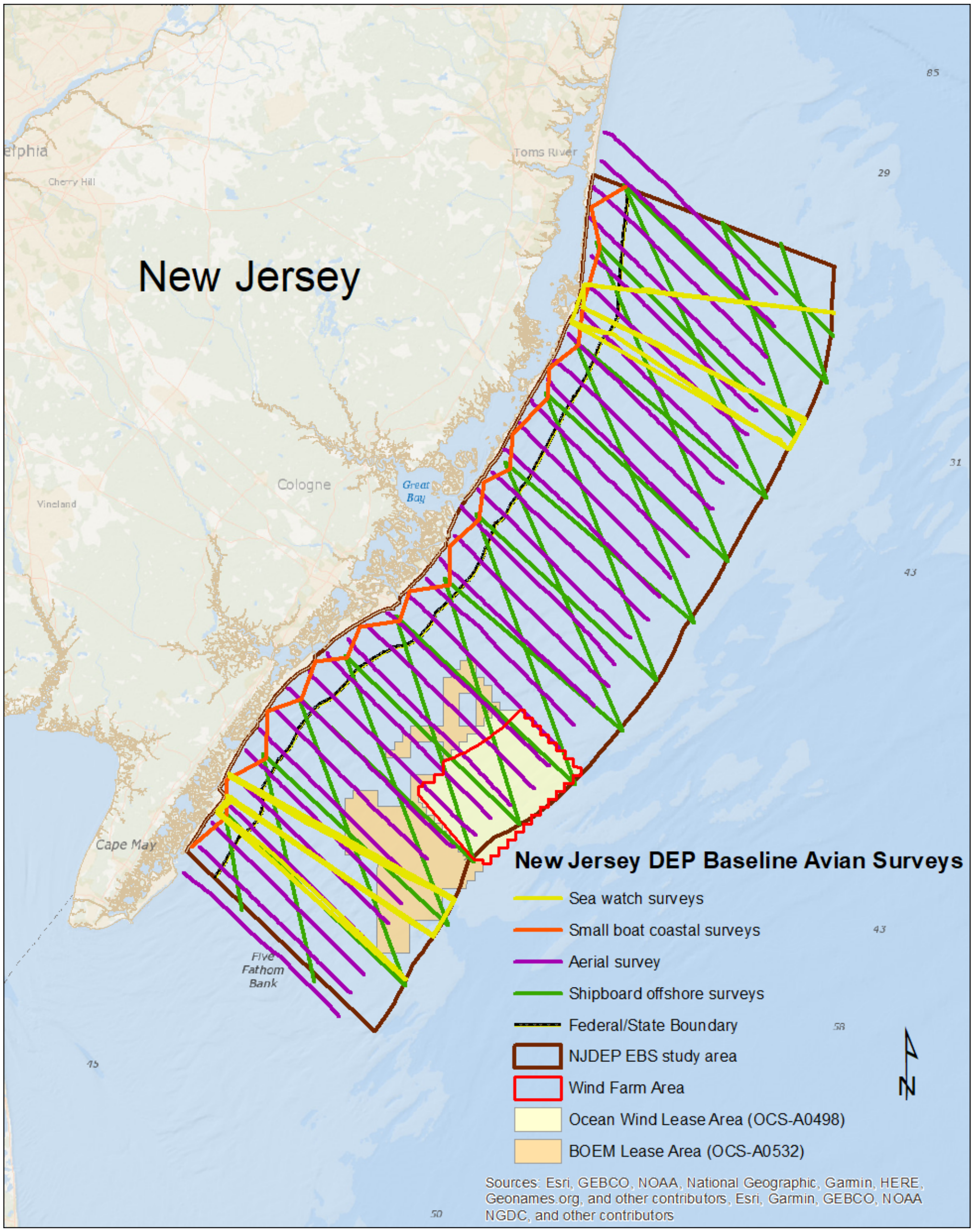


Figure 3-2: New Jersey DEP Ecological Baseline Studies (EBS) avian surveys conducted in the study area during 2008 and 2009.

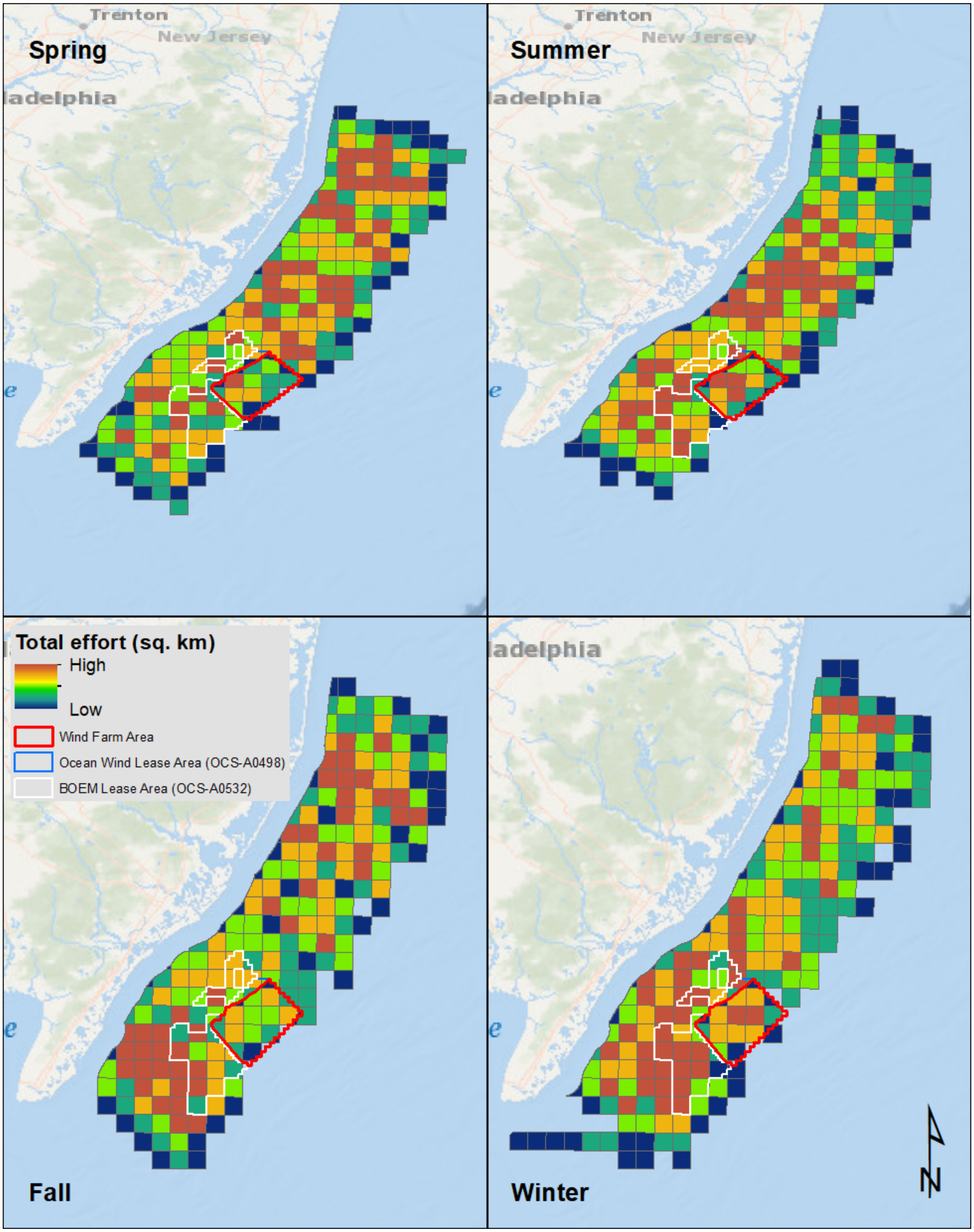


Figure 3-3: Overall NJDEP EBS survey effort by season. While effort varied by OCS lease block and season, the entire study area, including the Wind Farm Area, was thoroughly surveyed each season.

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 Atlantic Offshore Seabird Dataset Catalog (https://coast.noaa.gov/digitalcoast/data/atloffshoreseabird.html) 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 NJDEP EBS surveys.

The MDAT and NJDEP information sources each have strengths and weaknesses. NJDEP 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 NJDEP 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.

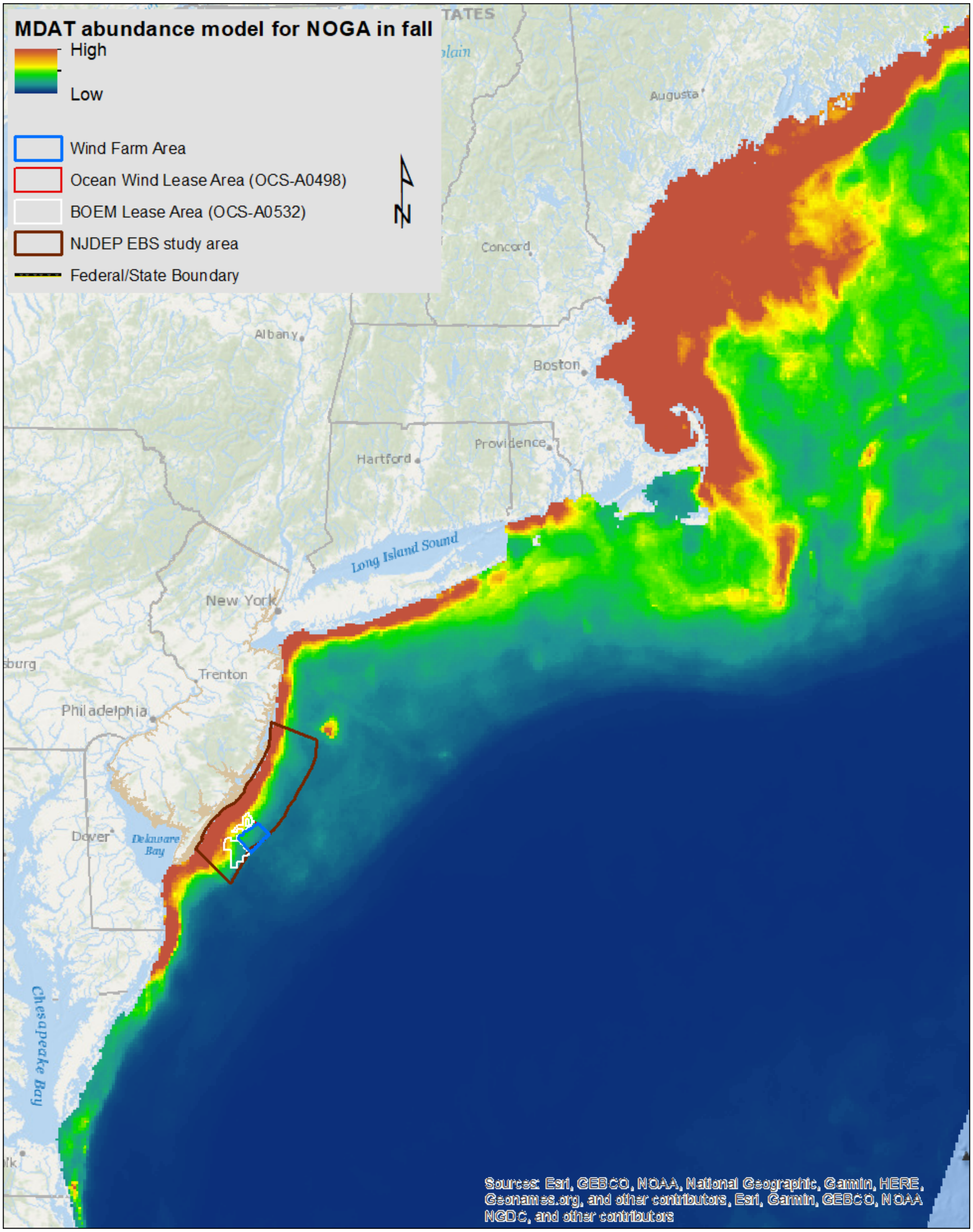


Figure 3-4: Example Marine-life Data and Analysis Team (MDAT) abundance model for Northern Gannet in fall

3.2.4.1.1 Secondary Sources

3.2.4.1.1.1 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 (K. Coleman, Pers. Comm.). The database is currently being managed by the U.S. Fish and Wildlife Service, Division of Migratory Birds, Database Manager Kaycee Coleman. A request was made to the Database Manager for all observations in New Jersey waters regardless of data source or age. All data received were mapped to determine the occurrence of rare species with the Array and lease areas as well as adjacent areas north and south of these areas.

3.2.4.1.1.2 Mid-Atlantic Diving Bird Tracking Study

A satellite telemetry tracking study in the mid-Atlantic was developed and supported by BOEM and the USFWS with objectives aimed at determining fine scale use and movement patterns of three species of marine diving birds during migration and winter (Spiegel et al. 2017). These species – the Red-throated Loon (*Gavia stellata*), Surf Scoter (*Melanitta perspicillata*), and Northern Gannet (*Morus bassanus*) – are all considered species of conservation concern and exhibit various traits that make them vulnerable to offshore wind development. Nearly 400 individuals were tracked using satellite transmitters over the course of five years (2012–2016), including some tagged Surf Scoters as part of the Atlantic and Great Lakes Sea Duck Migration Study by Sea Duck Joint Venture partners[2]. Results provide a better understanding of how these diving birds use offshore areas of the mid-Atlantic OCS and beyond.

For each diving bird species during each season (spring migration, fall migration, and winter), the percentage of area of the wind farm array and lease areas overlapped by the 50%, 75%, and 95% utilization distribution contours was calculated in R version 3.5.0 (R Core Team 2018) using package rgeos version 0.3-26 (Bivand and Rundel 2017) by calculating the area of spatial intersection.

3.2.4.1.1.3 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), BRI has deployed satellite transmitters on fall migrating raptors at three different raptor migration research stations along the north Atlantic coast (DeSorbo et al. 2012, 2018c, 2018a). These collective efforts have resulted in the deployment of satellite transmitters on 38 Peregrine Falcons (35 hatch year birds and 3 adults) and 16 Merlins (13 hatch year and 3 adults). Satellite-

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

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[3] where these data are stored and processed. Filtered locations from these tagged animals were mapped along with Peregrine Falcon and Merlin observations from the NJDEP EBS.

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

Since 2013, BOEM and the USFWS have supported a study using nanotags and an array of automated VHF telemetry stations to track the movements of vulnerable terns and shorebirds. The study was designed to assess the degree to which these species use offshore federal waters during breeding, pre-migratory staging periods, and on their migrations. In a pilot study in 2013, they attached nanotags to Common Terns (*Sterna hirundo*) and American Oystercatchers (*Haematopus palliatus*) and set up eight automated 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*). 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. Results are forthcoming.

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

The first map panel (A) presents the NJDEP EBS data as proportions of total effort-corrected counts. For each OCS Lease Block, the proportion of all effort-corrected counts (total counts per square kilometer or survey area) was calculated in the surveyed area that were 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 NJDEP EBS surveys, while Panel C shows the density output over the entire northwest Atlantic. Density data are scaled in a similar way to the NJDEP EBS data, so that the low-high designation for density is similar for both datasets. However, there are

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

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 we chose to exclude them from mapping and analysis to reduce anomalies in predicted species densities and strengthen the analysis. Additionally, while the color scale for the MDAT data is approximately matched to that used for the NJDEP EBS data, the values that underlie them are different (the MDAT data are symbolized using an ArcMap default color scale, which uses standard deviations from the mean to determine the color scale rather than quantiles). Maps should be viewed in a broadly relative way between local and regional assessments and even across species.

3.2.4.3 Exposure Assessment Metrics

To assess bird exposure at the local (i.e., New Jersey WEA) and regional scales (i.e., U.S. Atlantic waters), the Wind Farm 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 Wind Farm 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 Wind Farm Area. The 25th, 50th, and 75th weighted quantiles of this dataset were calculated, and identified the quantile into which the density estimate for the Wind Farm Area fell for a given species and season combination. 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 Wind Farm Area for each season-species: 0 (Minimal) was assigned when the density estimate for the Wind Farm 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 NJDEP EBS data set. The mean relative density for the Wind Farm Area (a collection of 20 partial or full OCS Lease Blocks) was calculated. To compare the Wind Farm Area to other locations, the nearest 18 lease blocks to each lease block surveyed in each season (winter, n = 228; spring, n = 240; summer, n = 224; and fall, n = 224) was identified and the relative density of each Wind Farm Area-sized block was calculated. Thus, a dataset of relative densities for all possible Wind Farm Area-sized blocks was compiled within the NJDEP EBS study and used this data set to assign scores to all species-season combinations, based on the same quartile categories described for the MDAT models above. If a score for a species-season combination was not available for the NJDEP EBS (local assessment), and because the avian surveys made every effort to survey all species, excluding none, 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 Wind Farm Area compared to all other areas, the MDAT quartile score and NJDEP EBS 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 Wind Farm 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 (NJDEP EBS 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 both spatial scales, or above-average density at one of the two scales and low density at the other scale. 'Medium' exposure describes several different combinations of densities; one or both scales must be at least above-average density, but this category can also include 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 NJDEP EBS data and the regional MDAT on the left and right, respectively.

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

Exposure Level	Definition	Scores
High	Wind Farm Area densities at both local and regional scales are above the 75th percentile.	3, 3
	OR	
	Local densities are greater than the 75th percentile and regional densities are between the 50th and 75th percentiles, or vice versa.	3, 2

3.2.4.5 Aggregating Scores to Year and Taxonomic Group

The seasonal scores were aggregated into annual scores for each species and taxonomic group 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 'Seaducks'; 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).

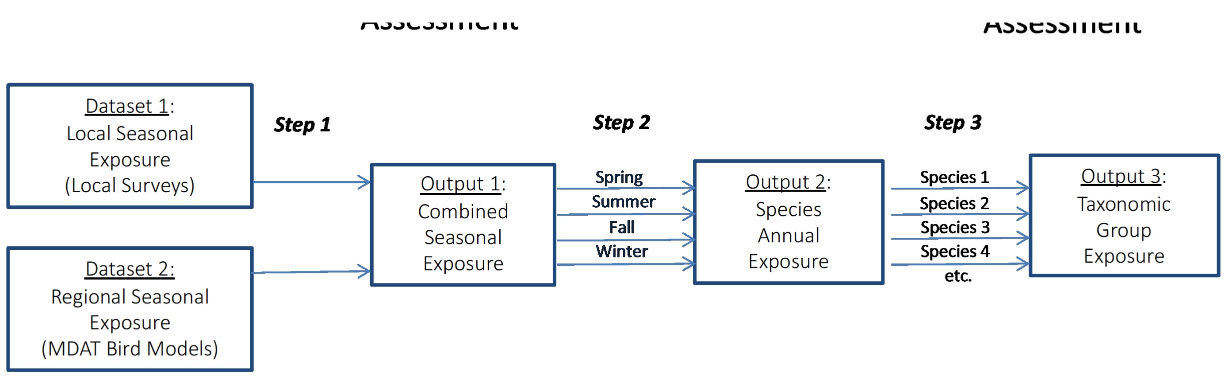


Figure 3-5: Diagram of the exposure analysis flow from local and regional exposure analyses to final taxonomic group exposure values. Local (NJDEP EBS surveys) and regional (MDAT bird models) exposure assessments were combined in Step 1 to calculate seasonal exposure scores. Seasonal exposure scores 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 Wind Farm 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 Wind Farm Area and over the entire survey area for each species from the NJDEP EBS data. Uncommon species with few detections in the Wind Farm Area may be somewhat over-rated for exposure using this method, while common species with relatively few detections in the Wind Farm 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 Wind Farm 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 Wind Farm 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 Wind Farm Area than in other locations. A Minimal exposure score should not be interpreted to mean there are no individuals of that species in the Wind Farm Area. In fact, common species may receive a Minimal exposure score even if there are still substantial numbers of individuals in the Wind Farm Area, so long as their predicted densities *outside* are higher still. 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 3.1.3.4).

3.2.4.7 Exposure Categories

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

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

Final Exposure Level	Definition
Minimal	Minimal seasonal exposure scores 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 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 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 offshore environment, and the offshore environment is primary habitat during any season

3.2.5 Behavioral Vulnerability Framework

Behavioral vulnerability assessment was conducted in two parts. First, a species or species group vulnerability to displacement was qualitatively assessed based upon existing vulnerability assessments (Desholm 2009, Willmott et al. 2013, Furness et al. 2013) and recent data on avoidance/attraction to existing offshore wind developments in Europe (Dierschke et al. 2006). Second, for species that were determined to not consistently avoid offshore wind developments or documented to be attracted, vulnerability to collision was qualitatively assessed based upon existing vulnerability assessments (Furness et al. 2013, Wade et al. 2016) and flight height data collected during the NJDEP EBS surveys. To fill gaps, literature based on studies completed in recent years was reviewed for information on avian risk related to offshore wind development in Europe (Garthe and Hüppop 2004, Desholm 2009, Furness et al. 2013, Johnston et al. 2014b) and the United States (Willmott et al. 2013). Behavioral vulnerability level categories used in this assessment are described in Table 3-6.

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

Behavioral Vulnerability Level	Definition
Minimal	Low ranking for collision or displacement risk in Wade et al. (2016) AND/OR No evidence of collisions or displacement in the literature. Unlikely to fly within the RSZ.
Low	Low ranking for collision or displacement risk in Wade et al. (2016) AND/OR Little evidence of collisions or displacement in the literature. Rarely flies within the RSZ.
Medium	Moderate ranking for collision or displacement risk in Wade et al. (2016) AND/OR Evidence of collisions or displacement in the literature. Occasionally flies within the RSZ.
High	High ranking for collision or displacement risk in Wade et al. (2016) AND/OR Significant evidence of collisions or displacement in the literature. Regularly flies within the RSZ.

Flight height data were grouped by taxonomic group and placed into one of three categories relative to the rotor-swept zone (RSZ): less than 100 ft, 100-1000 ft, and 1000 ft or more. Total numbers of birds flying within each RSZ group was summarized in R and plotted as percentages of the total numbers of birds in each group.

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

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

Spatially, bird exposure to the Wind Farm Area will be similar during both phases. However, exposure to all construction activities are 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 foundation type was not expected to change the assessment because, overall, the assessment was qualitative and included the entire Wind Farm Area. The potential effects of the Offshore Cable Corridor are not considered a hazard to bird populations and were not assessed.

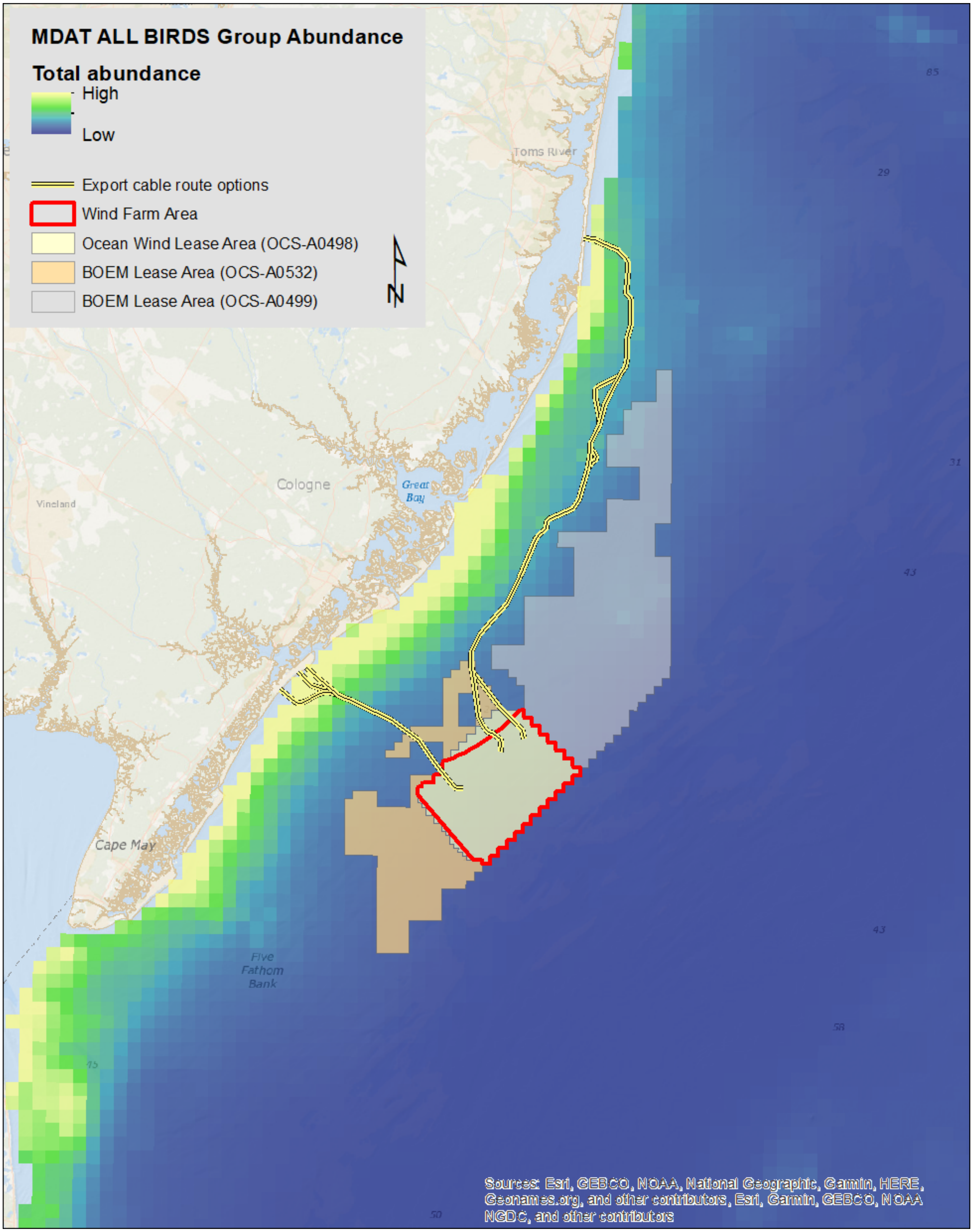


Figure 3-6: Bird abundance estimates from the MDAT models.

Flight heights were important in the assessment of behavioral vulnerability. Locally derived flight heights were gathered from the NJDEP EBS surveys or were obtained from existing literature. Depending on the turbine model selected for the Project, turbine heights vary; the rotor swept zone (RSZ) may be up to 788 ft at MLLW (240 m) in diameter. The lower blade tip is 70.8 ft at MLLW (21.6 m) (Figure 1-2). Using the NJDEP baseline data, flight heights were assessed for a total of 48,759 birds. Of these, 79%, were estimated to be below 100 ft (30 m) (Figure 3-7). Furthermore, it is likely the majority of birds in flight within the 100-1,000 ft range are weighted towards the lower altitudes. Due to the spherical volume of air the rotor sweeps the risk is not equal at all altitudes within the RSZ with the potential for exposure reduced towards the lower (and upper) tip heights.

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 Eagle Act and the ESA are assessed individually. A summary table is provided at the end of the assessment.

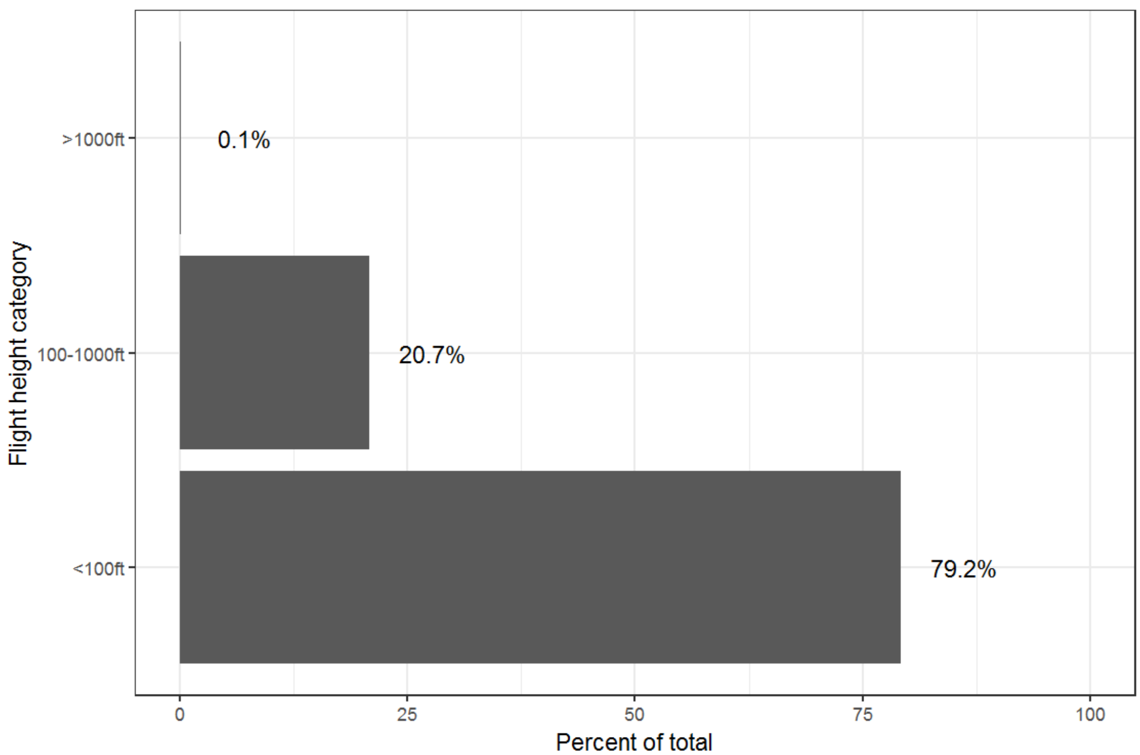


Figure 3-7: Flight heights for all birds combined (n = 48,759) derived from NJDEP EBS data, showing the number of birds in each flight band.

3.4 Shorebirds

3.4.1 Spatiotemporal Context

Shorebirds are coastal breeders and foragers and generally avoid straying out over deep waters during breeding. Few shorebird species breed locally on the U.S. Atlantic coast, 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 are federally protected under the ESA – the Piping Plover and the Red Knot – and are thus addressed in detail below. Shorebirds of conservation concern identified in the USFWS IPaC database are listed in Table 3-7.

Table 3-7: Shorebirds of conservation concern in New Jersey, 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	NJ Status	Federal Status
Red Knot	*Calidris canutus rufa*	E	T
Piping Plover	*Charadrius melodus*	E	T

3.4.2 Exposure Assessment

Exposure was assessed using species accounts and NJDEP EBS 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 3-8). Due to the Minimal exposure, a vulnerability and risk assessment was not conducted for non-ESA shorebird species.

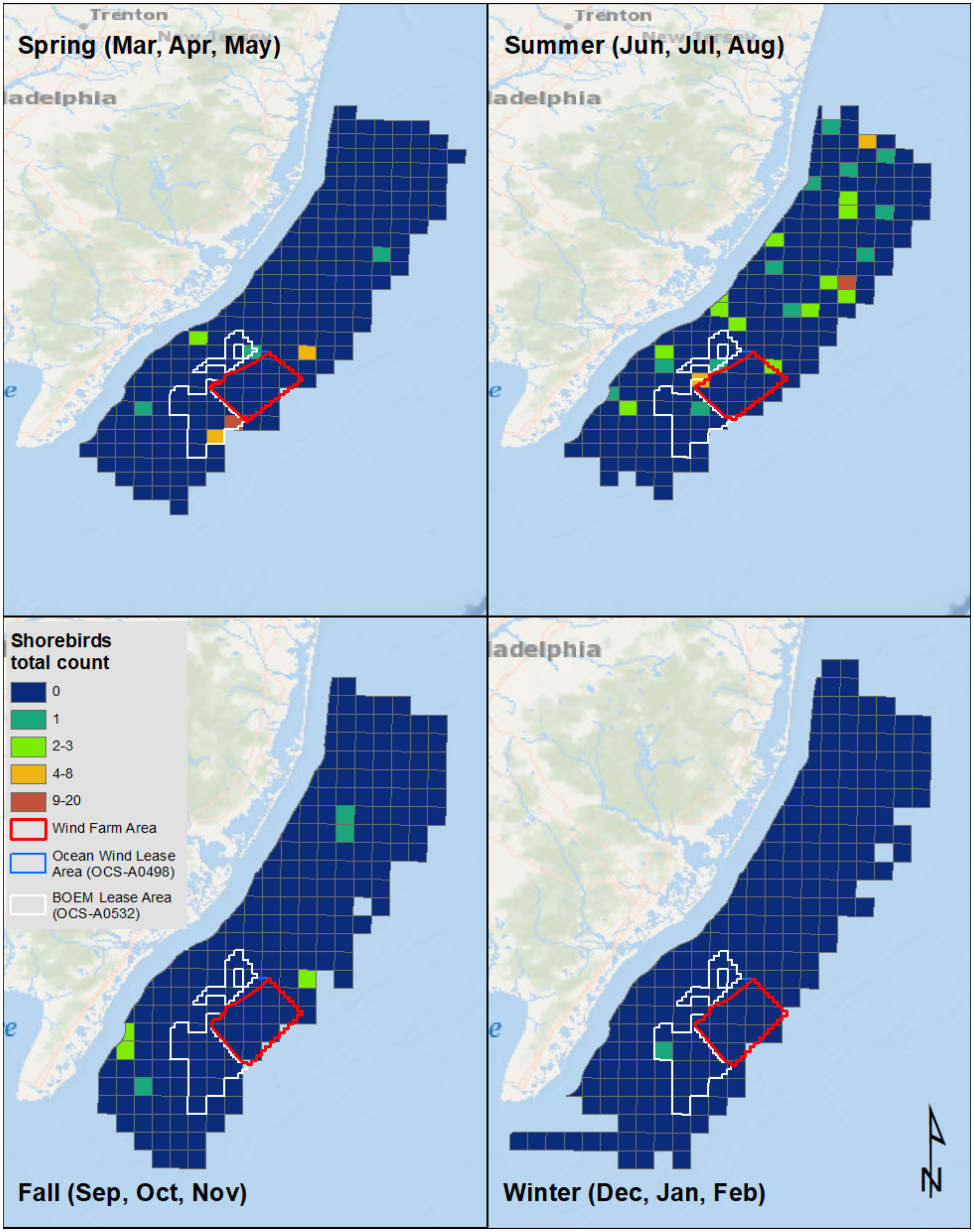


Figure 3-8: Shorebirds observed, by season, during the NJDEP EBS surveys. While there were low densities of all species, among the species observed, Red-necked Phalarope, Least Sandpiper, and Short-billed Dowitchers were the most common.

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, 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, [USFWS] U.S. Fish and Wildlife Service 2009, [BOEM] 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, [USFWS] U.S. Fish and Wildlife Service 2009, Burger et al. 2011).

Piping Plovers are present in New Jersey during spring and fall migratory periods, and during the breeding season (Figure 3-9; [USFWS] U.S. Fish and Wildlife Service 2018). They breed above the high tide line along the coast, primarily on sand beaches (USFWS 2018). 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 RSZ 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). As such, at least some individuals of this species likely traverse the New Jersey WEA ([BOEM] Bureau of Ocean Energy Management 2012). Migration occurs primarily during nocturnal periods, with the average takeoff time appearing to be around 5–6 pm (Loring et al. 2017).

Figure 3-9: Piping plover occurrence in New Jersey (USFWS 2018).

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 migration. (NOTE: for this section, exposure was considered only for the offshore component of the Wind Farm Area). A recent nanotag study tracked migrating Piping Plovers captured in Massachusetts and Rhode Island. The study estimated that two of the tracked birds (*n*= 102) would be exposed to the northern portion of the New Jersey Lease Area and zero birds would be exposed to the southern portion of the New Jersey Lease area where the Wind Farm Area is located. The exposure estimates are considered a minimum estimate because of lost tags and incomplete coverage of the offshore environment by land-based receivers. In addition, probability densities developed from the tracking data indicated low to little use of the southern portion of the New Jersey Lease Area (Loring et al. 2019). Overall, there is no habitat for the species in the Lease and/or Wind Farm Area, and the expected exposure to individuals of this species is “minimal”.

3.4.3.1.3 Behavioral Vulnerability Assessment

The migratory flight height of Piping Plovers tagged with nanotags were generally above the RSZ (820 ft; 250 m), with 15.2% of birds flying through the RSZ in Wind Energy Areas (Loring et al. 2019). Offshore radar studies have recorded shorebirds flying at 3,000 to 6,500 ft (1,000 to 2,000 m; Rachardson 1976, Willaims and Williams 1990 *in* Loring et al. 2019), while nearshore radar studies have recorded lower flight heights of 330 ft (100 m). Flight heights can vary with weather; during times of poor visibility the birds may flight lower within the rotor swept zone (Dirksen et al. 2000 *in* Loring et al. 2019). Since the birds generally migrate at flight heights above the RSZ, potential exposure to collisions with turbines, construction equipment, or other structures is reduced. They also have good visual acuity and maneuverability in the air (Burger et al. 2011), and there is no evidence to suggest that they are particularly vulnerable to collisions. Thus, Piping Plovers have “minimal” to “low” vulnerability to collision with construction equipment.

This species has “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.

Table 3-8: 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

Given that the exposure of Piping Plovers will be fleeting during 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”.

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) on their circumpolar travels (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)[4]. 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 New Jersey only during migratory periods ([BOEM] 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, [BOEM] 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 Wind Farm 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 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 collision for shorter-distance migrants that can traverse the WEA within the RSZ, particularly during the fall (Loring et al. 2018). Five birds tagged in New Jersey departed in late August and flew directly offshore; two other birds left in November and followed the coast south (Loring et al. 2018). In the telemetry study, one bird from Massachusetts (*n* = 99) and two birds from New Jersey (*n* = 35; from Stone Harbor Point, Brigantine Natural Area, and Avalon Point) were detected crossing the New Jersey Wind Energy Area. The exposure estimates are considered an estimate due to lost tags and incomplete coverage of the offshore environment by land-based receivers. Migration flights are generally undertaken at night, but in fine weather conditions, perhaps lessening any risk of collision (Loring et al. 2018). Overall, there is no habitat for the species in the Lease and/or Wind Farm Area, and the expected exposure to individuals of this species is "low" to "medium".

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

3.4.3.2.3 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). These individuals may fly at lower altitudes during periods of poor weather and high winds, however (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.

This species has "minimal" vulnerability to displacement during 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 3-9: 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 "low".

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, thus they are capable of crossing large areas of ocean and may traverse the Wind Farm Area during spring and fall migration periods. The IPaC database did not indicate any wading birds in the Wind Farm Area or adjacent waters.

3.5.2 Exposure Assessment

Exposure was assessed using species accounts and NJDEP EBS survey data. Exposure to construction and operation is considered to be "minimal" because wading birds spend a majority of the year in freshwater aquatic systems and near-shore marine system and there is little use of Wind Farm Area by wading bird. There were few observations of species within this group during all seasons (Figure 3-10). Due to the assessment of Minimal exposure, a vulnerability and risk assessment was not conducted.

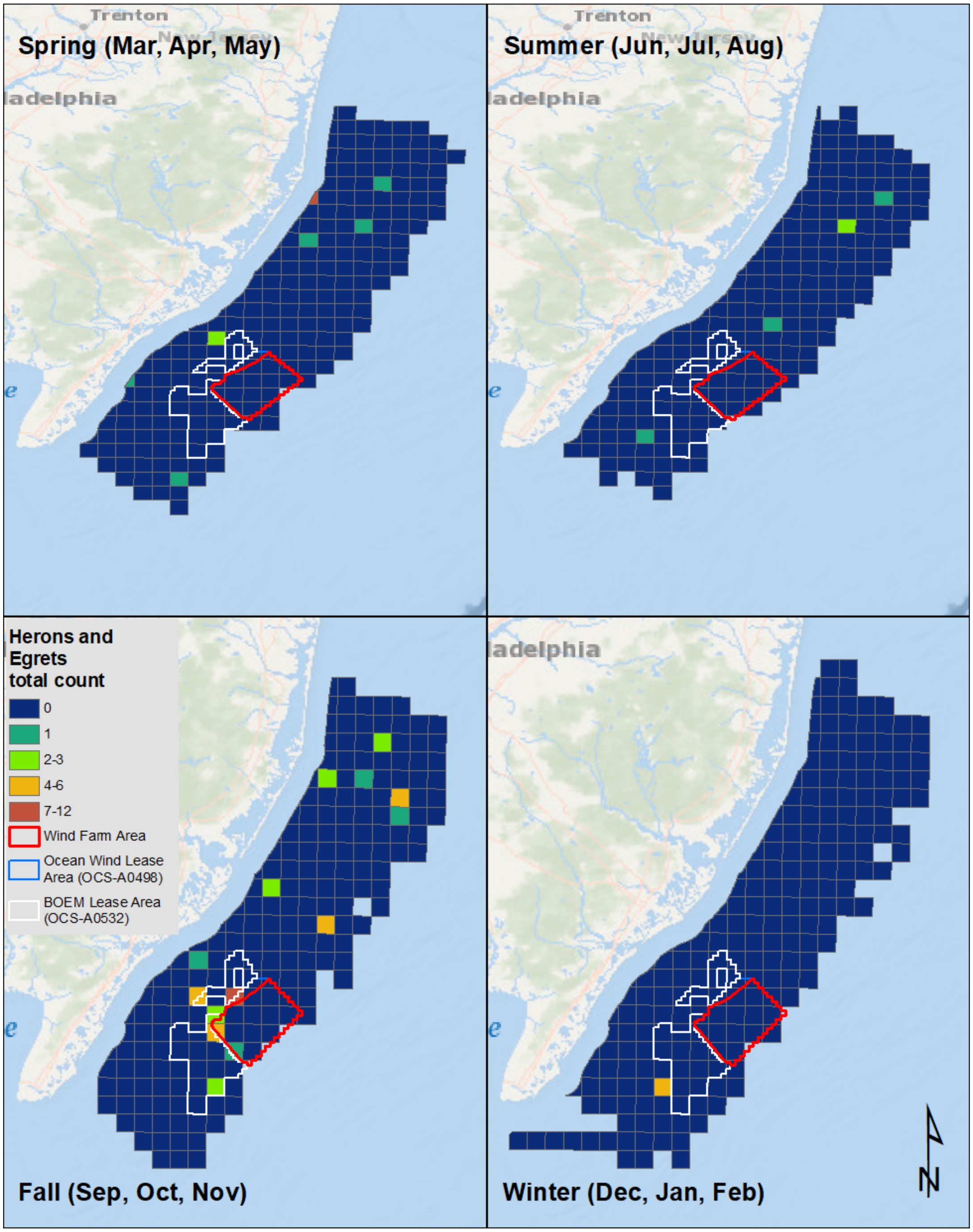


Figure 3-10: Herons and egrets observed, by season, during the NJDEP EBS surveys. Only a small number of Great Blue Heron and Yellow-crowned Night Heron were observed offshore.

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 will be dictated in large part by their morphology and flight strategy (i.e., flapping vs. soaring), which influences species' ability or willingness to cross large expanses of open water where thermal formation is poor (Kerlinger 1985). Interactions between raptors and offshore structures are likely to be predominantly limited to migration. Of the raptors in eastern North America, the eagles, *Buteo* hawks, and large *Accipiter* hawks (i.e., Northern Goshawks) are rarely observed offshore (DeSorbo et al. 2012, 2018c). The Sharp-shinned Hawk, Cooper's Hawk, Northern Harrier, American Kestrel, and Osprey 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 (the Barred Owl and Great-horned Owl) are generally considered to avoid the offshore environment. The Northern Saw-whet Owl has 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). The Long-eared Owl also migrates along the coast and winters 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). The Merlin is the most abundant diurnal raptor observed at offshore islands during fall migration (DeSorbo et al. 2012, 2018c). Peregrine Falcons fly hundreds of 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 peregrines (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), while breeding adult peregrines 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 Wind Farm Area or adjacent waters, other data resources, such as satellite telemetry data, suggest falcons may pass through the Wind Farm Area during migration (Figure 3-11; Figure 3-12). 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, NJDEP EBS survey data, and individual tracking data. Raptor exposure to the Wind Farm Area is expected to be limited to falcons. Exposure analysis determined minimal exposure to construction and operation activities (Table 3-10), however we adjusted this to a "low" to "medium" exposure because individual tracking data indicates they may pass through the OWC01 during migration (Figure 3-11; Figure 3-12). Falcons may be attracted to turbines as offshore perching and hunting sites, which may increase temporal exposure during migration.

Table 3-10. Number of species in each exposure category in each season for the raptor group.

Taxonomic Group	Season	Minimal	Low	Medium	High
Raptors	Winter	3	·	·	·
	Spring	3	·	·	·
	Summer	3	·	·	·
	Fall	3	·	·	·

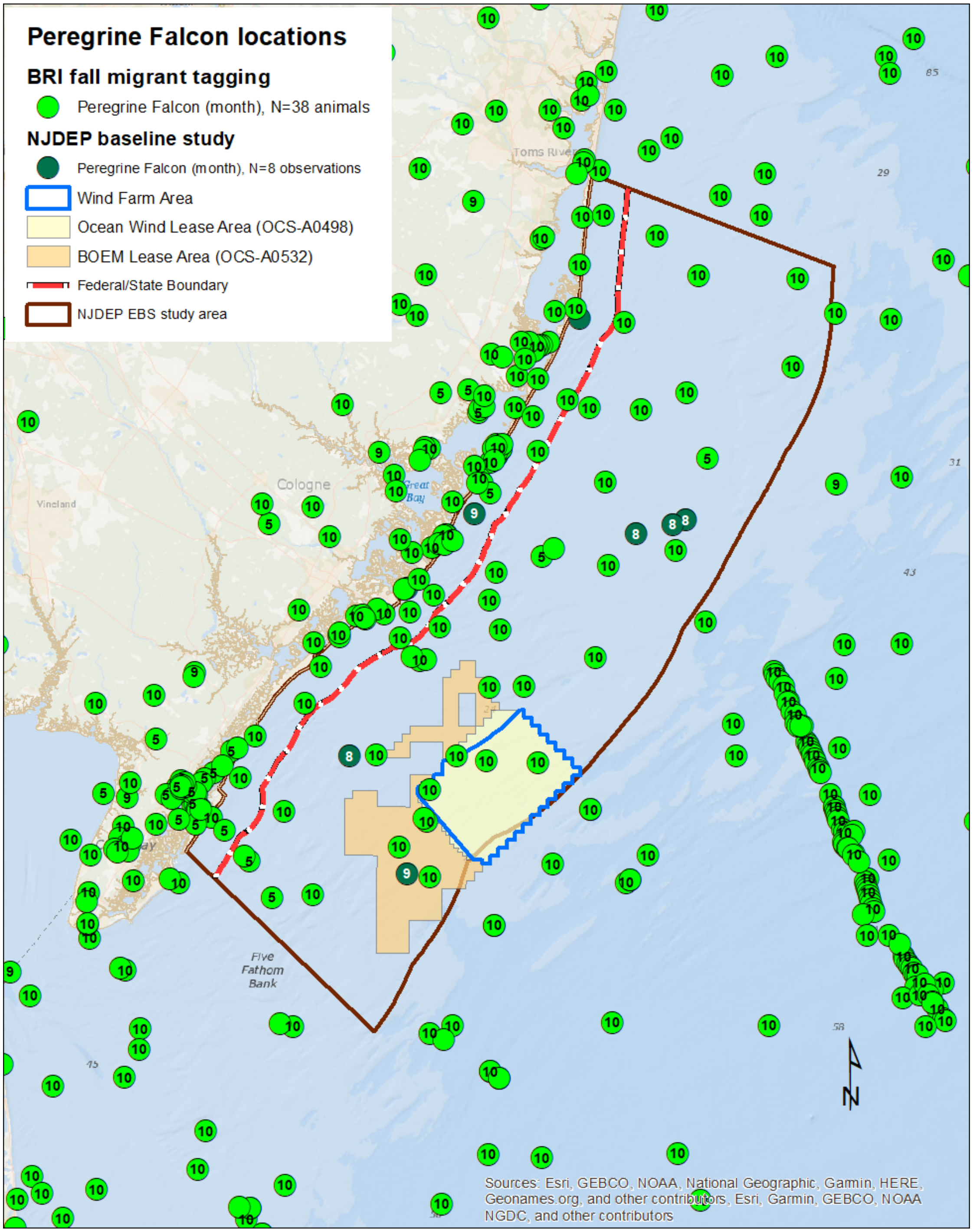


Figure 3-11: Observations of Peregrine Falcons observed during the NJDEP surveys, and the location estimates of birds instrumented with satellite transmitters at the Block Island Raptor Research Station at Block Island, Rhode Island (DeSorbo et al. 2018c). Sample size of satellite-tagged birds includes three adult females, 18 hatch-year females, and 17 hatch-year males. The number in the point represents the month. The points in a line are from a bird that presumably perched and traveled on a boat.

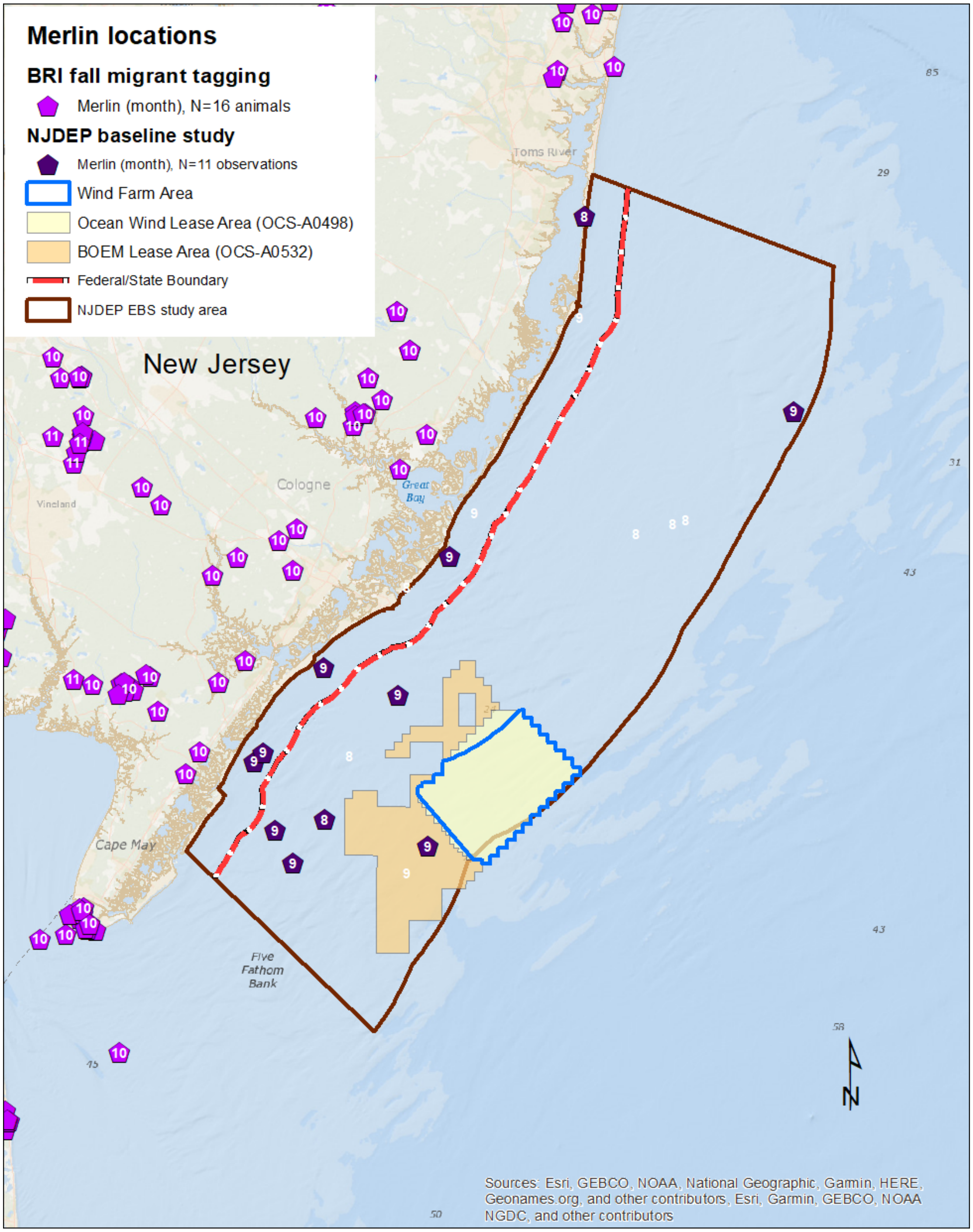


Figure 3-12: Observations of Merlins observed during the NJDEP surveys, and the location estimates of birds instrumented with satellite transmitters at the Block Island Raptor Research Station, Block Island, Rhode Island (DeSorbo et al. 2018c). Sample size of satellite-tagged birds includes three adult females and 13 hatch-year females. The number in the point represents the month.

3.6.3 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. 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 their urban nest site in Massachusetts (T. French, MassWildlife, pers. comm.). Carcasses were not detected in post-construction mortality studies at several projects with falcon activity (Hein et al. 2013, Bull et al. 2013, DiGaudio and Geupel 2014). American Kestrel carcasses have been found in post-construction monitoring of much smaller terrestrial turbines (1.8 MW) in Washington State (Erickson et al. 2008), but American Kestrel mortality has been demonstrated to decrease as turbine size increases (Smallwood 2013). Evidence of nocturnal soaring, perching and feeding under lighted structures in terrestrial and offshore settings has been noted in Peregrine Falcons (Cochran, 1975; Johnson et al., 2011; Kettel et al., 2016; Voous, 1961), and these behaviors increase the exposure risk in this species. However, observations of raptors at the Anholt Offshore Wind Farm in the Baltic Sea (20 km from the coast) indicate avoidance behavior (13-59% of birds observed depending on the species), which has the potential to cause a barrier for migrants in some locations, but also may reduce collision risk; the percentage of Merlins and 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 11), 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.

Table 3-11: Summary of raptor vulnerability.

Effect	Description	Evidence from literature	
		Construction	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

3.6.4 Risk Analysis

Risk of potential impacts to non-falcon raptors populations is considered minimal due to minimal exposure. Population level impacts to falcon is considered "low" to "medium" because falcons have low to medium 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.

3.7 Eagles Listed Under the Bald and Golden Eagle Protection Act

3.7.1 Spatiotemporal Context

Both Bald Eagles and Golden 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 US, 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 the mid-Atlantic U.S., spanning coastal plain habitat in Virginia, Delaware, North Carolina, South Carolina, and other southeastern states.

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

Bald Eagles are present year-round in New Jersey and nesting is concentrated on the edge of Delaware Bay ([NJDEP] New Jersey Department of Environmental Protection 2017). In a study evaluating the space use of Bald Eagles captured in Chesapeake Bay, the coast of New Jersey was associated with moderate levels of use (Mojica et al. 2016). Bald Eagles were rarely observed in offshore surveys (all observations <3.7 mi [6 km] from shore [Williams et al. 2015]). Given the fact that the study area in that study was near one of the largest Bald Eagle population centers in North America (Chesapeake Bay), this finding further supports the notion that Bald Eagles rarely venture large distances offshore.

3.7.2 Exposure

Exposure was assessed using species accounts, tracking studies, and knowledge of eagle wing morphology. Golden Eagle exposure to the Wind Farm 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 Wind Farm Area is also expected to be "minimal" because the Wind Farm 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 only contained one Bald Eagle observation, which was close to shore in state waters.

3.7.3 Vulnerability

Although there is little research on eagle interactions with offshore developments, eagles are expected to have "minimal" vulnerability to collision and displacement. Neither species is expected to forage over the Wind Farm 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 the tropical regions. On their migrations, neotropical migrants generally travel at night and at high altitudes where favorable winds can aid them along their trip.

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

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

The Blackpoll Warbler is the species that is most likely to fly offshore during migration (Faaborg et al. 2010, DeLuca et al. 2015b). Migrating songbirds have been detected at or in the vicinity of smaller offshore wind developments in Europe (Kahlert et al. 2004, Krijgsveld et al. 2011, Pettersson and Fågelvind 2011) and may have greater passage rates during the middle of the night (Huppop and Hilgerloh 2012). While, the IPaC database did not indicate any songbirds in the Wind Farm Area or adjacent waters, evidence from the literature and from the NJDEP EBS dataset indicates some songbirds migrate offshore including New Jersey.

3.8.2 Exposure Assessment

Exposure was assessed using species accounts, NJDEP EBS survey data, and literature. Exposure to construction and operation is considered to be "minimal" to "low" because songbirds have limited spatial and temporal exposure, they do not use the offshore marine system as habitat, and there is little evidence of songbird use of the Wind Farm Area outside of the migratory periods. Some passerines were encountered in the Wind Farm Area migration periods, but in low numbers (Figure 3-13). Overall, the exposure of these species will be limited to migration, and actual exposure is likely low.

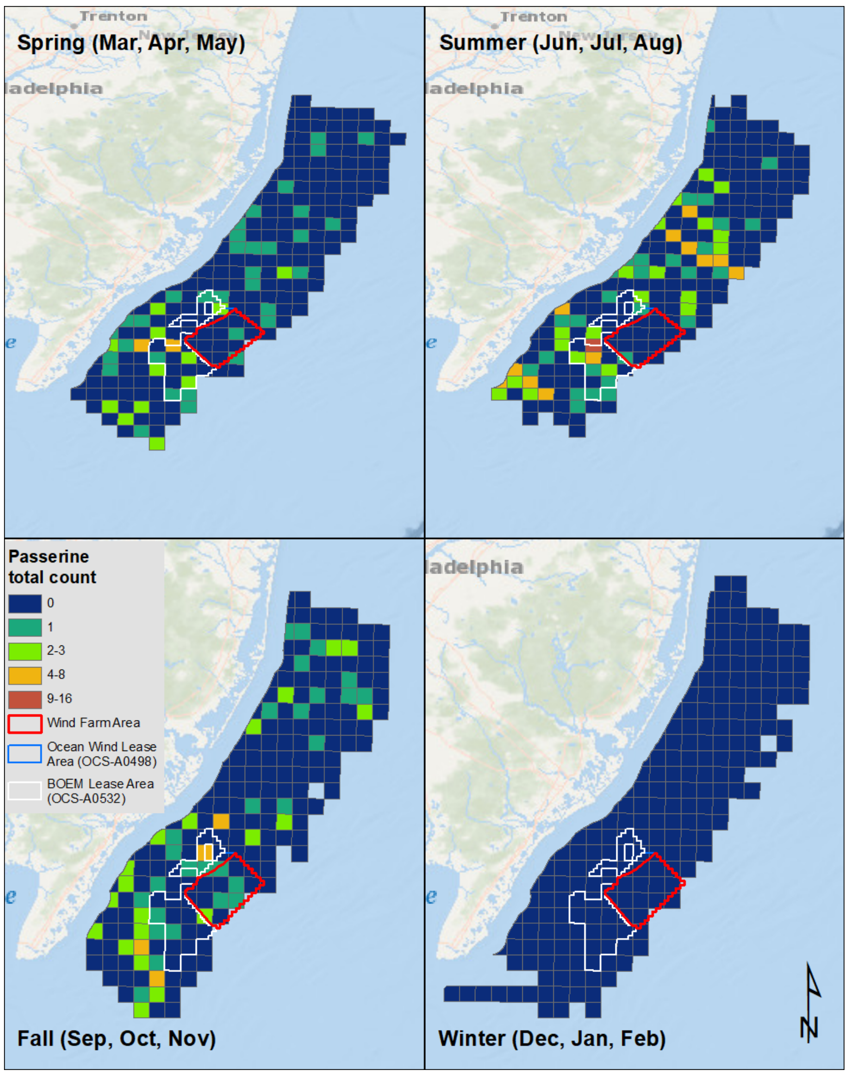


Figure 3-13: Songbirds (passerines) observed, by season, during the NJDEP EBS surveys. While there were low densities of all species, among the species observed, martins, swallows, swifts, warblers, and sparrows were the most common.

3.8.3 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 terrestrial avian fatality rates range from 3–5 birds per MW per year ([AWWI] 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 with headwinds. While the sample size is low (*n* = 333), flight heights recorded during the NJDEP EBS survey show that songbirds generally fly below the RSZ during the day (Figure 3-14). 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.

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 3-12).

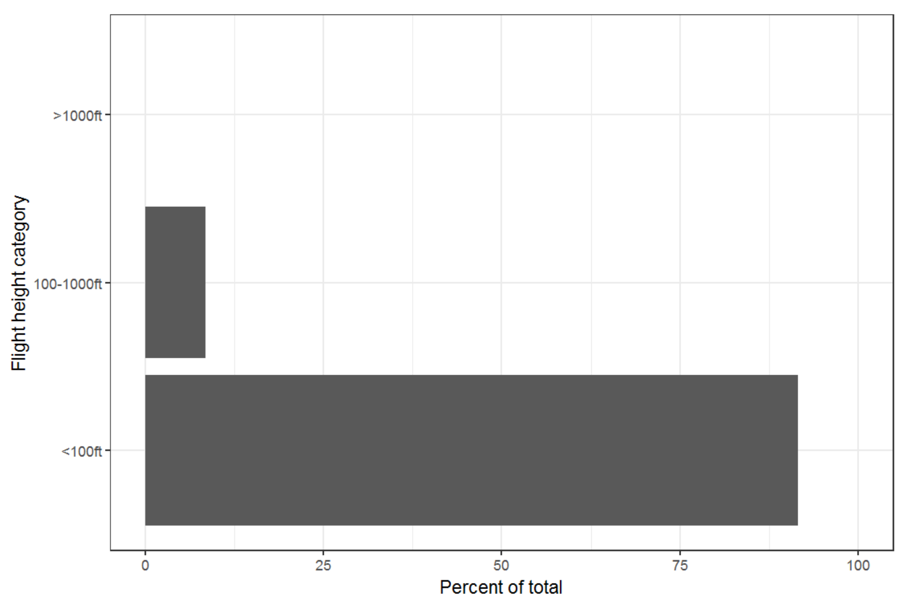


Figure 3-14: Flight heights of songbirds (n =333) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

Table 3-12: Summary of songbird vulnerability.

Effect	Description	Evidence from literature	
		Construction	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

3.8.4 Risk Analysis

This analysis suggests that the potential population-level impacts to songbirds is "low" because, while these birds have low-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 US 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 use saltmarshes, beaches, and other strictly coastal habitats, that are not captured in other groupings, such as grebes and waterfowl. 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 the Marine Bird section, below. The IPaC database did not indicate any coastal waterbirds in the Wind Farm Area or adjacent waters.

3.9.2 Exposure Assessment

Exposure was assessed using species accounts, NJDEP EBS survey data, and literature. Exposure is considered to be "minimal" (Table 3-13, Table 3-14, Table 3-15) because coastal waterfowl spend a majority of the year in freshwater aquatic systems and near-shore marine systems, and there is little use of Wind Farm Area during any season (Figure 3-15). No skimmers were observed offshore during the NJDEP EBS surveys. Due to the 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 dabblers, geese, and swans group.

Taxonomic Group	Season	Minimal	Low	Medium	High
Dabblers, Geese, and Swans	Winter	12	·	·	·
	Spring	12	·	·	·
	Summer	12	·	·	·
	Fall	11	·	1	·

Table 3-14. Number of species in each exposure category in each season for the coastal diving duck group.

Taxonomic Group	Season	Minimal	Low	Medium	High
Coastal Diving Ducks	Winter	6	·	·	·
	Spring	6	·	·	·
	Summer	6	·	·	·
	Fall	5	·	·	1

Table 3-15. Number of species in each exposure category in each season for the grebe group.

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

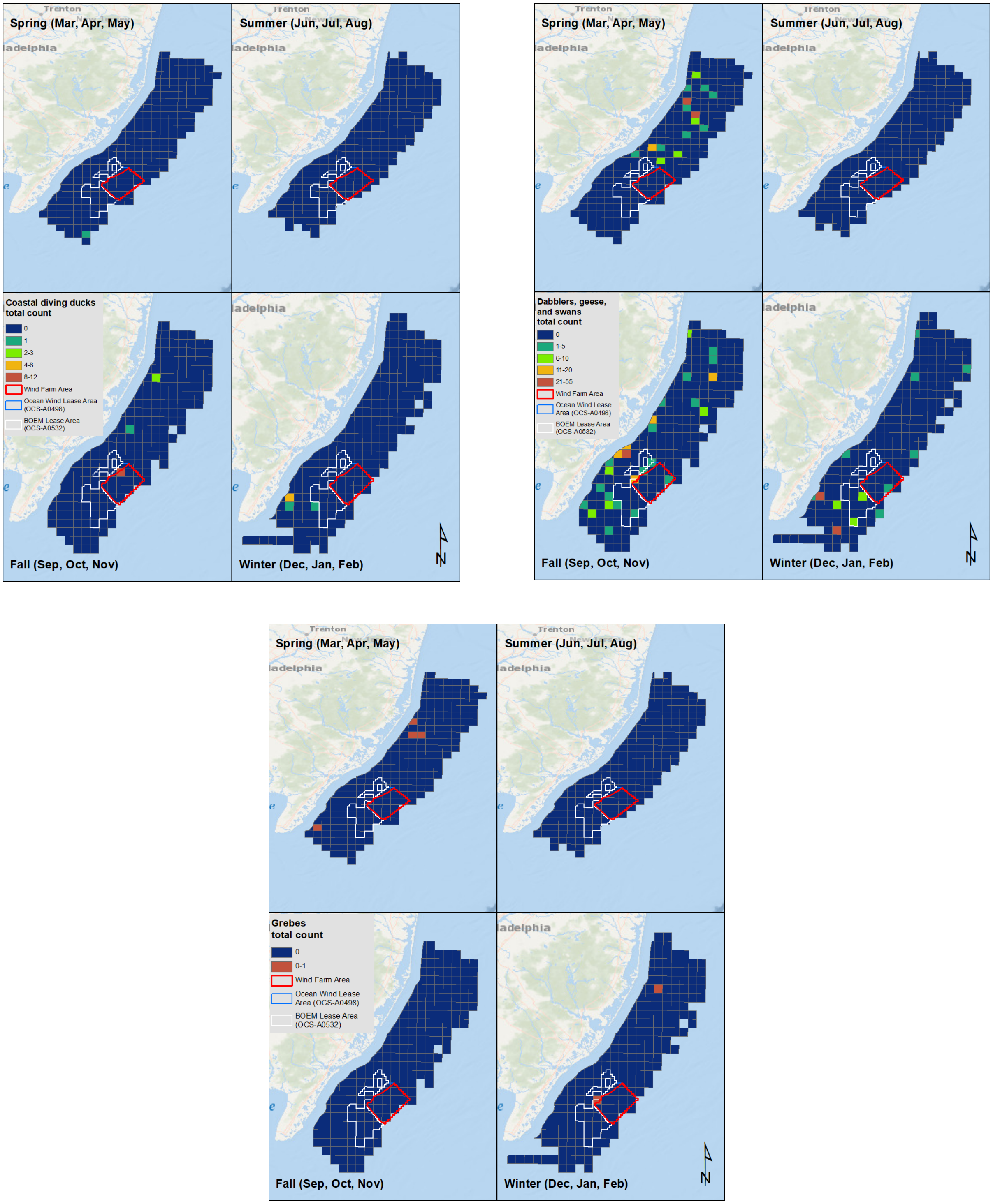


Figure 3-15: Coastal ducks, geese, and grebes observed, by season, during the NJDEP EBS surveys. While there were low densities of all species, among the species observed, Black Duck, Wood Duck, Green-winged Teal, Northern Pintail, and American Coot were the most common.

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 Wind Farm Area during multiple time periods, either seasonally or year-round, including loons, storm-petrels and shearwaters, gannets, gulls and terns, and auks. The IPaC database indicated that some marine birds of conservation concern may be present in the Wind Farm Area and adjacent waters (Table 3-16); New Jersey listed species identified in the database were Gull-billed Tern and Least Tern. Other data resources, however, indicate Roseate Tern (ESA species) may pass through the Wind Farm Area during migration and is discussed in detail in the tern section.

In the following sections, the assessments for major taxonomic groups of marine birds is reviewed, including discussion of their exposure (summarized in Table 3-17), and their densities inside and outside of the Wind Farm Area (summarized in Table 3-18). Part VI of this assessment provides seasonal densities as supplemental data.

Table 3-16: Marine birds of conservation concern identified in IPaC database: New Jersey and federal status (E = Endangered; T = Threatened; SC = Special Concern; BCC = Bird of Conservation Concern).

Common Name	Scientific Name	NJ Status	Federal Status
Audubon's Shearwater	*Puffinus lherminieri*		BCC
Great Shearwater	*Puffinus gravis*		BCC
Gull-billed Tern	*Gelochelidon nilotica*	SC	BCC
Least Tern	*Sterna antillarum*	E	BCC
Red-throated Loon	*Gavia stellata*	-	BCC

Table 3-17: Annual exposure scores for each marine bird species in each taxonomic group in the NJDEP EBS and MDAT data sets.

Taxonomic Grouping	Species	Annual Species Exposure Score
Seaducks	Common Eider	1
	Surf Scoter	2
	White-winged Scoter	4
	Black Scoter	1
	Long-tailed Duck	1
	Red-breasted Merganser	4
Loons	Red-throated Loon	4
	Common Loon	11
Grebes	Horned Grebe	1
	Red-necked Grebe	0
Shearwaters and Petrels	Wilson's Storm-Petrel	0
	Leach's Storm-Petrel	0
	Northern Fulmar	0
	Cory's Shearwater	3
	Sooty Shearwater	0
	Great Shearwater	2
	Manx Shearwater	0
	Audubon's Shearwater	0

Taxonomic Grouping	Species	Annual Species Exposure Score
Gannet	Northern Gannet	1
Cormorants and Pelicans	Double-crested Cormorant	2
	Great Cormorant	0
	Brown Pelican	0
Gulls	Pomarine Jaeger	0
	Parasitic Jaeger	1
	Black-legged Kittiwake	0
	Sabine's Gull	0
	Bonaparte's Gull	5
	Little Gull	0
	Laughing Gull	1
	Ring-billed Gull	4
	Herring Gull	5
	Iceland Gull	0
	Lesser Black-backed Gull	0
	Great Black-backed Gull	3
Terns	Least Tern	0
	Caspian Tern	0
	Black Tern	0
	Common Tern	8
	Forster's Tern	0
	Royal Tern	0
Auks	Dovekie	0
	Common Murre	2
	Thick-billed Murre	0
	Razorbill	2
	Black Guillemot	0
	Atlantic Puffin	0

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

Table 3-18: Densities (counts/km^2 of survey transect) within the Wind Farm Area and overall for each species from the NJDEP EBS data.

Taxonomic Grouping	Species	Average counts/sq.km in the Wind Farm Area	Average counts/sq.km in NJDEP OCS survey area
Sea ducks	Common Eider	0	0.001
	Surf Scoter	0.017	0.46
	White-winged Scoter	0.056	0.038
	Black Scoter	0.035	0.283
	Long-tailed Duck	0	0.083
	Red-breasted Merganser	0.005	0.004
	Unidentified Scoter	0	0.086
	Unidentified Diving/Sea Duck	0	0
Loons	Red-throated Loon	0.071	0.229
	Common Loon	0.389	0.48
	Unidentified Loon	0	0.002
Grebes	Horned Grebe	0	0
	Red-necked Grebe	0	0.001
Shearwaters and Petrels	Wilson's Storm-Petrel	0.149	0.477
	Leach's Storm-Petrel	0	0
	Northern Fulmar	0	0.001

Taxonomic Grouping	Species	Average counts/sq.km in the Wind Farm Area	Average counts/sq.km in NJDEP OCS survey area
	Cory's Shearwater	0.025	0.042
	Sooty Shearwater	0	0.001
	Great Shearwater	0.004	0.005
	Manx Shearwater	0	0.001
	Audubon's Shearwater	0	0
	Unidentified Shearwater	0	0
	Unidentified Storm-petrel	0.004	0.001
Gannet	Northern Gannet	0.663	1.595
Cormorants and Pelicans	Double-crested Cormorant	0	0.194
	Great Cormorant	0	0.001
	Brown Pelican	0	0.001
	Unidentified Cormorant	0	0
Gulls	Pomarine Jaeger	0	0
	Parasitic Jaeger	0.003	0.004
	Black-legged Kittiwake	0.003	0.024
	Sabine's Gull	0	0.001
	Bonaparte's Gull	0.074	0.121
	Little Gull	0	0
	Laughing Gull	0.395	0.573
	Ring-billed Gull	0	0.015
	Herring Gull	0.45	0.555
	Iceland Gull	0	0
	Lesser Black-backed Gull	0	0.001
	Great Black-backed Gull	0.273	0.295
	Unidentified small gull	0	0.002
	Unidentified Jaeger	0	0
	Unidentified Large Gull	0.022	0.022
Terns	Least Tern	0	0.002
	Caspian Tern	0	0
	Black Tern	0	0.001
	Common Tern	0.179	0.276
	Forster's Tern	0.005	0.073
	Royal Tern	0.001	0.019
	Unidentified small Tern	0.022	0.022
	Unidentified Small Gull/Tern	0	0
	Unidentified large Tern	0	0
Auks	Dovekie	0.002	0.018
	Common Murre	0.011	0.006
	Thick-billed Murre	0.002	0.002
	Razorbill	0.056	0.107
	Black Guillemot	0	0
	Atlantic Puffin	0	0
	Unidentified Alcid	0.002	0.01

3.10.1 Loons

3.10.1.1 Spatiotemporal Context

Common Loons and Red-throated Loons are both known to use the Atlantic OCS in winter. Analysis of satellite-tracked Red-throated Loons, captured and tagged in the mid-Atlantic area, found their winter distributions to be largely inshore of the mid-Atlantic WEAs, although they did overlap with the Wind Farm 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 (Williams et al. 2015a). The NJDEP EBS and MDAT models show higher use of the Wind Farm Area by loons in the spring than other seasons.

3.10.1.2 Exposure Assessment

Exposure was assessed using species accounts, tracking data, NJDEP EBS survey data, and MDAT models. Exposure to construction and operation is considered to be "low" to "medium" because loons may pass through the Wind Farm Area during spring and fall migration, and Common Loons may use the area during the winter (Table 3-19). Red-throated Loons had significantly lower average counts within the Wind Farm Area than the entire NJ DEP survey area, while Common Loon counts was similar between the two areas (Table 3-18). In addition, tracking data indicate that Red-Throated Loons largely pass through the area only during spring migration (Figure 3-16).

Table 3-19: Number of loon species in each exposure category by season.

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

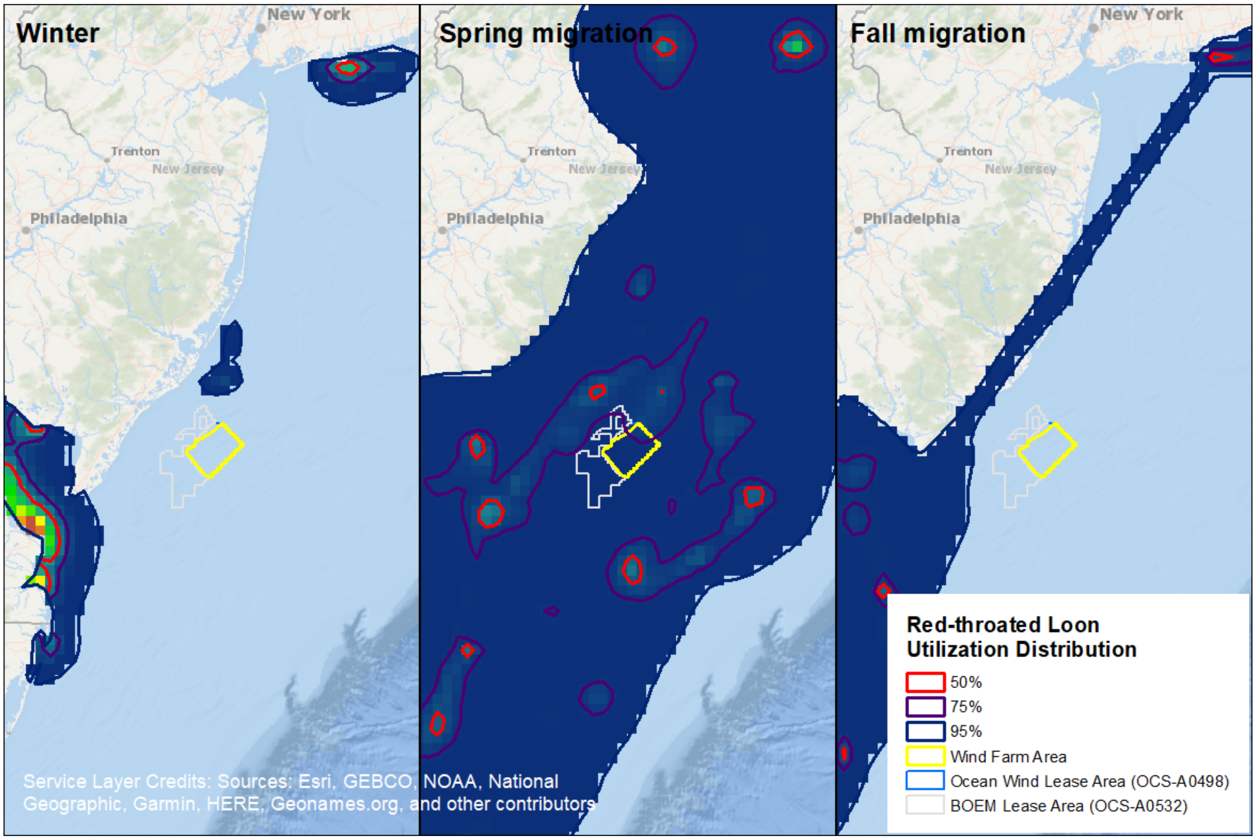


Figure 3-16: Dynamic Brownian bridge movement models for Red-throated Loons (n = 46, 46, 31 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the birds stay close to shore in the winter and during fall migration but may pass through the Wind Farm Array during spring migration.

3.10.1.3 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). Although there is some evidence that Red-throated Loons may return to wind farm areas after construction has been completed (APEM 2016). Common Loons likely will 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. Vulnerability is considered to be “medium” to “high” for loons during all phases because they are known to display a strong avoidance to offshore wind developments (Table 21), particularly Red-throated Loons, although they primarily fly low and are not considered vulnerable to collision (generally, below 82 ft [25 m]; Figure 3-17).

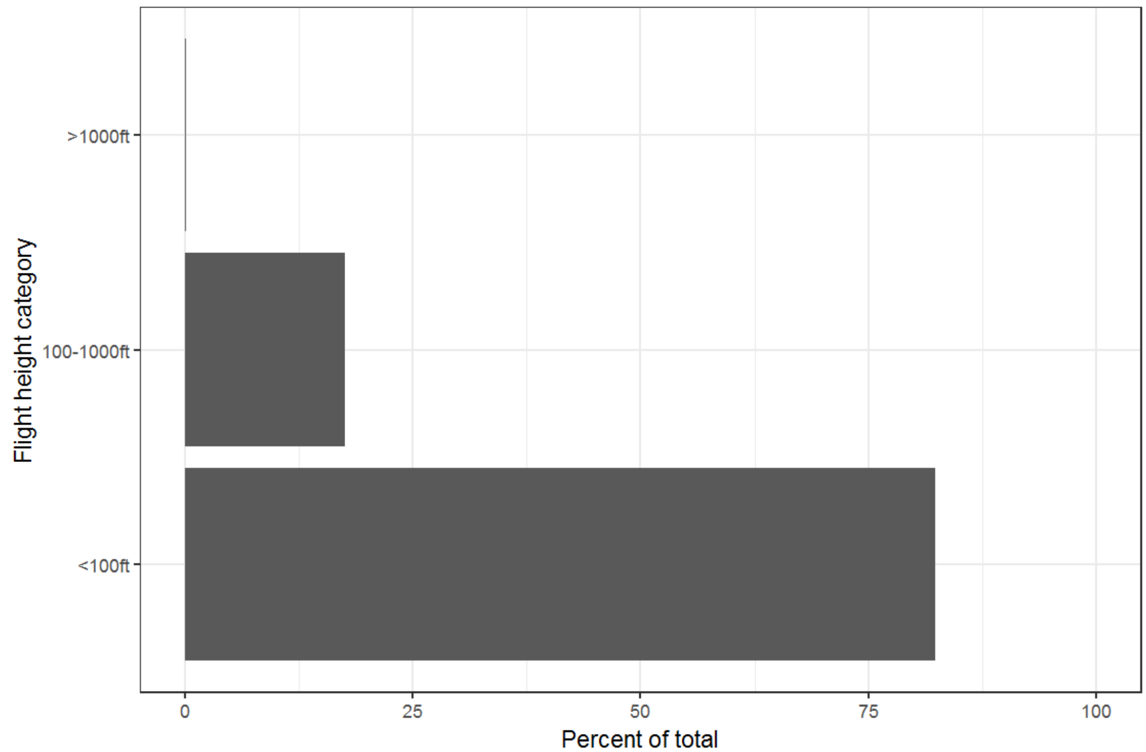


Figure 3-17: Flight heights of loons (n = 2,825) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

Table 3-20: Summary of loon vulnerability.

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

3.10.1.4 Risk Analysis

This analysis suggests that the potential impacts to loon populations is "low" to "medium" because, overall, these birds have low to medium exposure, both spatially and temporally, and a medium to 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. Overall, habitat loss, due to displacement from this project, is unlikely to impact population trends because of the relatively small size of the project area in relation to available foraging habitat.

3.10.2 Sea Ducks

3.10.2.1 Spatiotemporal Context

The sea ducks include Common Eider, scoters, and Long-tailed Ducks, all of which are northern or Arctic breeders that use the Atlantic OCS heavily in winter. Most sea ducks forage on mussels and/or other benthic invertebrates, and generally winter in shallow inshore waters or out over large offshore shoals where they can access prey. Surf Scoters tracked with satellite transmitters remained largely inshore of the Wind Farm Area (Figure 3-18; Berlin et al. 2017 *in* Spiegel et al. 2017).

3.10.2.2 Exposure Assessment

Exposure was assessed using species accounts, tracking data, NJDEP EBS survey data, and MDAT models. Exposure is considered to be "minimal" to "low" because sea duck annual exposure score was generally minimal to low (Table 3-21), the average counts of sea duck within the Wind Farm Area were generally lower than in the NJDEP EBS survey area (Table 3-18), and the literature indicates that sea duck exposure will be primarily limited to migration or travel between wintering sites.

Table 3-21: Number of species in each exposure category by season for sea ducks.

Taxonomic Group	Season	Minimal	Low	Medium	High
Sea ducks	Winter	3	1	2	·
	Spring	5	1	·	·
	Summer	6	·	·	·
	Fall	2	4	·	·

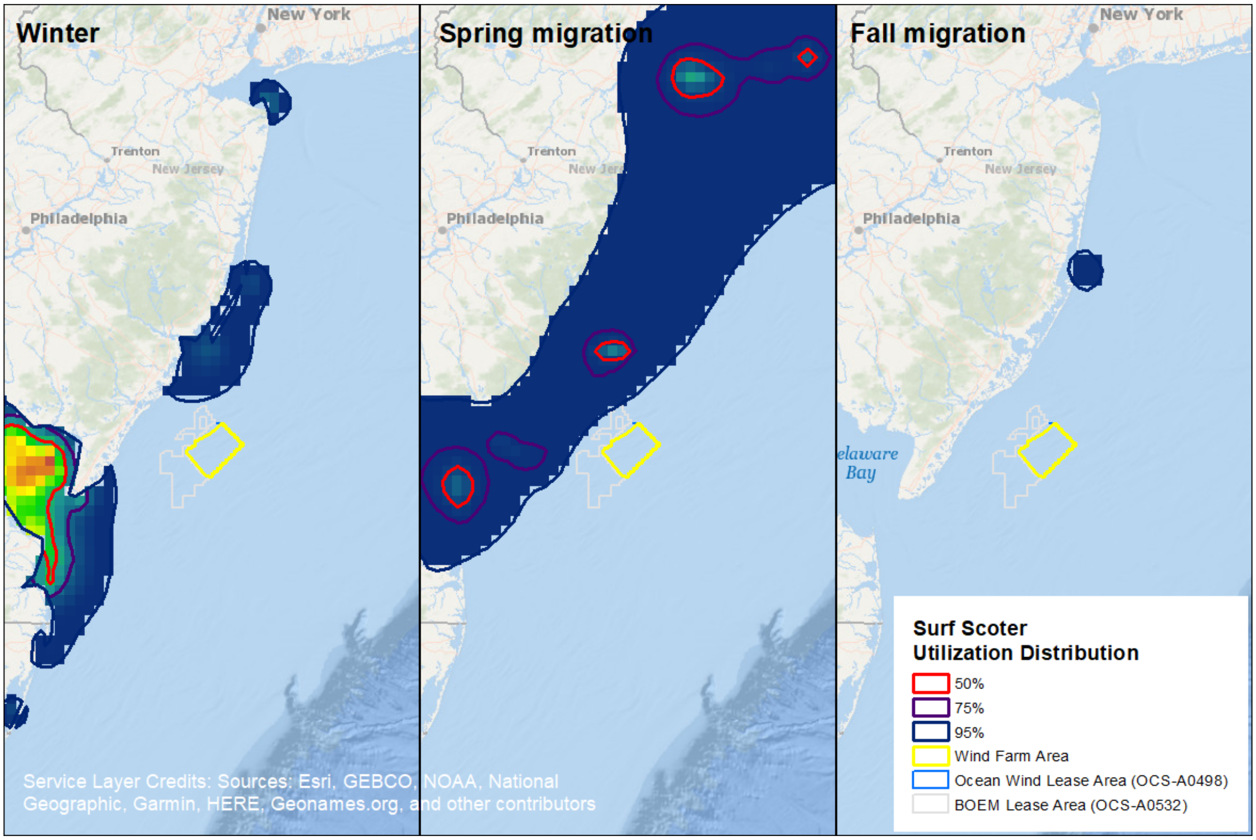


Figure 3-18: Dynamic Brownian bridge movement models for Surf Scoter (n = 78, 87, 83 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the birds stay close to shore in the winter and during fall migration but may pass near the western portion of Wind Farm Array during spring migration.

3.10.2.3 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 (generally, below 100 ft [30 m]; Figure 3-19). 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). 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 limited to displacement from offshore wind developments. Sea duck vulnerability to temporary displacement is considered to be “medium” to “high” during construction and initial operation (Table 25), because sea ducks are known to display a strong avoidance to offshore wind developments. However, since there is evidence of birds returning to wind farms once they become operational, vulnerability to permanent displacement will vary by species and is considered “low” to “medium”.

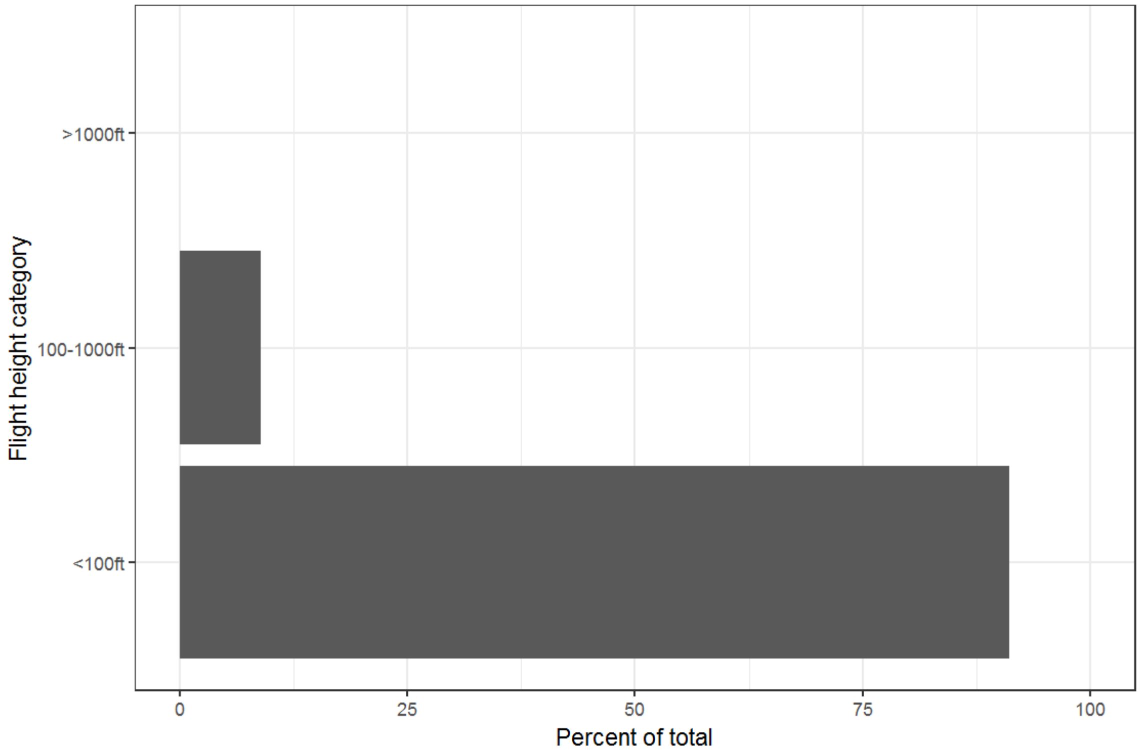


Figure 3-19: Flight heights of sea ducks (n =10,546) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

Table 3-22: Summary of sea duck vulnerability.

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

3.10.2.4 Risk Analysis

This analysis suggests that the potential impacts to sea duck populations is “minimal” to “low” because, overall, these birds have minimal to low exposure, both spatially and temporally, and low to medium vulnerability to permanent displacement due to avoidance behaviors.

3.10.3 Petrels, Shearwaters, and Storm-Petrels

3.10.3.1 Spatiotemporal Context

Petrels, shearwaters, and storm-petrels that breed in the southern hemisphere visit the northern hemisphere during the austral winter (boreal summer) in vast numbers. These species use the U.S. Atlantic OCS region so heavily that, in terms of sheer numbers, they easily swamp the locally breeding species and year-round residents at this time of year (Nisbet et al. 2013). Several of these species (e.g., Cory's Shearwater, 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, NJDEP EBS 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 Wind Farm Area (Williams et al. 2015a). The annual exposure score is minimal to low (Table 3-23).

Table 3-23: Number of species in each exposure category by season for shearwaters, petrels, and storm-petrels.

Taxonomic Group	Season	Minimal	Low	Medium	High
Petrels, Shearwaters, and Storm-Petrels	Winter	8	·	·	·
	Spring	8	·	·	·
	Summer	7	1	·	·
	Fall	7	·	1	·

3.10.3.3 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 (Figure 3-20) clearly indicates the birds fly below 100 ft (30 m) and thus are not exposed to the RSZ. Species within this group forage on vertically migrating bioluminescent prey and are instinctively attracted to artificial light sources (Imber 1975, Montevecchi 2006). This may be particularly true during periods of poor visibility, when collision risk is likely to be highest. There is little data, however, on avian behavior in the marine environment during such periods, as surveys are limited to good weather during daylight hours. 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. Based upon the above evidence, offshore wind developments pose little risk to the petrel group, and vulnerability is considered to be "minimal" during all development phases (Table 3-24).

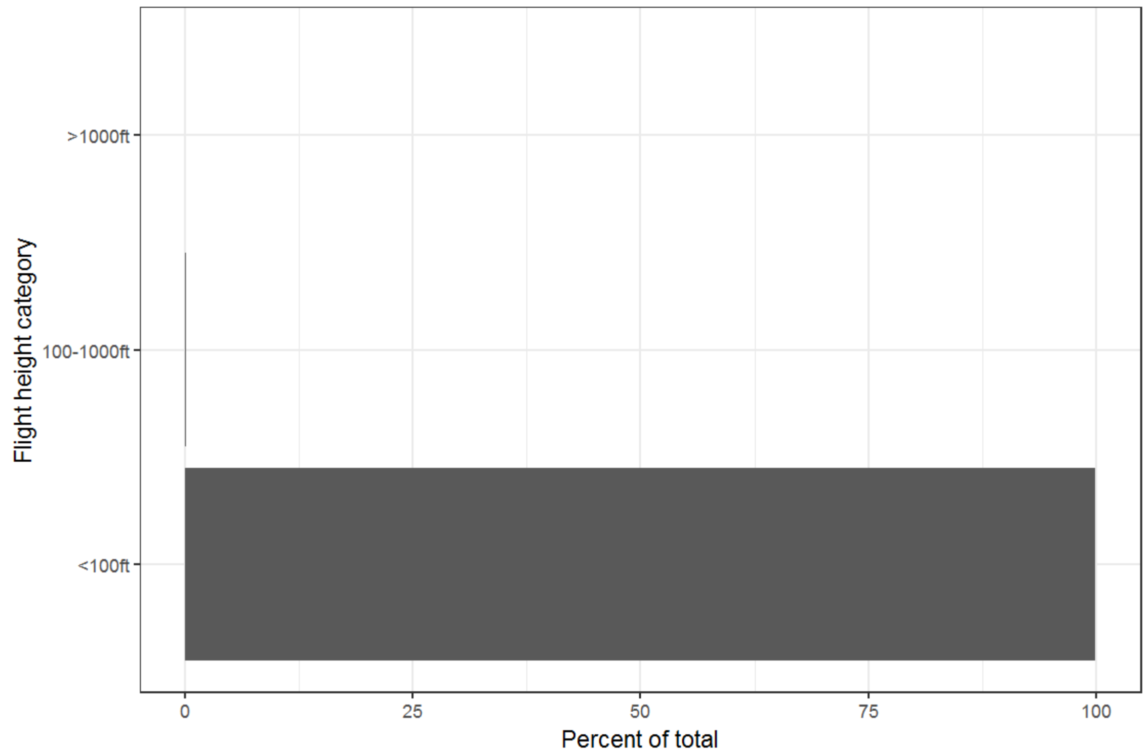


Figure 3-20: Flight heights of shearwaters and petrels (n = 2,662) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

Table 3-24: Summary of petrel, shearwater, and storm-petrel vulnerability.

Effect	Description	Evidence from literature	
		Construction	Operation
Collision	Mortality and injury caused by collision with Project structures	Minimal	Minimal
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

3.10.3.4 Risk Analysis

This analysis suggests that the potential impacts to the petrel group populations is "minimal" because, overall, these birds have minimal spatial exposure and minimal vulnerability to collision and displacement.

3.10.4 Gannets, Cormorants, and Pelicans

Only 15 Brown Pelicans were detected during the NJDEP EBS survey. Since pelicans are rare in the area, and New Jersey is at the northern extent of their range, they will not be discussed in detail. Northern Gannets and cormorants are addressed separately below, due to the potential vulnerability of Northern Gannets highlighted in European studies.

3.10.4.1 Gannets

3.10.4.1.1 Spatiotemporal Context

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

3.10.4.1.2 Exposure Assessment

Exposure was assessed using species accounts, tracking data, NJDEP EBS survey data, and MDAT models. Exposure is considered to be "low" to "medium" for gannets because the annual exposure score was low (Table 3-25) and average counts of Northern Gannets within the Wind Farm Area was substantially lower than the entire NJDEP EBS survey area (Table 3-18), but individual tracking data indicates the Wind Farm Array is within a core use area for the birds during the winter, spring, and fall (Figure 3-21).

Table 3-25: Exposure scoring by season for Northern Gannets.

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

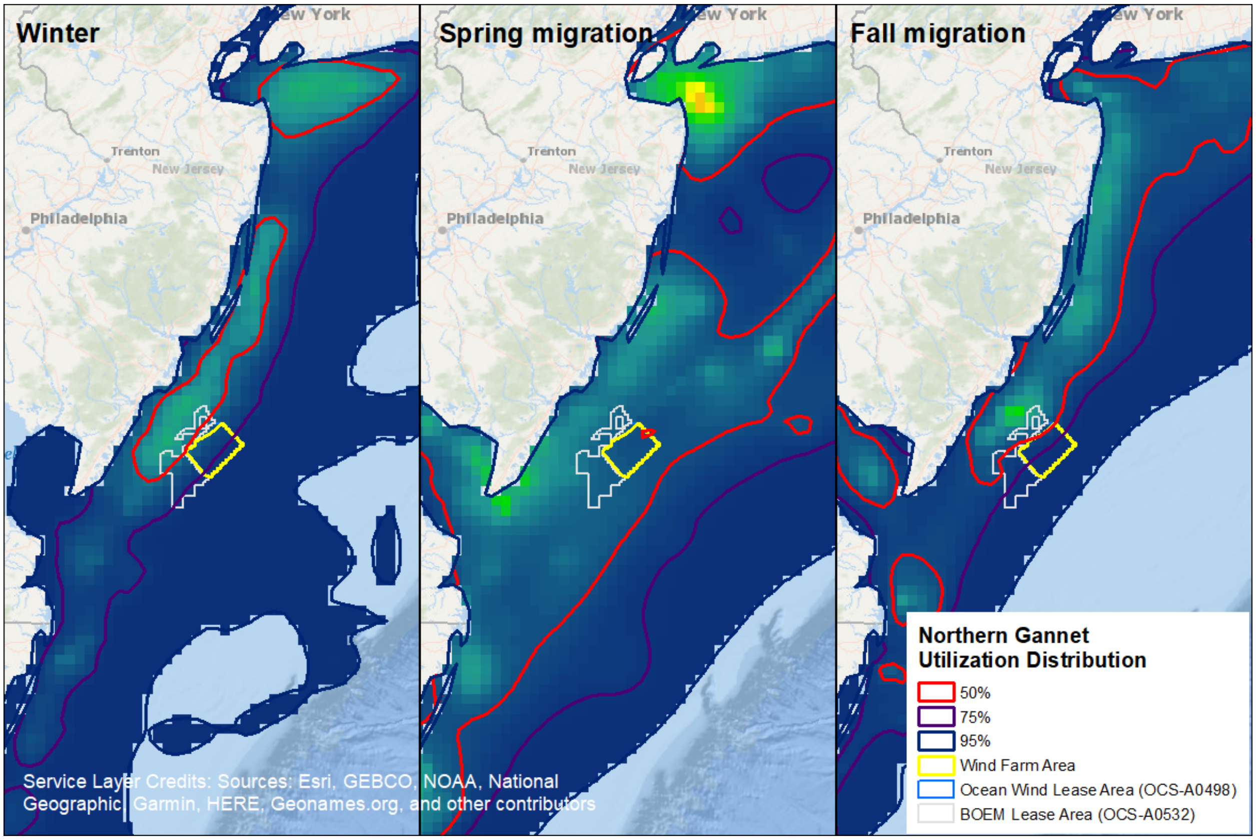


Figure 3-21: Dynamic Brownian bridge movement models for Northern Gannets (n = 34, 35, 36 [winter, spring, fall]) that were tracked with satellite transmitters. The models indicate the Wind Farm Area is used by gannets during the winter, spring, and fall.

3.10.4.1.3 Behavioral Vulnerability Assessment

The Northern Gannet is identified as being vulnerable to both displacement and collision. Gannets are considered to be vulnerable to displacement from habitat because studies indicate 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 a 99.1% (total) rate (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 Wind Farm 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. 2014b). Flight height data collected during the NJDEP EBS surveys shows the birds flying below the lowest position of the blade tip 75% of the time (Figure 3-22).

Based upon the above evidence, the risk of offshore developments to Northern Gannets is collision and displacement. The vulnerability of Northern Gannet to collision is considered to be "low" during construction and operation, however, but vulnerability to displacement is considered "medium" because Northern Gannets are known to avoid offshore wind developments (Table 30).

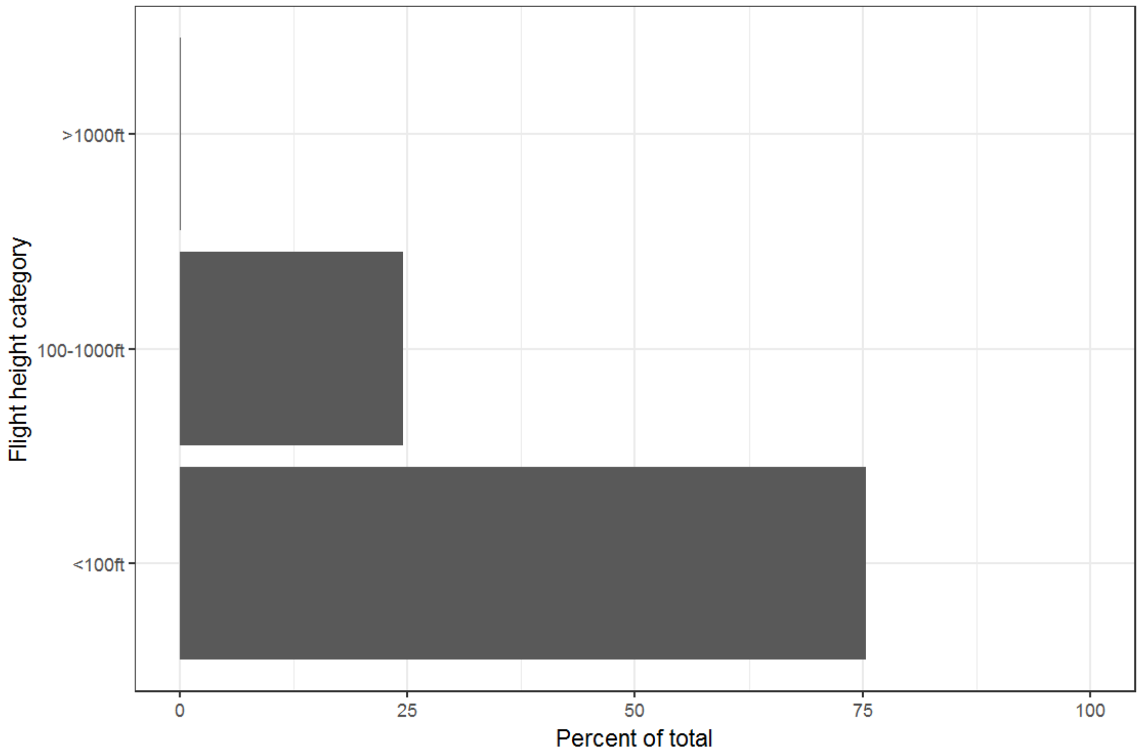


Figure 3-22: Flight heights of Northern Gannets (n = 13,109) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

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	Medium	Medium
Displacement (Permanent)	Permanent avoidance and/or displacement from habitat	Medium	Medium

3.10.4.1.4 Risk Analysis

This analysis suggests that the potential impacts to the Northern Gannet population is "low" to "medium" because, overall, these birds have low to medium exposure, both spatially and temporally, and 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. Overall, habitat loss, due to displacement from this project, is unlikely to impact population trends because of the relatively small size of the project area in relation to available foraging habitat.

3.10.4.2 Cormorants

3.10.4.2.1 Spatiotemporal Context

The Double-crested Cormorant (*Phalacrocorax auritus*) is the most likely species of cormorant to be exposed to the Wind Farm 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); only three Great Cormorants were observed during the NJDEP EBS surveys. 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).

3.10.4.2.2 Exposure Assessment

Exposure was assessed using species accounts, NJDEP EBS survey data, and MDAT models. Exposure is considered to be "minimal" to "low"_for cormorants because the annual exposure score was minimal to low (Table 3-26), and few to no cormorants were observed within the Wind Farm Area during the NJDEO EBS surveys (Table 3-18).

Table 3-26: Number of species in each exposure category by season for cormorants and pelicans.

Taxonomic Group	Season	Minimal	Low	Medium	High
Cormorants and Pelicans	Winter	2	1	·	·
	Spring	3	·	·	·
	Summer	2	1	·	·
	Fall	3	·	·	·

3.10.4.2.3 Behavioral Vulnerability Assessment

Cormorants have been documented to be attracted to wind turbines (Krijgsveld et al. 2011, Lindeboom et al. 2011), may fly through the RSZ (Figure 3-23), and rank in the middle of collision vulnerability assessments (Furness et al. 2013). Based upon the evidence, the risk to cormorants is from collision; there is little evidence to suggest they will be displaced by offshore wind farms. While there is evidence that cormorants may be vulnerable to collision, there have been no observations of collision, and thus vulnerability is considered to be "low" during construction and operation (Table 3-27).

Table 3-27: Summary of cormorant 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

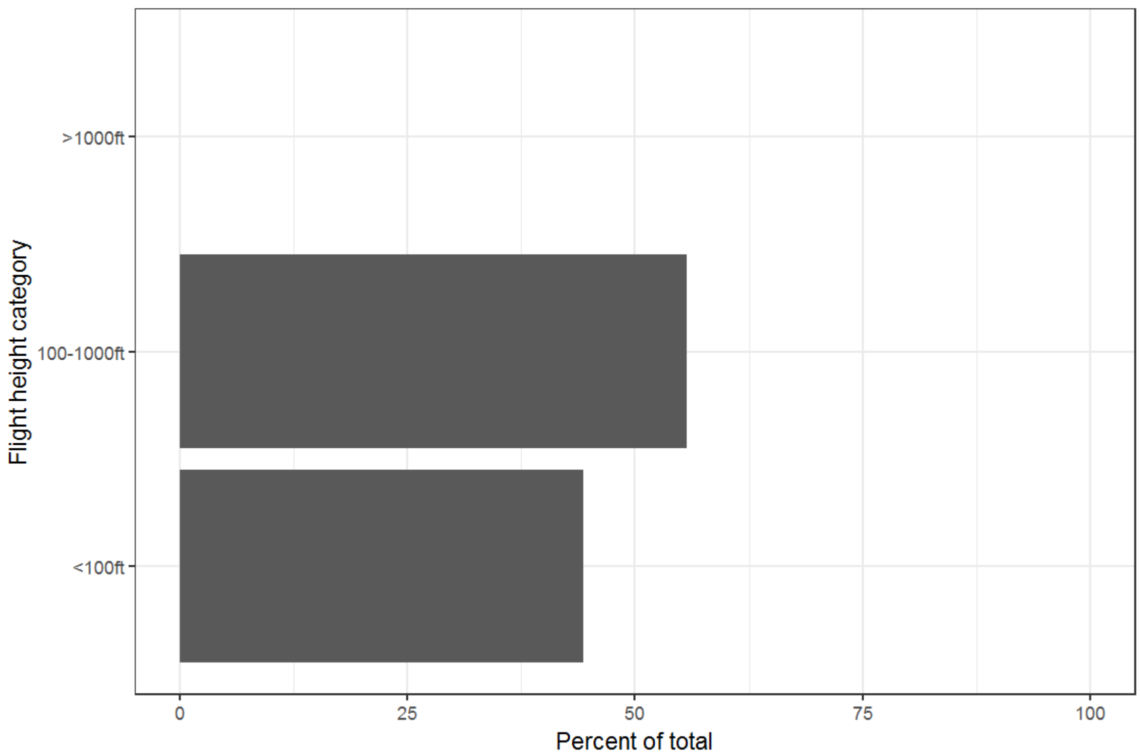


Figure 3-23: Flight heights of cormorant (n = 6,201) and pelicans (n = 15) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

3.10.4.2.4 Risk Analysis

This analysis suggests that the potential impacts to cormorant populations is “minimal” to “low” because, overall, these birds have minimal to low exposure, both spatially and temporally, and low vulnerability to collision and minimal vulnerability to displacement.

3.10.5 Gulls, Skuas, and Jaegers

3.10.5.1 Spatiotemporal Context

There are 12 species of gulls, skuas, and jaegers that could be exposed to the Project, but only nine species in this group were observed in the NJDEP surveys. There are multiple gull species that could potentially pass through the Lease and associated Wind Farm Area. The regional MDAT abundance models show that these birds have a wide distribution ranging from near shore (gulls) to offshore (jaegers). Herring Gull (*Larus argentatus*) and Great Black-backed Gull (*L. marinus*) are resident in the region year-round, and are found further offshore outside of the breeding season (Winship et al. 2018). The jaegers are all Arctic breeders that regularly migrate through the western North Atlantic region. The Parasitic Jaeger (*Stercorarius parasiticus*) is often observed closer to shore during migration than the others species (Wiley and Lee 1999) and Great Skuas (*S. skua*) may pass along the Atlantic OCS outside the breeding season.

3.10.5.2 Exposure Assessment

Exposure was assessed using species accounts, NJDEP EBS survey data, and MDAT models. Exposure is considered to be “minimal” to “medium” (Table 3-28). The average counts/sq. km for gulls within the Wind Farm Area were slightly less than those in the NJDEP EBS survey area (Table 3-18).

Table 3-28: Number of species in each exposure category by season for gulls, skuas, and jaegers.

Taxonomic Group	Season	Minimal	Low	Medium	High
Gulls	Winter	8	2	2	·
	Spring	9	2	1	·
	Summer	10	2	·	·
	Fall	10	2	·	·

3.10.5.3 Behavioral Vulnerability Assessment

Jaegers and gulls are considered to be vulnerable to collision but not displacement. Jaegers and gulls rank low in vulnerability to displacement assessments (Furness et al. 2013) and there is no evidence in the literature that they are displaced from offshore wind developments (Krijgsveld et al. 2011, Lindeboom et al. 2011). Little is known about how jaegers will respond to offshore wind turbines, but the birds generally fly below the potential RSZ (0–10 m above the sea surface) although could fly higher during kleptoparasitic chases (Wiley and Lee 1999). Gulls ranks at the top of collision vulnerability assessments because they can fly within the RSZ (Johnston et al. 2014b), 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). However, the flight height of a majority of the gulls observed during the NJDEP EBS surveys were below the lowest position of the turbine blade (Figure 3-24). Herring Gulls have been detected within the rotor swept height during 28.4% of observations and Great Black-backed Gulls during 33.1% of observations. 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).

Based upon the above evidence, the risk to jaegers and gulls is limited to collision with wind turbines and the jaegers and gull vulnerability is considered to be "medium" to "high" during construction and operation (Table 3-29), because jaegers and gulls have the potential to fly within the RSZ.

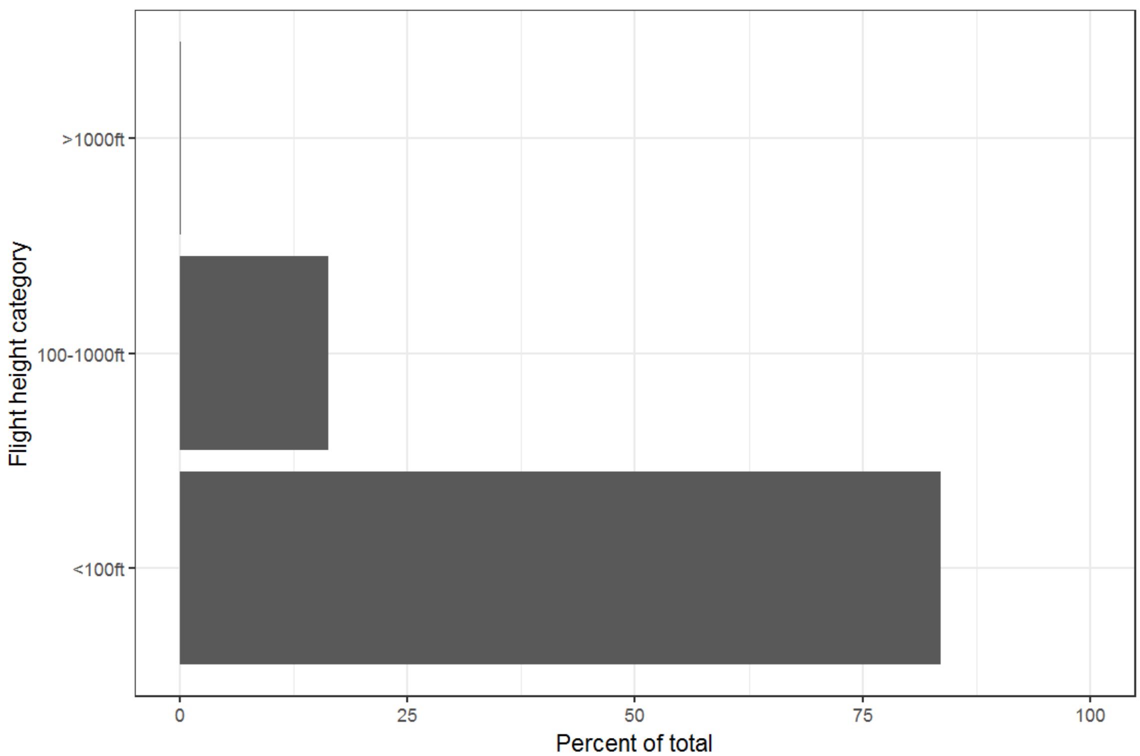


Figure 3-24: Flight heights of gulls, skuas, and jaegers (n = 8,959) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

Table 3-29: Summary of gull, skua, and jaeger vulnerability.

Effect	Description	Evidence from literature	
		Construction	Operation
Collision	Mortality and injury caused by collision with Project structures	Medium to High	Medium to High
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

3.10.5.4 Risk Analysis

This analysis suggests that potential impacts to gull populations is "low". Overall these birds have low to medium exposure and medium to high vulnerability to collision, but the overall risk was adjusted down because research suggests that they may exhibit meso-avoidance, and resident gull populations in the region are not considered of conservation concern (Good 1998, Pollet et al. 2012, Burger 2015, Nisbet et al. 2017).

3.10.6 Terns

3.10.6.1 Spatiotemporal Context

Gull-billed Tern, Foster's Tern, Common Tern, Roseate Tern, Sandwich Tern, Least Tern, and Royal Tern are present during the spring, summer, and fall in New Jersey, although only low numbers of Roseate, Sandwich, and Caspian terns were observed during the NJDEP EBS surveys. New Jersey Endangered and Nongame Species program lists the breeding status of Caspian Tern as "Special Concern", Common Tern as "Special Concern", Gull-billed Tern as "Special Concern", and Least Tern as "Endangered"[5] . Forster's Tern are also known to breed along the Mid-Atlantic coast including New Jersey (McNicholl et al. 2001), but are not listed as a species of concern. Terns generally restrict themselves to coastal waters during breeding, although they may pass through the Wind Farm Area on their migratory journeys. Roseate Terns are federally listed as well as state listed and are addressed in detail below.

3.10.6.2 Exposure Assessment

Exposure was assessed using species accounts, NJDEP EBS 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, none of the tracked birds (*n*=257) were estimates to pass through the northern or southern portions of the New Jersey Lease Area (Loring et al. 2019). Exposure is considered to be "low" to "medium" because tern annual exposure score was minimal to high (Table 3-30) and the average

[5] https://www.njfishandwildlife.com/ensp/pdf/spclspp.pdf

counts within the Wind Farm Area were generally lower than the NJDEP EBS survey area (Table 3-18). All species received a "minimal" annual score except for Common Tern that received a "medium" score (the seasonal scores greater than minimal in Table 3-30 are for Common Tern).

Table 3-30: Number of species in each exposure category by season for terns.

Taxonomic Group	Season	Minimal	Low	Medium	High
Terns	Winter	6	·	·	·
	Spring	5	·	·	1
	Summer	5	1	·	·
	Fall	5	1	·	·

3.10.6.3 Behavioral Vulnerability Assessment

Terns are considered to be vulnerable to collisions but not displacement. Terns rank in the middle of collision vulnerability assessments (Garthe and Hüppop 2004, Furness et al. 2013), fly 2.8–12.7% at rotor swept height, have a 30–69.5% macro avoidance rate (Cook et al. 2012), and have been demonstrated to avoid rotating turbines (Vlietstra 2007). Tern flight heights recorded in the NJDEP EBS surveys indicate terns are almost exclusively flying below the potential RSZ (Figure 3-25). A recent nanotag study estimated that Common Terns primarily flew below the RSZ (<82 ft [25 m]) and that the frequency of Common Terns flying offshore within the RSZ (82–820 ft [25–250 m]) ranged from 0.9–9.8 % (Loring et al. 2019). While the nanotag flight height estimated birds flying below 164 ft (50 m), radar and observational studies provide evidence that terns in some instances can initiate migration at higher altitudes, 3,000–10,000 ft (1,000–3,000 m; Loring et al. 2019). The probability of tern mortality is predicted to decline as the distance from the colony increases (Cranmer et al. 2017). Common Terns and Roseate Terns tended to avoid the airspace around a 660 kW turbine (Massachusetts Maritime Academy in the U.S.) when the turbine was rotating and usually avoided the RSZ (Vlietstra 2007). This finding is corroborated by mortality monitoring of small to medium turbines (200 and 600 kW) in Europe, where mortality rates rapidly declined with distance from the colony (Everaert et al. 2007). Most observed tern mortalities in Europe have occurred at turbines <98 ft (30 m) from nests (Burger et al. 2011).

Based upon the above evidence, the risk to terns is limited to collision with wind turbines and the tern vulnerability is considered to be "low" during construction and operation (Table 3-31), because terns generally fly below the RSZ and potentially avoid rotating turbines.

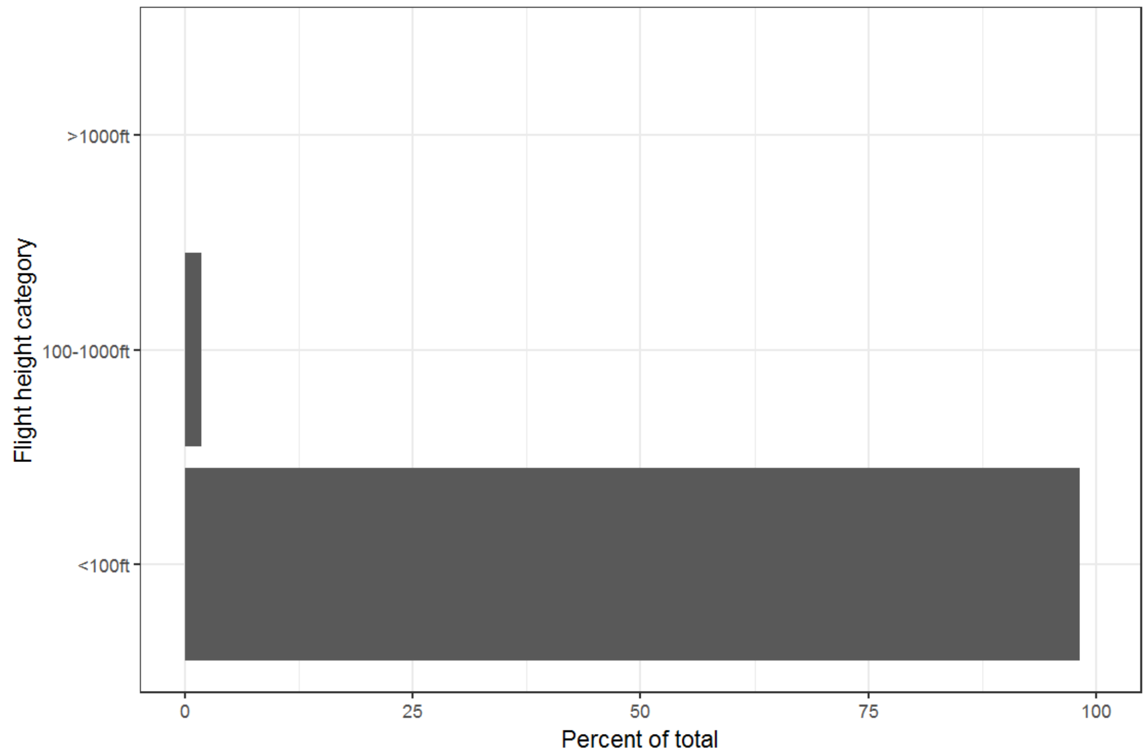


Figure 3-25: Flight heights of terns (n = 2,708) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

Table 3-31: Summary of tern vulnerability.

Effect	Description	Evidence of risk 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

3.10.6.4 Risk Analysis

This analysis suggests that the risk of potential effects to tern populations "low" because, because these birds have low to medium exposure, both spatially and temporally, and low vulnerability to collision.

3.10.6.5 Endangered Tern Species

3.10.6.5.1 Roseate Tern

3.10.6.5.2 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 ([USFWS] 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 ([USFWS] U.S. Fish and Wildlife Service 2010). Over 90 % of remaining individuals breed at just three colony locations in Massachusetts (Bird, Ram, and Penikese Islands 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). There are no breeding colonies in New Jersey.

Roseate Terns generally migrate through the mid-Atlantic 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 10 km of the colony, though they may travel 30–50 km from the colony while provisioning chicks ([USFWS] 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 ([USFWS] U.S. Fish and Wildlife Service 2010). Foraging activity during the staging period is known to occur up to 16 km from the coast, though most foraging activity occurs much closer to shore (Burger et al. 2011).

Roseate Tern migration routes are poorly understood, but they appear to migrate primarily well offshore (Nisbet 1984, [USFWS] U.S. Fish and Wildlife Service 2010, Burger et al. 2011, Mostello et al. 2014, Nisbet et al. 2014). The NJDEP EBS surveys had no observations of Roseate Terns, but nine observations (15 individuals) of Roseate Terns were reported in the Northwest Atlantic Seabird Catalog near the NJDEP EBS study area, all during May and June (Figure 3-26).

During migration periods, very few Roseate Terns are predicted to occur within the Wind Farm Area according to the MDAT models (Winship et al. 2018) and supported by the NJDEP EBS and Northwest Atlantic Seabird Catalog data. Overall, the regional MDAT models show that the birds are generally concentrated closer to shore during spring migration and have low exposure in New Jersey waters during the summer and fall. However, Roseate Terns may occur at the Wind Farm Area ephemerally during spring and fall migration (Burger et al. 2011, [BOEM] Bureau of Ocean Energy Management 2014).

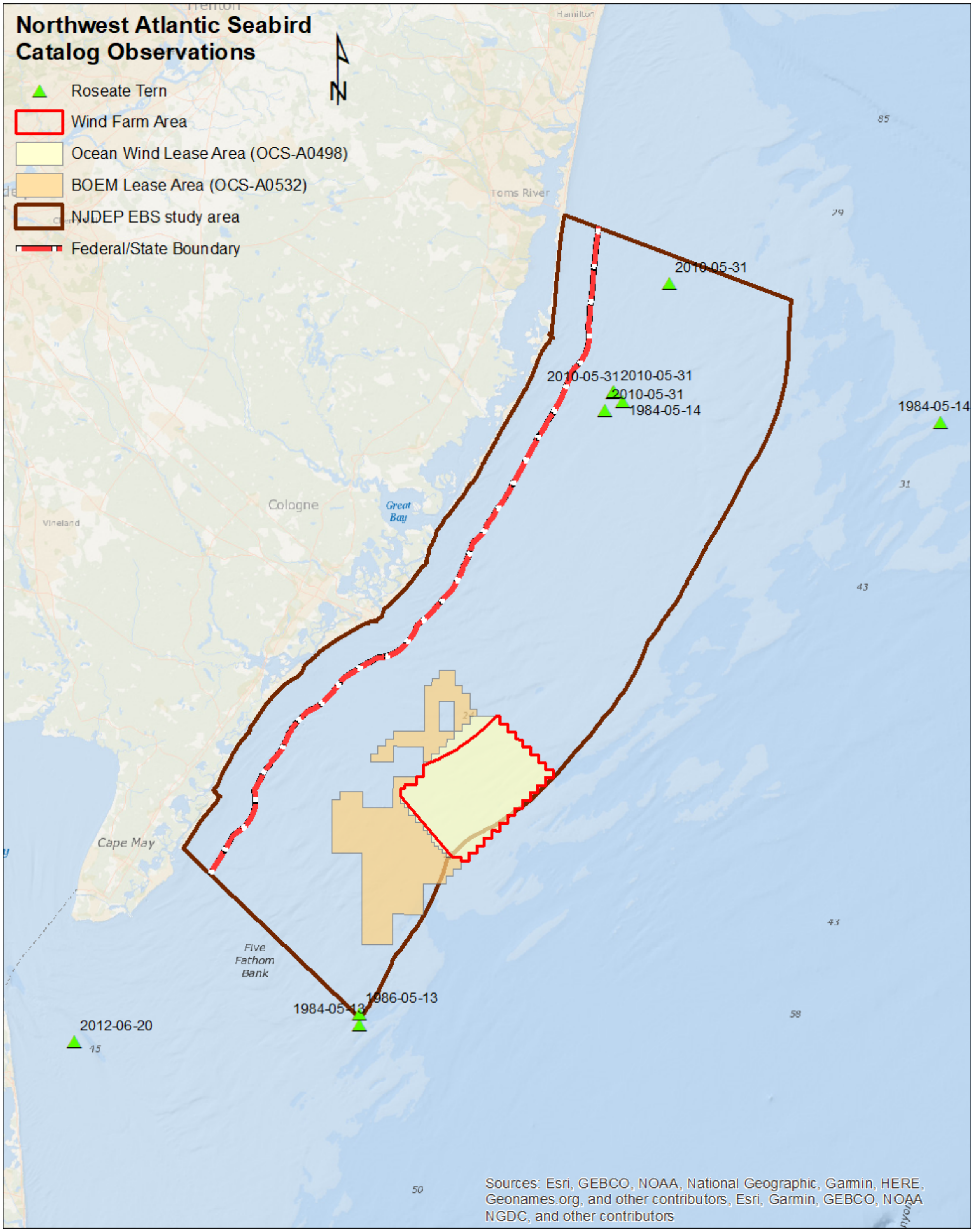


Figure 3-26: Roseate Tern observations from the Northwest Atlantic Seabird Catalog.

3.10.6.5.3 Exposure

Exposure was assessed using species accounts, tracking studies, NJDEP EBS survey data, and MDAT models. The available information on foraging habits, and travel activity between foraging and roosting/breeding sites, all indicate minimal exposure of Roseate Terns to the Project during breeding or staging. Roseate Terns have not been confirmed in the Wind Farm Area and an analysis of unknown tern observations in the Northwest Atlantic Seabird Catalog from within the NJDEP EBS study area in the Wind Farm Area indicate few, if any of the unknowns were likely Roseate Tern[6]. 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, none of the tracked birds (*n*=145) were estimates to pass through the northern or southern portions of the New Jersey Lease Area (Loring et al. 2019). Thus, they display limited spatial and temporal exposure, and the expected exposure of Roseate Terns is "minimal" and is limited to migration.

3.10.6.5.4 Vulnerability

Terns rank in the middle of collision vulnerability assessments (Furness et al. 2013), fly less than 13 % of time at rotor swept height (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 the 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, [MMS] Minerals Management Service 2008a).

Tern flight height during foraging is typically low, and European studies of related tern species at much smaller turbines have suggested that approximately 4–10 % of birds may fly at rotor height (66–492 ft [20–150 m asl]) during local flights (Jongbloed 2016). Estimates of tern flight height from surveys in the Nantucket Sound area suggested that 95% of Common/Roseate Terns flew below the RSZ ([MMS] Minerals Management Service 2008b). Common Terns are known to migrate over land at considerable heights (3,000—10,000 ft [1,000–3,000 m]), though strong

---

[6] 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 we cut down the to NJDEP EBS study area.
Step 2: The proportion of Roseate Terns to all identified terns was calculated (0.003).
Step 3: The proportions from step 2 were applied to the count of 367 unidentified terns in the dataset, assuming the same proportions in unknown data apply.
Result: This returns an estimate of 0.93 (~1) additional Roseate Tern that could have occurred in the NJDEP EBS study area.

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 meters; Perkins et al. 2004, [MMS] Minerals Management Service 2008). A recent nanotag study estimated that terns primarily flew below the RSZ (<82 ft [25 m]) and that Roseate Terns flying offshore only occasionally flew within the lower portion of the RSZ (federal waters, 6.4 %; Wind Energy Areas, 0%; Loring et al. 2019).

Based upon the above evidence, the risk to Roseate Terns is limited to collision with wind turbines and the Roseate Tern vulnerability is considered to be "low" during construction and operation, because terns generally fly below the RSZ and potentially avoid rotating turbines.

3.10.6.5.5 Risk

This analysis suggests that the potential impacts to individual Roseate Terns is "minimal", because these birds have minimal exposure, both spatially and temporally, and low vulnerability to collision.

3.10.7 Auks

3.10.7.1 Spatiotemporal Context

The auk species present in the region are generally northern or Arctic-breeders that winter along the U.S. Atlantic OCS. The annual abundance and distribution of auks along the eastern seaboard in winter is erratic, however, depending 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 V).

3.10.7.2 Exposure Assessment

Exposure was assessed using species accounts, NJDEP EBS survey data, and MDAT models. Exposure is considered to be "minimal" to "low" because auk annual exposure score ranged from minimal to low, few birds were observed during the NJDEP EBS surveys, and the average counts were similar between the Wind Farm Area and the NJDEP EBS survey area (Table 3-18).

Table 3-32: Number of species in each exposure category by season for auks.

Taxonomic Group	Season	Minimal	Low	Medium	High
Auks	Winter	4	2	·	·
	Spring	4	2	·	·
	Summer	6	·	·	·
	Fall	6	·	·	·

3.10.7.3 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% (Orsted 2018). Auks have a 45–68% macro-avoidance rate and a 99.2% total avoidance rate (Cook et al. 2012). At considerably smaller turbines, 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 recorded during the NJDEP EBS surveys indicate the birds are flying below 100 ft (30 m) the vast majority of the time (Figure 3-27).

Based upon the above evidence, the risk to auks is limited to displacement from wind developments, and auk vulnerability is considered to be "medium"_during construction and operation (Table 3-33)because auks are known to display a strong avoidance to offshore wind developments.

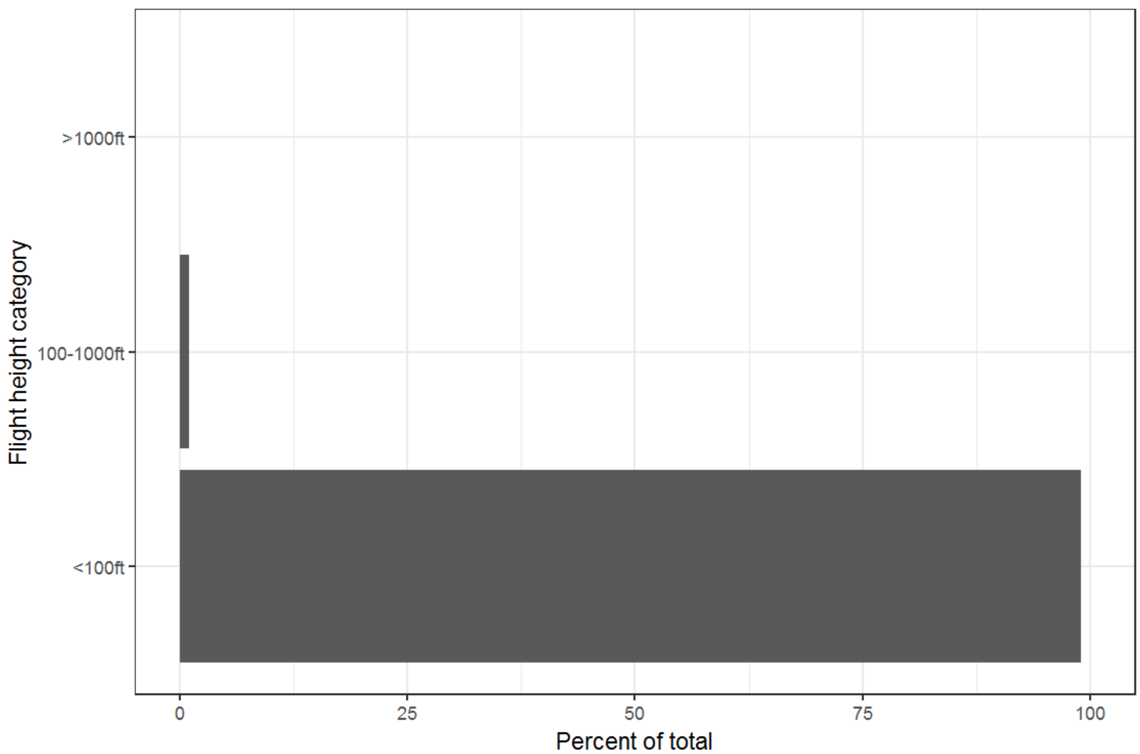


Figure 3-27: Flight heights of auks (n = 407) derived from NJDEP EBS data, showing the number of birds of each species or grouping (and the proportion of the total for that survey) in each flight band.

Table 3-33: Summary of auk vulnerability.

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

3.10.7.4 Risk Analysis

This analysis suggests that potential impacts to auk populations is "minimal" to "low" because, the birds have Minimal to Low exposure and medium vulnerability to permanent displacement due to avoidance behaviors.

3.11 Mitigation

In general, exposure to bird populations has been avoided by siting the Project offshore in a wind energy area designated by BOEM. The proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts for the Project are presented in COP, Volume II, Table 1.1-2.

3.12 Summary and Conclusions

This offshore avian assessment considered the potential impacts on birds during construction and operation within the Project's Wind Farm Area. Any exposure of birds to construction activities is considered temporary. Overall, construction and operation activities occurring in the Wind Farm Area are not expected to affect the populations of coastal or marine birds (Table 3-34).

The Wind Farm 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 Wind Farm 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 Wind Farm Area. However, considerable uncertainty exists about what the proportion of migrating Peregrine Falcon 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. Some migratory songbirds, particularly Blackpoll Warbler, may also be exposed to the Wind Farm Area during fall migration, but population level impacts are unlikely because exposure of the population to the Wind Farm Area is expected to be minimal to low and limited to migration.

Of the marine birds, loons and Northern Gannet were the only species that received a medium overall exposure assessment. Satellite tracking data indicates the Red-throated Loons will be exposed primarily during spring migration and the NJDEP EBS surveys and MDAT models also indicate higher use during the spring. The NJ DEP EBS surveys and MDAT models indicate Common Loon will be exposed during the spring, fall, and winter. Individual tracking data of Northern Gannet indicate use of the Wind Farm Area during the winter, spring, and fall, but the survey and MDAT models showed gannet use typically closer to shore. Loons and Northern Gannet are documented to avoid wind farms, but displacement from the Wind Farm Area is unlikely to affect population trends because of the relatively small size of the project area in relation to available foraging habitat.

Federally-listed species were also assessed, included 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 Wind Farm 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 minimal because shorebirds fly substantially above the RSZ during migrations. Roseate Terns exposure is considered to be minimal because Roseate Terns are rarely observed offshore in New Jersey and would only potentially pass through the Wind Farm Area during migration.

Table 3-34: Overall summary of the assessment of potential effects on birds.

Group	Exposure	Vulnerability to			Overall Risk of Impacts (adjusted up or down)***
		Collision	Displacement		
			Temporary	Permanent	
Shorebirds	minimal	.	.	.	.
Piping Plover	minimal	minimal - low	minimal	.	**minimal**
Red Knot	low - medium	low	minimal	.	**low**
Wading Birds	minimal	.	.	.	.
Raptors (falcons)*	low - medium	low - medium	minimal - low	minimal - low	**low - medium**
Eagles	minimal	minimal	.	.	**minimal**
Songbirds	minimal - low	low - medium	minimal	minimal	**low**
Coastal Waterbirds	minimal	.	.	.	.
Marine Birds					
Loons	low - medium	minimal	medium - high	medium - high	**low - medium**
Sea ducks	minimal - low	minimal	medium - high	low - medium	**minimal - low**
Petrels, Shearwaters, Storm-Petrels	minimal - low	minimal	minimal	minimal	**minimal**
Gannets, Cormorants, Pelicans**					
Northern Gannet	low - medium	low	medium	medium	**low - medium**
Double-crested Cormorant	minimal - low	low	minimal	minimal	**minimal - low**
Gulls, Skuas, Jaegers	minimal - medium	medium - high	minimal	minimal	low
Terns	low - medium	low	minimal	minimal	**low**
Roseate Tern	minimal	low	.	.	**minimal**
Auks	minimal - low	minimal	medium	medium	**minimal - low**

*Almost exclusively Peregrine Falcon and Merlin. Non-falcon raptors have limited use of the offshore environment.
**Brown Pelicans were not considered
*** A final risk level was determined using expert opinion that incorporated other population information into the evaluation. If a final risk assessment was adjusted, justification is provided in the species group risk text and then highlighted in either green (down) or orange (up) in this final summary table.

4 Part IV: Birds – Onshore

This section discusses the birds that may be impacted by construction and operation of the Project's onshore facilities (BL England and Oyster Creek), which include cable landfall sites, onshore export cables, onshore AC substations, and onshore grid connection cables.

Impacts to birds are regulated under three federal laws: the ESA, the Migratory Bird Treaty Act (MBTA), and the Bald and Golden Eagle Protection Act (Eagle Act). In addition, the National Environmental Policy Act (NEPA) requires that federal agencies evaluate environmental consequences of major federal actions. This assessment was developed to meet COP requirements, provide information for NEPA review, and support agency consultations.

The assessment follows requirements under 30 CFR 585.626(a)(3), which state that the COP should present information on the "...the presence/absence and distribution of biologically sensitive resources in the vicinity of your proposed activities and structures, including... birds. Include information on temporal and spatial abundance and seasonality of use for each species."

In addition, the assessment follows the *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* ([BOEM] Bureau of Ocean Energy Management 2016b). Under 'Attachment A: Best Management Practices', BOEM states the following with regard to avian resources: "The lessee shall evaluate avian use in the project area and design the project to minimize or mitigate the potential for bird strikes and habitat loss. The amount and extent of ecological baseline data required will be determined on a project-to-project basis."

4.1 Assessment Methods and Data Sources

4.1.1 Impact-producing Factors

The potential impacts of the onshore components of the Project to birds were evaluated by considering the exposure of birds to project hazards. Hazards (i.e., impact producing factors) are defined as the changes to the environment caused by project activities during each development phase that have the potential to adversely affect wildlife ([BOEM] Bureau of Ocean Energy Management 2012, Goodale and Milman 2016). For the onshore components of the Project, the primary hazard is habitat conversion during construction, causing an indirect effect of reduced foraging and breeding habitat. Other potential hazards are temporary disturbance from construction and operation activities, causing displacement from breeding and foraging habitat; and the presence of construction equipment, which in rare instances could cause individual mortality. As hazards such as seabed disturbance, noise, and vessel traffic are expected to be temporary and highly localized, the following sections will focus primarily on habitat conversion. During operation, maintenance activities have the potential to cause temporary habitat conversion (e.g., ground disturbance), but the disturbance would generally be similar or less than the construction of the onshore export cables, impact smaller areas, and is expected to be of shorter duration. Thus, operation is not expected to have any specific long-term hazards (Table 4-1).

Table 4-1: Potential effects of the coastal onshore Project components on birds and the Project phases for which they are assessed. Effects of decommissioning are expected to be less than or equal to construction activities.

Impact-producing Factor(s)	Effect	Project Component	Description	Construction & Decommissioning	Operation
Land disturbances	Habitat Conversion (Temporary)	Coastal and Upland	Temporary disturbance of upland habitat by Project activities	✓	✓
Land disturbances	Habitat Conversion (Permanent)	Coastal and Upland	Permanent disturbance of upland habitat by Project activities	✓	✓
Construction equipment and activities	Disturbance (Temporary)	Coastal and Upland	Noise and vibration producing activities	✓	✓
Construction equipment	Mortality	Coastal and Upland	Contact with equipment	✓	✓

4.1.2 Assessment Methods

Temporary and permanent impacts to these avian species from activities related to the proposed Project were assessed. The terrestrial areas impacted by the Project occur along onshore export cables routes, and at cable landfall sites, onshore AC substations, and onshore grid connection cables. Since the Project will use trenchless technology methods such as horizontal direction drilling (HDD) to go under any barrier beaches if practicable, barrier beaches are not considered an area that will be affected by Project activities and is not assessed. Species of conservation concern (i.e., federally listed) are discussed in section 4.6.

The impact assessment was conducted by evaluating the habitat that would be modified by onshore project components and the birds likely to occur in the habitat. This approach is different from the bat section (Part II: Bats) or the offshore bird section (Part III: Birds – Offshore), that assess exposure and behavioral vulnerability. A different approach was taken because a) hazards generally only cause indirect effects (i.e., habitat conversion and disturbance), b) the area disturbed is limited, and c) vulnerability to habitat conversion is generally similar across the species.

Habitat was identified for each Onshore Export Cable Route option with Google Earth (satellite and street view) and through an assessment conducted by HDR. Then, using the best available datasets, the species likely to occur in each habitat type were identified. The final risk assessment was conducted using a weight-of-evidence approach by considering the severity of habitat conversion and duration of hazard. The following risk categories were used:

- Minimal: Development primarily co-located in disturbed areas with little to no permanent habitat conversion; hazard(s) temporary.

- Low: Development primarily co-located in disturbed areas with some permanent habitat conversion; hazard(s) temporary.
- Medium: Development in non-disturbed areas with some permanent habitat conversion; hazard(s) temporary and/or permanent.
- High: Development in non-disturbed areas with permanent habitat conversion; multiple temporary and permanent hazards.

4.1.3 Data Sources

Data on possible bird species present was compiled from breeding bird atlas results, survey results, and eBird citizen science data (Sullivan et al. 2009) from within and nearby each study corridor. The primary datasets used to assess exposure included: the USFWS IPaC database ([USFWS] U.S. Fish and Wildlife 2018); Assessment of Pinelands Birdlife (Brady 1980); Breeding Bird Survey (Sauer et al. 2017); Galloway Township Resource Inventory (Cuviello 2011); and eBird (EBird 2018).

4.2 Overview of Onshore Project Areas

There are two proposed study corridors for the Project: The Oyster Creek Study Corridor, located in Ocean County, NJ and the BL England Study Corridor located in Atlantic County and Cape May County, NJ . Each onshore project area includes multiple potential Onshore Export Cable Routes that contain a diverse set of habitats, including coastal wetlands, forested wetlands, forested uplands, forested lowlands, barrier beaches, and bay island habitats. A broad range of avian species utilize these habitats during breeding, wintering, and migration periods. Avian groups found in these habitats include songbirds, shorebirds, raptors, waterfowl, waders, and seabirds. Below each study corridor is assessed in detail.

Descriptions of the potential Onshore Export Cable Routes for each landfall site are listed below along with the New Jersey Wildlife Action Plan (NJWAP) Landscape Regions and Conservation Focal Areas (CFAs) that they are within or close to (New Jersey Division of Fish and Wildlife 2018). Conservation Focal Areas are defined in the NJWAP as: “portions of the landscape regions that are of particular conservation interest because they have important habitats and species assemblages, and represent the best opportunities for protecting, restoring, and sustaining the state’s wildlife diversity. They also include important opportunities for habitat connectivity, a critical factor in increasing resilience in a changing landscape”. Descriptions of the Landscape Regions, CFAs, and associated focal species follow.

4.3 Description of Conservation Focal Areas associated with the onshore cable routes

Here, the conservation focal area habitats are described, and avian groups associated with onshore cable route options, including onshore substations and onshore grid connection Points. Details on conservation focal areas and the list of all associated Species of Greatest Conservation Need (SGCN) can be found in the most recent New Jersey Wildlife Action Plan (New Jersey Division of Fish and Wildlife 2018). Any focal SGCN in relevant CFAs that are “important to fulfilling the life history requirements" of that species are listed (see Appendix C of the NJWAP for details). Focal SGCN, which represent 107 of 656 identified SGCN species, are a list of priority species of greatest conservation need and the feasibility to address threats to these species.

4.3.1 Atlantic Coastal Landscape

This landscape region is composed of barrier islands, beaches, tidal salt marshes, rivers, shallow bays and lagoons. A high level of development occurs within this landscape region leading to an ecologically impaired environment.

Focal SGCN: American Oystercatcher, American Woodcock, Black Rail, Black Skimmer, Blue-winged Warbler, Common Tern, Forster's Tern, Least Tern, Little Blue Heron, Northern Harrier, Peregrine Falcon, Pied-billed Grebe, Piping Plover, Red Knot, Red-headed Woodpecker, Ruddy Turnstone, Scarlet Tanager, Snowy Egret, Tricolored Heron, and Wood Thrush.

- Cape May Peninsula CFA
    - This CFA is largely composed of coastal marsh habitat with some open water associated with back bays. Coastal wetland (70%) and tidal water (22%) make up 92% of this CFA. Habitat in this CFA is important for beach nesting birds, migratory shorebirds, and long-legged wading birds. This area is well known for the large numbers of migratory birds including waterbirds, passerines, and raptors resulting from its geographical positioning on the coast.
- Great Barnegat Bay CFA
    - This CFA includes large areas of marsh and bay. Tidal water (43%), coastal wetland (35%), deciduous wetland forest (6%), and wetland forest mixture (6%) make up 90% of this CFA. This habitat is important as nesting areas for osprey, terns, and gulls as well as a migratory stopover sites for passerines.

4.3.2 Delaware Bay Landscape

This landscape region includes large areas of wooded forest along with riparian systems that feed into Delaware Bay, where important salt marsh and sand beaches are critical foraging and breeding habitat for migratory birds.

Focal SGCN: American Oystercatcher, American Woodcock, Black Rail, Black Skimmer, Blue-winged Warbler, Bobolink, Common Tern, Eastern Meadowlark, Forster's Tern, Grasshopper Sparrow, Kentucky Warbler, Least Tern, Little Blue Heron, Northern Bobwhite, Northern Harrier, Peregrine Falcon, Pied-billed Grebe, Prothonotary Warbler, Red Knot, Red-headed Woodpecker, Ruddy Turnstone, Scarlet Tanager, Snowy Egret, Tricolored Heron, Vesper Sparrow, Wood Thrush.

- Cape May Peninsula Mosaic CFA
    - This CFA is highly fragmented landscape consisting largely of forest and some field and marsh. The western periphery borders Delaware Bay and as such is greatly

important to shorebirds, while the whole of the CFA is important to southbound migrants. Wetland forest mixture (32%), coastal wetland (15%), upland forest mixture (13%), deciduous wetland forest (10%), coniferous wetland forest (9%), and shrub wetland (6%) make up 85% of this CFA.

- Lower Great Egg Harbor Watershed CFA
    - This CFA consists largely of tidal rivers and forests with a high level of fragmentation inland of these wetlands. This CFA is important for Bald Eagles, Ospreys, and nesting and migrating landbirds and waterbirds. This CFA is a patchwork of habitat types including upland forest mixture (25%), coastal wetland (22%), wetland forest mixture (13%), deciduous upland forest (11%), tidal water (6%), coniferous upland forest (6%), coniferous wetland forest (6%), and deciduous wetland forest (5%) making up 94% of the landscape.

4.3.3 Pinelands Landscape

This landscape region is defined by the pine barren habitat that predominates on the landscape. Cedar swamps and other wetland types also are found here and add to the richness of the landscape.

Focal SGCN: American Woodcock, Blue-winged Warbler, Bobolink, Cerulean Warbler, Eastern Meadowlark, Grasshopper Sparrow, Kentucky Warbler, Little Blue Heron, Northern Bobwhite, Pied-billed Grebe, Prothonotary Warbler, Red-headed Woodpecker, Scarlet Tanager, Snowy Egret, Vesper Sparrow, Wood Thrush.

- Core Pinelands Area CFA
    - This CFA encompasses the Pinelands Protection Area with large areas of pine/oak forest and forested wetlands. The pinelands are an important habitat for Pine Barren specialists and important breeding habitat for neotropical migrant birds. This CFA is made up of coniferous upland forest (38%), coniferous wetland forest (16%), upland forest mixture (14%), wetland forest mixture (13%), and shrub upland (5%) totaling 86% of the landscape.

4.4 BL England Study Corridor

4.4.1 BL England Habitat

Coastal habitats within the BL England Study Corridor include areas of saline low marsh and high marsh, marsh border, intertidal flat, *Phragmites australis* community, and beach community dominated by beach grass and herbs. Forested areas of the study corridor consist of forested wetlands including cedar swamps and hardwood swamps, and lowland and upland forests. Lowland forests are characterized by southern white cedar, and other broadleaf species, with edge habitat consisting of gray birch, willow oak, sweet gum, and several other water tolerant species. Upland forests are characterized by pines, especially the pitch pine, often associated with shortleaf pine and oaks. Upland areas also include successional fields dominated by trees and shrubs with herbs and grasses. Urban development is interspersed within the mixed forest communities and dominates the northwestern portion of the study corridor. Terrestrial plant species found in the communities present in the study corridor are presented in Table 4-2. Portions of the study corridor include Pinelands National Reserve and Lester G. MacNamara (Tuckahoe) Wildlife Management Area lands. The Pinelands National Reserve, protected from development, extends into the center of the study corridor and is rich in ecological diversity with over 1,000 species of plants and animals (National Park Service 2018). Habitats within the Pinelands NR are unique to the area, consisting of forested uplands, forested swamps, pygmy pine plains, savannahs, and wetlands ([PPA] Pinelands Preservation Alliance 2018). The Tuckahoe Wildlife Management Area encompasses the southern portion of the study corridor, but no facilities have been developed at the site. The site was once dominated by common reed (*Phragmites australis*) but was recently restored to 90% smooth cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*S. patens*), which are native species commonly found in low marsh communities. Coastal wetland sections of the BL England Study Corridor also fall within State-level Important Bird Areas, while some upland sections fall within Continental-level Important Bird Areas, as identified by the National Audubon Society (Figure 4-1).

Table 4-2: Common vegetation present within the BL England Study Corridor

Common Name	Scientific Name
Atlantic white cedar[1]	*Chamaecyparis thyoides*
bayberry[4,6,7]	*Myrica pensylvanica*
beach grass[5]	*Ammophila breviligulata*
black cherry[6]	*Prunus serotina*
black gum[1]	*Nyssa sylvatica*
black oak[2]	*Quercus velutina*
blackjack oak[2]	*Quercus. marilandica*
broomsedge bluestem[6]	*Andropogon virginicus*
camphorweed[7]	*Heterotheca subaxillaris*
chickweed[6]	*Stellaria spp.*
coastal panicgrass[7]	*Panicum amarum*
common cocklebur[5]	*Xanthium strumarium*
common reed[4]	*Phragmites australis*
common wormwood[5]	*Artemisia vulgaris*
dandelion[6]	*Taraxacum officinale*
eastern red cedar[4,6]	*Juniperus virginiana*
glasswort[3]	*Salicornia virginica*
gray birch[1]	*Betula populifolia*
groundsel tree[4]	*Baccharis halimifolia*
Jesuit's bark[4]	*Iva frutescens*
marsh orach[3]	*Atriplex patula*
mullein[6]	*Verbascum thapsus*
pitch pine[1,2]	Pinus rigida

Common Name	Scientific Name
poison ivy[4,7]	*Toxicodendron radicans*
post oak[2]	*Quercus stellata*
Queen Anne's lace[6]	*Daucus carota*
rugosa rose[7]	*Rosa rugosa*
saltmeadow cordgrass[4]	*Spartina patens*
saltwort[5]	*Salsola kali*
sandbur[5]	*Cenchrus spp*
scrub oak	*Quercus berberidifolia*
seaside goldenrod[5,7]	*Solidago sempervirens*
seaside spurge[5]	*Euphorbia polygonifolia*
shortleaf pine[2]	*Pinus echinata*
smooth cordgrass[3,4]	*Spartina alterniflora*
staghorn sumac[7]	*Rhus typhina*
spike grass[4]	*Distichlis spicata*
swamp magnolia[1]	*Magnolia virginiana*
sweet gum[1]	*Liquidambar styraciflua*
switch grass[4,6]	*Panicum virgatum*
trident maple [1]	*Acer buergerianum*
Virginia creeper[7]	*Parthenocissus quinquefolia*
wild onion[6]	*Allium vineale*
willow oak	*Quercus phellos*
winged sumac[7]	*Rhus copallinum*
yucca[7]	*Yucca* spp

[1]Atlantic White Cedar Swamp Community (Atlantic County 1973).
[2]Mixed Forest Community (Atlantic County 1973).
[3]Low Marsh Community (Somers Point City 1993, Ocean City 2009) .
[4]High Marsh Community (Somers Point City 1993).
[5]Upland Beach Community (Somers Point City 1993 and Ocean City 2009)
[6]Old Field (Somers Point City 1993).
[7]Beach Dune Community (Ocean City 2009)

Figure 4-1: BL England Study Corridor, Audubon Important Bird Areas. Green indicates State priority while Blue indicates Continental priority

4.4.1.1 BL England Study Corridor Onshore Export Cable Route

There are multiple proposed Onshore Export Cable Route options within the BL England Study Corridor (Figure 4-2). For all proposed Onshore Export Cable Routes, the transmission lines will be co-located with existing developed areas (i.e., roads, rail lines, and existing transmission lines) that pass through residential and commercial areas wherever possible, thereby minimizing potential impacts to terrestrial wildlife habitat. The BL England Route will terminate at the BL England substation. The routes are within the Delaware Bay Landscape and Atlantic Coastal Landscape regions; and are close to the Cape May Peninsula CFA and within the Lower Great Egg Harbor Watershed CFA. The habitat along the route options varies, but includes high density urban residential areas (edge habitat), commercial areas, salt marsh, shrubs and grasses, and deciduous forest.

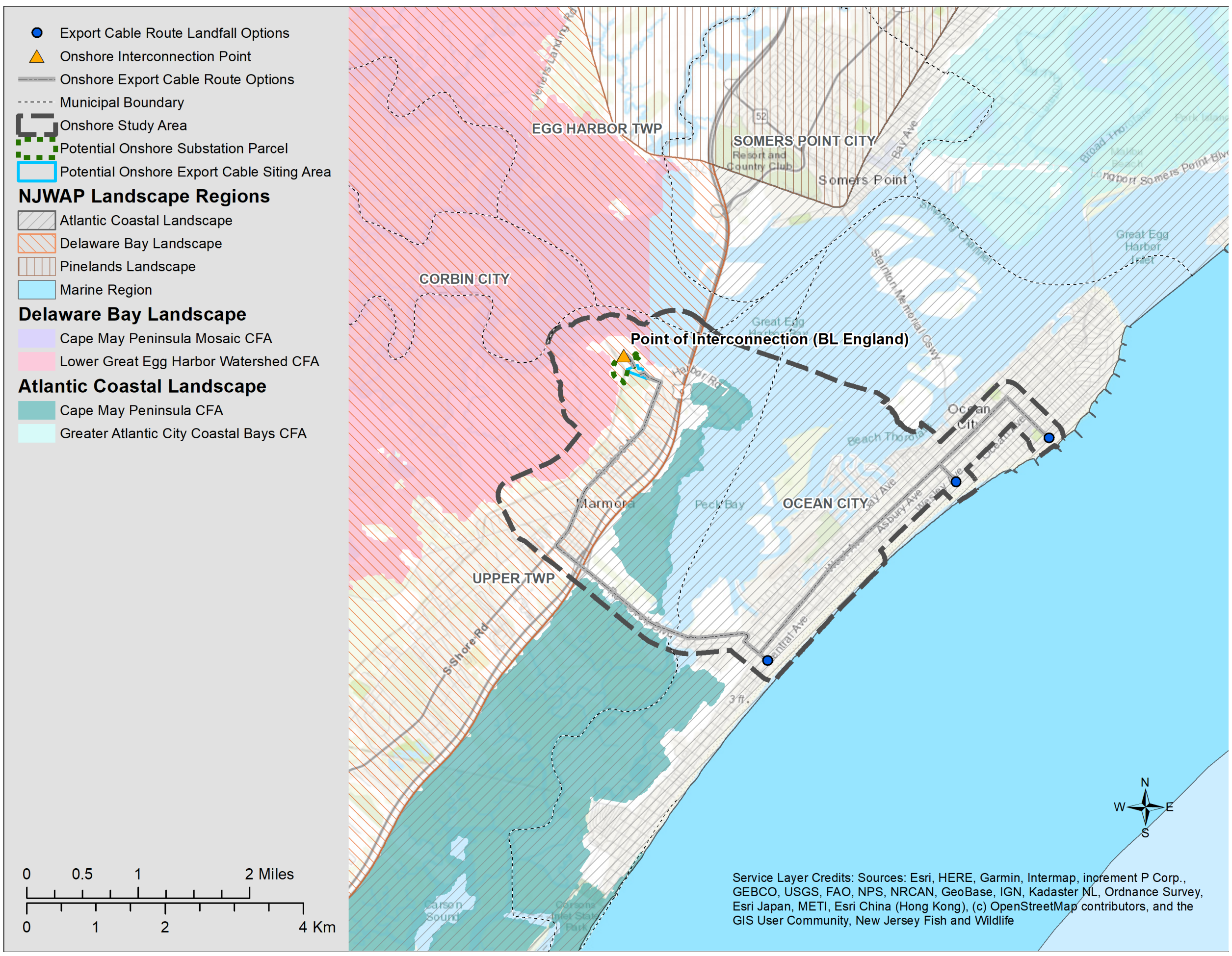


Figure 4-2. Possible BL England onshore cable routes and their associated New Jersey Wildlife Action Plan Landscape Regions and Conservation Focal Areas (CFA).

4.4.1.2 Landfall Sites

Exact landfall sites have not yet been determined but would likely occur in the Atlantic Coastal Landscape Region, either the Cape May Peninsula CFA or a non-focal area (not assigned as a CFA). This region includes barrier islands, beaches, tidal salt marshes, rivers, shallow bays and lagoons.

4.4.1.3 AC Substation

The proposed AC Substation parcel consists of a preexisting substation bordered by Great Egg Harbor Bay, salt marsh, and mowed lawn with scattered deciduous tree habitat.

4.4.1.4 Onshore Grid Connection Points

The grid connection will be in an existing highly disturbed and industrialized area adjacent to a golf course. The area is primarily covered with existing impervious surfaces that effectively do not provide viable bird habitat (Figure 4-3).

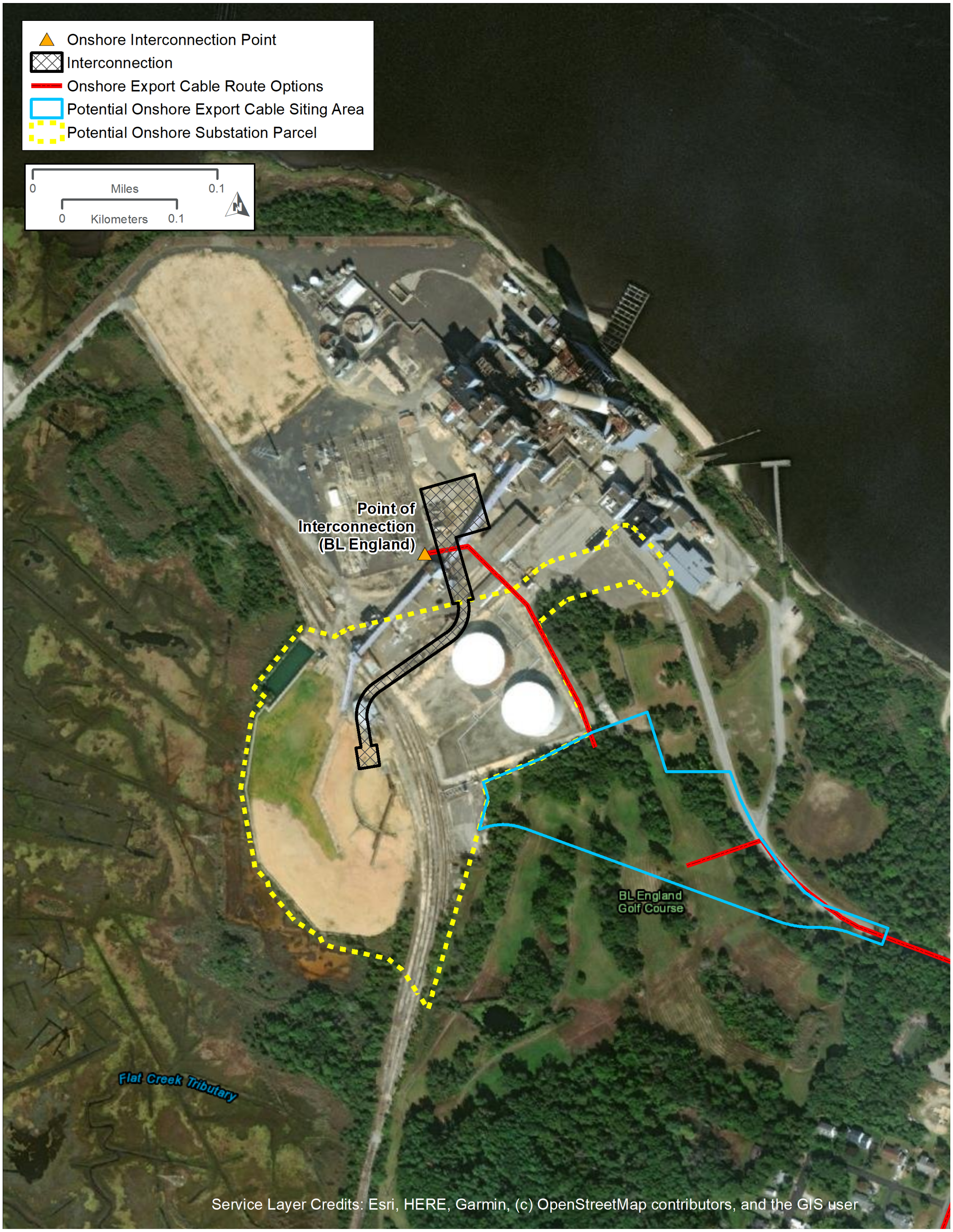


Figure 4-3: Map of BL England grid connection.

4.4.2 BL England: Birds Likely to Occupy the Existing Habitat

The bird surveys and resource inventories, detailed at the end of this section (Table 4-5), indicate a diversity of species occurring in the habitats described above, such as songbirds, raptors, and wading birds. Bird species likely occurring along the onshore cable corridor and at the onshore AC substation, and onshore grid connection points are those associated with coastal wetland (e.g., shorebirds), forested wetland (e.g., songbirds), forested lowland and upland habitats (e.g., songbirds and raptors), while bird species likely occurring at the cable landfall sites are those associated with coastal wetland (e.g., shorebirds, water birds), beach (e.g., marine birds, shorebirds), and bay island habitats (e.g., waterbirds, wading birds).

Landfall sites: Exact landfall sites have not yet been determined but would likely occur in the Atlantic Coastal Landscape Region, either the Cape May Peninsula CFA or a non-focal area (not assigned as a CFA). This region includes barrier islands, beaches, tidal salt marshes, rivers, shallow bays, and lagoons making this potentially an important location for coastal waterbirds, such as migrating and wintering shorebirds, including the federally listed Red Knot (*Calidris canutus*; see 3.4.3.2 for species detail). Piping Plovers (*Charadrius melodus*; see 3.4.3.1 for species detail) are known to breed in the area as well (Figure 3-9). The endangered Roseate Tern (*Sterna dougallii*; see 3.10.6.5.1 for details) could fly close to or roost onshore near landfall sites during migration but is unlikely to linger. Surveys will be conducted to determine the use of these proposed landfall sites by these species (and others) prior to construction as mentioned in the mitigation section (4.8). The nearest recorded Piping Plover nesting activity in 2019 was approximately 4 miles (6.5 km) to the south of the BL England landfall site (Heiser and Davis 2019). The nearest recorded Black Skimmer nesting activity in 2019 was approximately 5 miles (8 km) to the north of the BL England landfall site (Heiser and Davis 2019). The nearest recorded American Oystercatcher nesting activity in 2019 was reported approximately 3.7 miles (6 km) to the south of the BL England landfall site (Heiser and Davis 2019). The nearest recorded Bald Eagle nesting activity in 2019 was at Beesley's Point, within a few kilometers of the BL England landfall site and proposed substation location. This nest failed without producing young (Smith and Clark 2019). The nearest recorded Peregrine Falcon nesting activity in 2019 was in Ocean City on a nesting platform in a marsh, as well as on the Ocean City-Longport Bridge. These nests fledged four and two young, respectively (Clark and Wurst 2019). Osprey nesting activity in the vicinity of Ocean City and Great Egg Harbor (BL England site) included 79 confirmed nests that produced 150 young (Wurst and Clark 2019).

Onshore Export Cable corridor: Descriptions of birds associated with cable corridors are provided along with descriptions of the Conservation Focal Areas (CFAs) and their respective Landscape Regions (see 4.3) and because of their proximity to the coast see a broad mix of species in all seasons (Table 4-5).

AC Substation: Assumed to be similar species as for the onshore export cable route.

Onshore Grid Connection Points: Provides little to no important bird habitat. Species common in disturbed areas may pass through the site.

4.5 Oyster Creek Study Corridor

4.5.1 Oyster Creek Habitat

Coastal habitats within the Oyster Creek Study Corridor include saline low and high marsh, *Phragmites australis* community, scrub-shrub wetlands, vegetated dunes, and barren beach. Forested areas of the study corridor consist of forested uplands, forested swamps, and pygmy pine plains. Forested uplands include mixed and coniferous forest communities dominated by oaks and pines. Forested wetlands are primarily Atlantic white cedar swamps dominated by Atlantic white cedar (*Chamaecyparis thyoides)* surrounded by hummocks of sphagnum mosses (*Sphagnum* spp.). An area of old farmland within the study corridor also includes areas of open fields, scattered pines and oaks, open sandy areas, and abandoned orchards. Terrestrial plant species identified within the communities present in the study corridor are presented in (Table 4-3).

As mentioned above, portions of the study corridor include Pinelands National Reserve land, Natural Heritage Priority Sites including Middle Branch Forked River (Lacey Township) and Island Beach Macrosite (Barnegat Light Borough), Island Beach State Park, Forsythe National Wildlife Refuge land, and Barnegat Light State Park. Coastal wetland sections of the BL England Study Corridor fall within State-level Important Bird Areas, while some upland sections fall within Continental-level Important Bird Areas, as identified by the National Audubon Society (Figure 4-4).

Table 4-3: Common vegetation present within Oyster Creek Study Corridor.

Common Name	Scientific Name	Common Name	Scientific Name
Atlantic white cedar[1]	*Chamaecyparis thyoides*	pine barrens heather[2]	*Hudsonia ericoides*
bayberry[5]	*Myrica pensylvanica*	pitch pine[2,5]	*Pinus rigida*
blackjack oak[2]	*Quercus. marilandica*	pitcher plants[1]	*Sarracenia spp*
blue huckleberry[2]	*Gaylussacia frondosa*	prickly pear[5]	*Opuntia compressa*
blueberry[2]	*Vaccinium vacillans*	saltmeadow cordgrass[3,4]	*Spartina patens*
bracken[5]	*Pteridium aquilinum*	saltmeadow rush[3,4]	*Juncus gerardii*
calico aster[5]	*Symphyotrichum lateriflorum (L.)*	scarlet oak[2]	*Quercus coccinea*
common reed[3,4]	*Phragmites australis*	scrub oak[2,5]	*Quercus ilicifolia*
dwarf huckleberry[2]	*Gaylussacia dumosa*	shortleaf pine[2]	*Pinus echinata*
eastern red cedar[5]	*Juniperus virginiana*	smooth cordgrass[3]	*Spartina alterniflora*
fragrant goldenrod[5]	*Solidago odora*	Sphagnum mosses	*Sphagnum* spp.
glasswort[3]	*Salicornia virginica*	spike grass[4]	*Distichlis spicata*
golden false heather[5]	*Hudsonia ericoides*	stiff aster[5]	*Ionactis linariifolius*
grass-leaved goldenrod[5]	*Euthamia graminifolia*	sundews[1]	*Drosera spp*
gray birch[1]	*Betula populifolia*	swamp azalea[1]	*Rhododendron viscosum*
groundsel tree[4]	*Baccharis halimifolia*	swamp magnolia[1]	*Magnolia virginiana*
hawkweed[5]	*Hieracium sp*	sweet-fern[2]	*Comptonia peregrina*
highbush blueberry[1]	*Vaccinium corymbosum*	switch grass[5]	*Panicum virgatum*
Jesuit's bark[4]	*Iva frutescens*	Virginia pine[2]	*Pinus virginiana*
low blueberry[2]	*Vaccinium angustifolium*	white oak[2]	*Quercus alba*
mountain laurel[2]	*Kalmia latifolia*	white panicled aster[5]	*Aster simplex*
orchids[1]	*Orchidaceae*	willow[2]	*Quercus phellos*

[1]Atlantic White Cedar Swamp Community ([PPA] Pinelands Preservation Alliance 2018).
[2]Mixed Forest Community (Radis and Sutton 1991 as summarized in AmerGen 2005, [PPA] Pinelands Preservation Alliance 2018).
[3]Low Marsh Community ([USFWS] U.S. Fish and Wildlife Service 1994, Partnership 2018).
[4]High Marsh Community ([USFWS] U.S. Fish and Wildlife Service 1994, Barnegat Bay Partnership 2018).
[5]Old Field Community ([USFWS] U.S. Fish and Wildlife Service 1994).

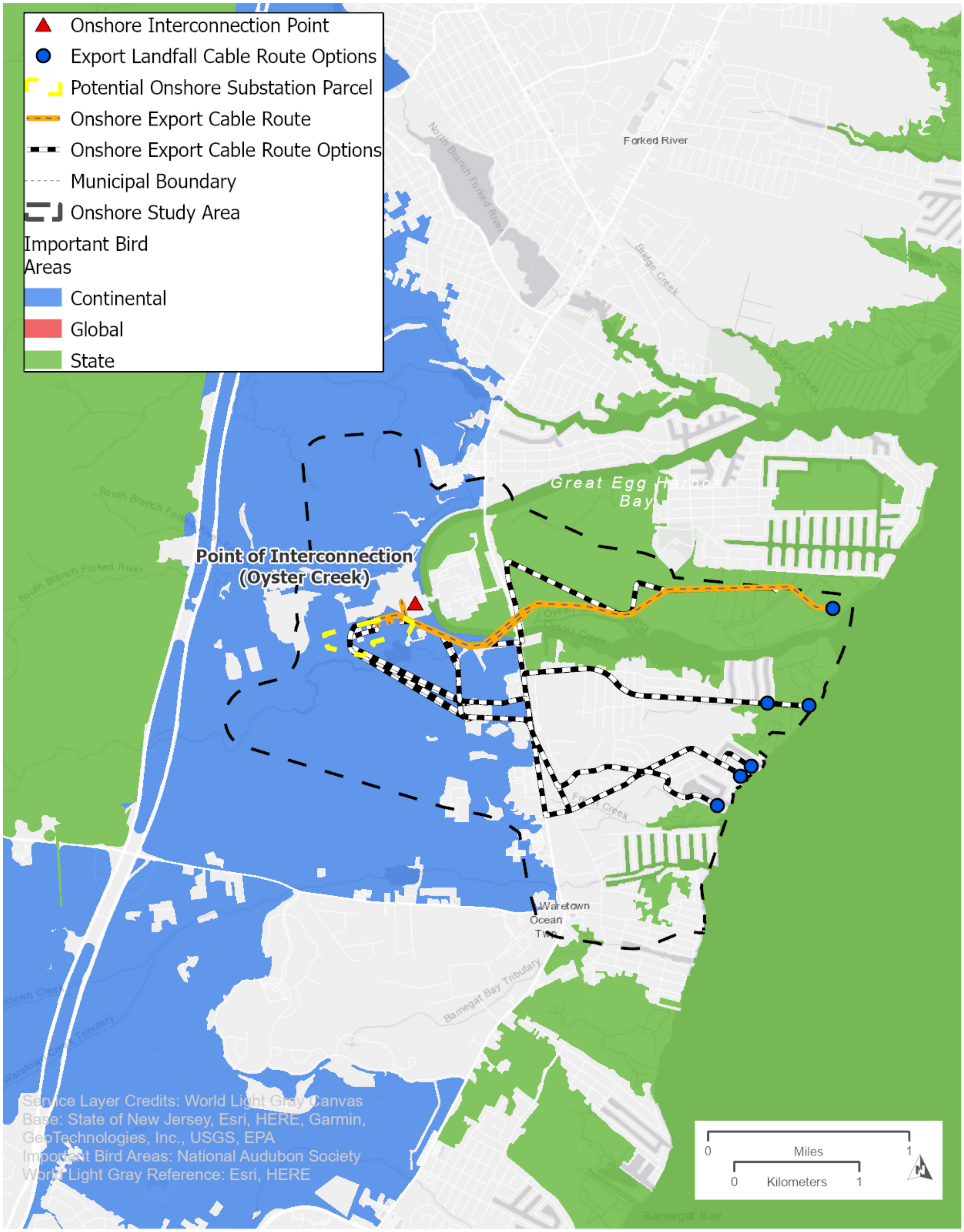


Figure 4-4: Oyster Creek Study Corridor, Audubon Important Bird Areas. Green indicates State priority while Blue indicates Continental priority

4.5.1.1 Oyster Creek Onshore Export Cable Route

There are multiple proposed Onshore Export Cable Route options within the Oyster Creek Study Corridor (Figure 4-5). For all proposed Onshore Export Cable Routes, the transmission lines will be co-located with existing developed areas (i.e., roads, rail lines, and existing transmission lines) that pass through residential and commercial areas wherever possible, thereby minimizing potential impacts to terrestrial wildlife habitat. The Oyster Creek Route will terminate at the Oyster Creek Substation. The routes are within the Pinelands Landscape and Atlantic Coastal Landscape regions; and close to Core Pinelands CFA are within the Greater Barnegat Bay CFA. The habitat along the route options varies, but includes urban residential areas (edge habitat), salt marsh, mixed forest (predominantly deciduous forest with scattered cedars and pines), shrubs, and grasses.

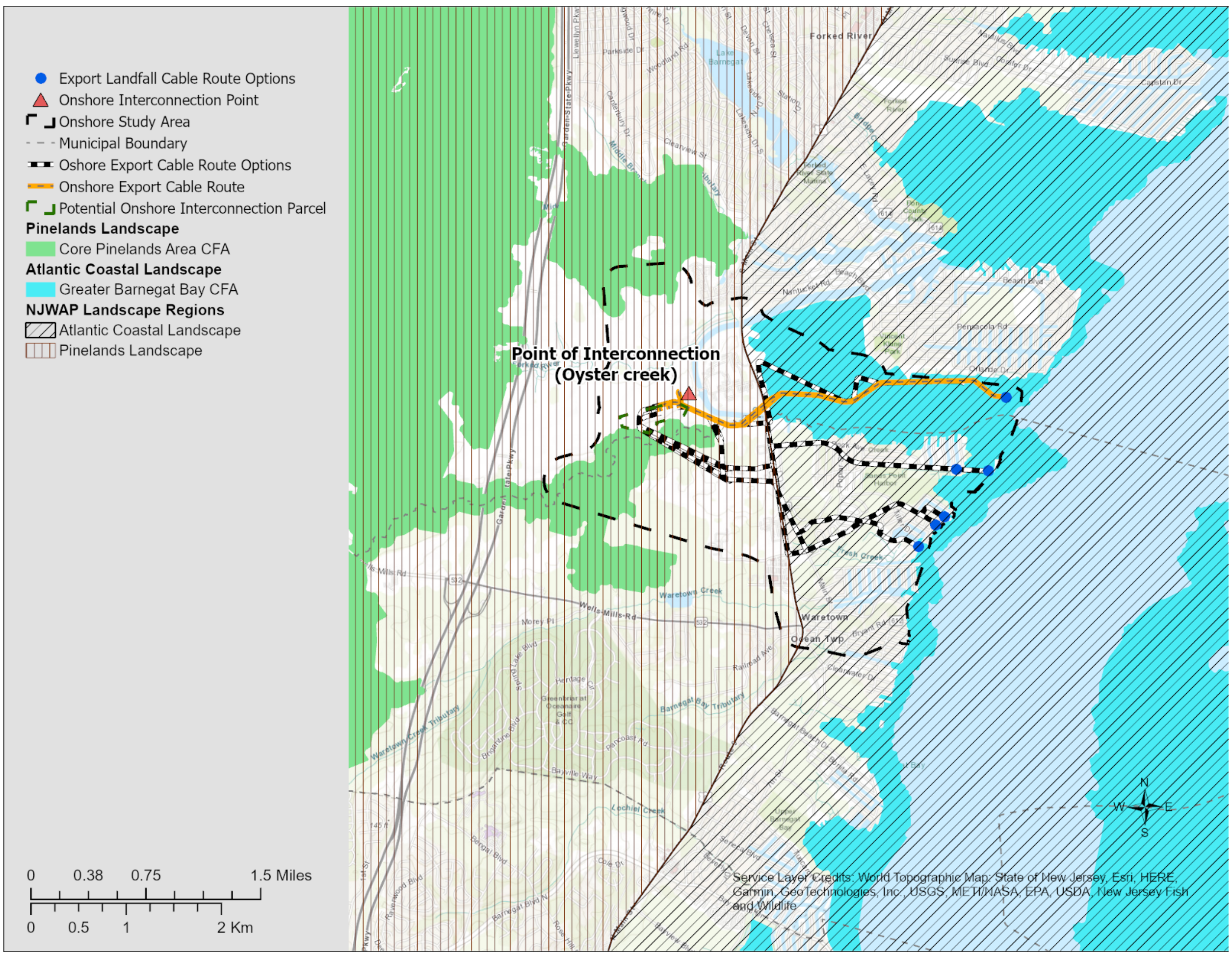


Figure 4-5. Possible Oyster Creek onshore cable routes and their associated New Jersey Wildlife Action Plan Landscape Regions and Conservation Focal Areas (CFAs).

4.5.1.2 Landfall Sites

Exact landfall sites have not yet been determined but would likely occur in the Great Barnegat Bay CFA (Atlantic Coastal Landscape Region) which includes a high proportion of tidal water and coastal wetland.

4.5.1.3 AC Substation

Proposed parcels for the AC Substation are located in areas of pineland forest and shrubland.

4.5.1.4 Onshore Grid Connection Points

The grid connection will be in an existing highly disturbed and industrialized area. The area is primarily covered with existing impervious surfaces, has little vegetation, and effectively does not provide viable bird habitat. A short section of overhead transmission lines, extending up to 0.5 miles (0.8 km), will potentially be installed in this area (Figure 4-6).

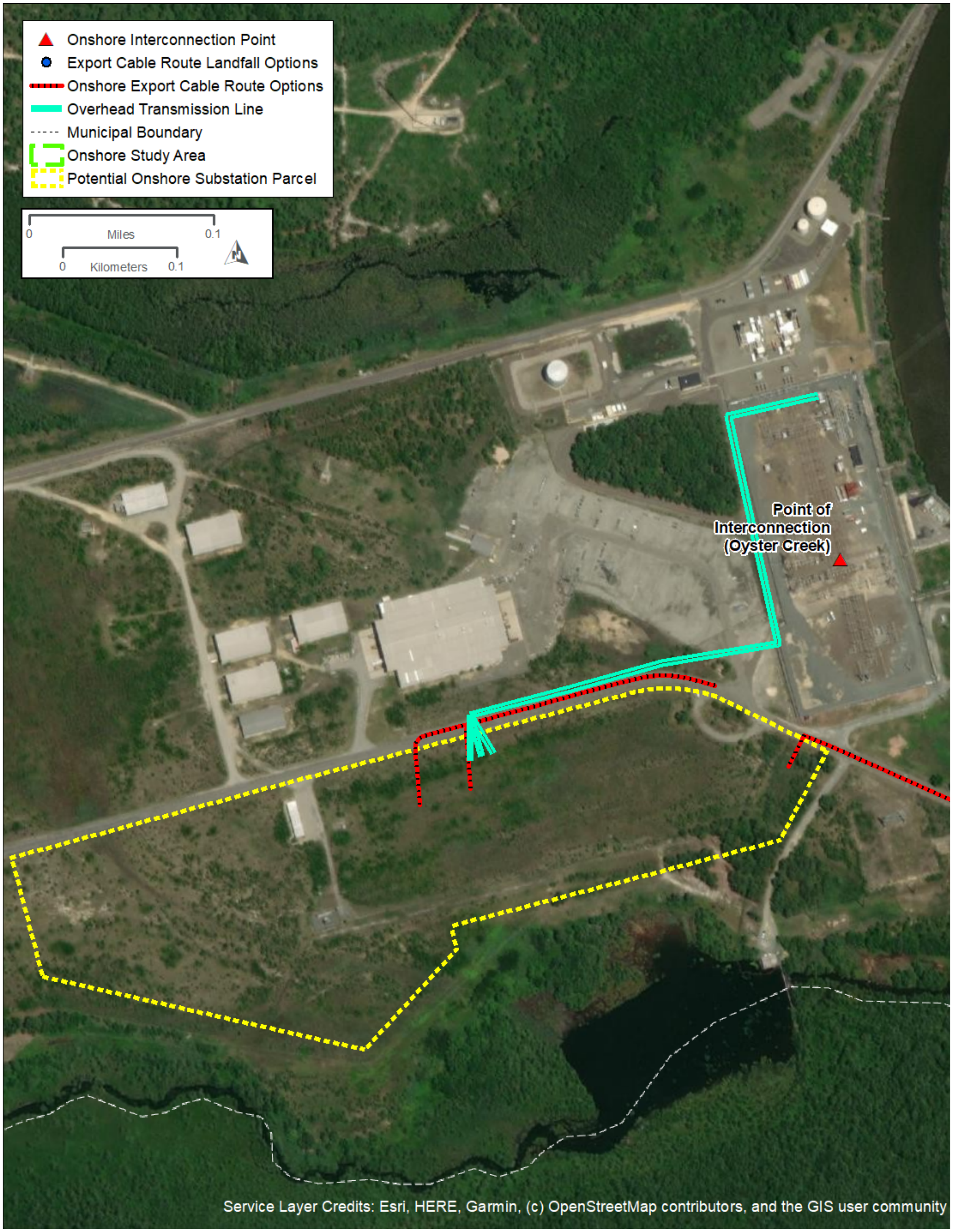


Figure 4-6: Map of Oyster Creek grid connection and location of the potential overhead transmission line.

4.5.2 <u>Oyster Creek: Birds Likely to Occupy the Existing Habitat</u>

The bird surveys and resource inventories detailed in (Table 4-6) indicate a diversity of species occurring in the habitats described above, such as songbirds, raptors, and wading birds. Bird species likely occurring along the onshore cable corridor and at the onshore AC substation, and onshore grid connection points associated with coastal wetland (e.g., shorebirds), forested wetland (e.g., songbirds), forested lowland and upland habitats, (e.g., songbirds and raptors), while bird species likely occurring at the cable landfall sites are those associated with coastal wetland (e.g., shorebirds, water birds), beach (e.g., marine birds, shorebirds), and bay island habitats (e.g., waterbirds, wading birds).

Landfall sites: Landfall sites have not yet been determined exactly, but would likely occur in the Great Barnegat Bay CFA (Atlantic Coastal Landscape Region) which includes a high proportion of tidal water and coastal wetland, making this potentially an important location for coastal waterbirds, such as migrating and wintering shorebirds, including the federally listed Red Knot (see 3.4.3.2 for species detail). Piping Plovers (see 3.4.3.1 for species detail) are known to breed in the area as well (Figure 3-9). The endangered Roseate Tern (see 3.10.6.5.1 for details) could fly close to or roost onshore near landfall sites during migration but is unlikely to linger. Surveys will be conducted to determine the use of these proposed landfall sites by these species (and others) prior to construction as mentioned in the mitigation section (4.8). The nearest recorded Piping Plover nesting activity in 2019 was reported along the barrier beaches approximately 4.4 miles (7 km) to the east and southeast of the Oyster Creek landfall site (Heiser and Davis 2019). The nearest recorded American Oystercatcher nesting activity in 2019 was reported along the barrier beaches approximately 4.4 miles (7 km) to the east and southeast of the Oyster Creek landfall site. The nearest recorded Bald Eagle nesting activity in 2019 was in Waretown, within a 1.2-1.9 miles (2-3 km) of the Oyster Creek landfall site and proposed substation location. This nest fledged two young (Smith and Clark 2019). The nearest recorded Peregrine Falcon nesting activity in 2019 was reported along the barrier beaches at Sedge Island approximately 4.4 miles (7 km) to the east and southeast of the Oyster Creek landfall site. This nest fledged a single young (Clark and Wurst 2019). Osprey nesting activity in the vicinity of Barnegat Bay and the Sedge Islands Wildlife Management Area (Oyster Creek site) included a combined 141 confirmed nests that produced 172 young (Wurst and Clark 2019).

Onshore Export Cable corridor: Descriptions of birds associated with cable corridors are provided along with descriptions of the Conservation Focal Areas (CFAs) and their respective Landscape Regions (see 4.3) and because of their proximity to the coast see a broad mix of species in all seasons (Table 4-6).

AC Substation: Assumed to be similar species as for the onshore export cable route.

Onshore Grid Connection Points: Provides little to no important bird habitat. Species common in disturbed areas may pass through the site.

4.6 Avian Species of Conservation Concern for BL England and Oyster Creek

Avian species found in the BL England and Oyster Creek study corridors include species listed by the federal government as Endangered, Threatened, and Birds of Conservation Concern, and by the State of New Jersey as Endangered, Threatened, and Special Concern, in addition to those identified above in the NJWAP as "focal SGCN" for relevant Landscape Regions.

The list of potential avian species found in the BL England study corridor include one Federally Endangered species, the Roseate Tern, two Federally Threatened species, the Piping Plover and Red Knot, and 46 species Federally listed as Birds of Conservation Concern. State listed species potentially found within the BL England study corridor include 19 species listed as Endangered, 14 species listed as Threatened, and 57 species listed as Special Concern (Table 4-7). Since Roseate Terns are only expected to be passing through the area during migration and exposure to onshore Project activities is likely ephemeral, they are not discussed in detail in this section. For further information on Roseate Tern see the Offshore Bird Section.

The list of potential avian species found in the Oyster Creek study corridor include one Federally Endangered species, the Roseate Tern, two Federally Threatened species, the Piping Plover and Red Knot, and 48 species Federally listed as Birds of Conservation Concern. State listed species potentially found within the Oyster Creek study corridor include 20 species listed as Endangered, 14 species listed as Threatened, and 57 species listed as Special Concern.

The U.S. Fish and Wildlife Service listed a subspecies of Red Knot (*Calidris canutus rufa*) as threatened under the Endangered Species Act of 1973, as amended in the Federal Register on December 11, 2014 ([USFWS] U.S. Fish and Wildlife Service 2015). The *rufa* subspecies breeds in the Arctic and winters at sites as far south as Tierra del Fuego, Argentina, at the southern tip of South America. During both migrations, Red Knots use key staging and stopover areas to rest and feed. Major spring stopover areas are located along the mid-Atlantic coast of the USA where birds utilize habitats including sandy coastal beaches at or near tidal inlets or the mouths of bays and estuaries, peat banks, salt marshes, brackish lagoons, tidal mudflats, mangroves, and sandy/gravel beaches where they feed on clams, crustaceans, invertebrates, and the eggs of horseshoe crabs (particularly in Delaware Bay) that come ashore to spawn in late May. Red Knot passage here occurs between the third week of Apr and first week of June, with the highest counts occurring from mid to late May (Baker et al. 2013). Red Knots tagged with digital VHF transmitters (nanotags) were detected at coastal New Jersey nanotag tower sites during fall migration (Loring et. al. 2018).

Piping Plover populations were federally listed as Threatened and Endangered in 1986. The Northern Great Plains and Atlantic Coast populations are Threatened, and the Great Lakes population is Endangered. Atlantic Coast Piping Plovers nest on coastal beaches, sandflats at the ends of sand spits and barrier islands, gently sloped foredunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Breeding and wintering plovers feed on exposed wet sand in wash zones; intertidal ocean beach; wrack lines; washover passes; mud, sand, and algal flats; and shorelines of streams, ephemeral ponds, lagoons, and salt marshes by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening. Small sand dunes, debris, and sparse vegetation within adjacent beaches provides shelter from wind and extreme temperatures. Piping Plovers arrive on the breeding grounds during mid-March through mid-May and remain for 3 to 4 months per year, and depart for the wintering grounds from mid-July through late October ([USFWS] U.S. Fish and Wildlife Service 2019). Piping Plovers tagged with digital VHF transmitters (nanotags) in Massachusetts and Rhode Island between 2015 and 2017 were detected at coastal New Jersey nanotag tower sites during fall migration (Loring et. al. 2019).

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

4.7 Potential Impacts of the Onshore Project Components to Birds

4.7.1 Construction and Installation

4.7.1.1 Habitat Conversion

Coastal beach areas: Overall, coastal disturbance, which could cause habitat conversion, is expected to be “minimal” to “low” because trenchless technology methods will be used where practicable. The trenchless exit pits will be located within the landfall construction compound (see Volume I, Section 6, of the COP with details on project dimensions and timing of construction activities).

If coastal disturbance is necessary during the seasons when federally listed species may be present (described above), the Project will conduct site-specific bird surveys prior to construction to identify if Piping Plovers or Red Knots are using the area. The project will also contact USFWS and state wildlife biologists for the most recent information on Piping Plover and Red Knot use of the area. Based upon the findings of the survey, the Project will then use best practices determined in coordination with the USFWS and the State to minimize any potential disturbance to listed species.

Upland areas: Overall, impacts to bird populations from onshore Project activities are expected to be “minimal” to “low” because facilities will be co-located with existing developed areas (i.e., roads, rail-lines, and existing transmission lines), whenever possible, to limit disturbance to habitat (Table 4-4).

Onshore, construction activities will be focused on two locations: BL England and Oyster Creek. Onshore activities will include installation of onshore export cables, construction of onshore substations, and AC cable connections from the substations to the existing grid (see Volume I of the COP with details on project dimensions and timing of construction activities).

Site preparation for the construction of the onshore substation will include grading, installation of a gravel layer, and installation of an access road. Onshore grid connection sites will require buried or overhead AC cables to connect the AC substation to the existing grid. Installation of overhead transmission lines is expected to result in little to no habitat loss because the lines will be located in existing highly disturbed areas. The cables will be installed within a permanent right-of-way and an additional parallel temporary construction corridor will be required. Work within the construction corridor may require some permanent removal of trees located along the edge. Due to the relatively small area being disturbed, and that the construction is going to occur in existing disturbed areas, the potential impacts to bird populations from permanent habitat conversion is expected to be “minimal” to “low”.

Where necessary, construction of onshore facilities may require clearing and grading within work areas. Clearing and grading during construction within temporary workspaces will result in temporary loss of forage and cover for birds within the corridor. However, the work will not affect habitat outside the corridor. Due to the short duration of the activities, and the actions taken to reduce impacts (see below), the potential impacts to bird populations from temporary habitat conversion is expected to be “minimal to “low”.

4.7.1.1.1 Temporary Disturbance: Noise and Vibration

Noise and vibration generated by construction equipment will likely temporarily displace some birds within nearby habitat. These birds are expected to return once construction activity is complete, and, thus, the potential impacts to bird populations are expected to be “minimal”.

4.7.1.1.2 Direct Mortality

Due to their generally high mobility, birds are likely to leave the corridor as construction progresses. Any direct mortality to birds from construction activities should be extremely limited; therefore, potential impacts to bird populations are expected to be “minimal”.

4.7.2 Operations and Maintenance

During operation and maintenance, there are expected to be few, if any hazards, that would cause potential effects ([BOEM] Bureau of Ocean Energy Management 2018) (Table 4-4).. There is the potential for birds to be temporarily disturbed by noise during maintenance activities, but these are expected to be ephemeral in nature, and birds that are disturbed would readily return to the area once the activities have ceased. Across the landscape, fixed above ground structures (e.g., buildings, transmission lines) can cause mortality due to collision or electrocution, but risk to birds from the Project are likely low because most transmission lines will be buried, and buildings will be built primarily in existing disturbed areas. Therefore, the potential impacts to bird populations are expected to be "minimal" for the operation of coastal and onshore components of the project.

4.7.2.1 Overhead Transmission Lines

Power lines can cause bird mortality (Loss et al., 2014) through collision or electrocution (Bevanger, 1994). Birds most prone to collisions with power lines are waterfowl, waterbirds, gamebirds, rails (Jenkins et al., 2010), owls, seabirds, and nocturnal migrants (Raine et al., 2017). Electrocution is most common with raptors, caused by birds spanning the distance between the wires with their wings, and has been recorded in over half of North American species (Lehman et al., 2007). However, power lines can provide benefits including the use of poles for hunting or nesting (D'Amico et al., 2018; Moreira et al., 2017).

As discussed above, the overhead transmission lines, if selected for the interconnection, will be short and located in existing industrial areas that provide little to no important bird habitat. Therefore, little bird interaction with the lines is expected, and potential impacts to bird populations are expected to be "minimal" during operation. Collision mortality can be reduced by increasing the visibility of wires (Barrientos et al., 2011) and minimizing lighting (Gehring et al., 2009). Electrocution can be reduced by ensuring the spacing between wires is further apart than the size of the largest species expected to use the surrounding area (Lehman et al., 2007), insulating conductors, and separating wires with different electric potentials (Dwyer et al., 2017). The transmission lines will be built, to the extent practicable, following the Avian Power Line Interaction Committee (APLIC) standard design guidance (https://www.aplic.org/). The guidance includes designing the lines to meet or exceed minimum clearance distances to minimize/eliminate the risk of electrocution; and marking wires with bird diverters to make wires more visible to minimize collision risk.

4.7.3 Decommissioning

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

Table 4-4: Summary of potential impacts of coastal and onshore activities to birds

Effect	Project Component	Description	Population level risk	
			Construction & Decommissioning	Operation
Habitat Conversion (Temporary)	Coastal and Upland	Temporary disturbance of upland habitat by Project activities	Minimal - Low	.

Effect	Project Component	Description	Population level risk	
			Construction & Decommissioning	Operation
Habitat Conversion (Permanent)	Coastal and Upland	Permanent disturbance of upland habitat by Project activities	Minimal - Low	Minimal
Disturbance (Temporary)	Coastal and Upland	Noise and vibration producing activities	Minimal - Low	Minimal
Mortality	Coastal and Upland	Contact with equipment	Minimal	Minimal

4.8 Mitigation

The proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts for the Project are presented in COP, Volume II, Table 1.1-2.

4.9 Summary and Conclusions

Project activities onshore are expected to have little impact on birds because nearly all development will be co-located with existing areas of development. Potential impacts will be minimized by using horizontal directional drilling in coastal areas and by conducting tree cutting during the winter. Prior to construction, on the ground bird surveys will be conducted to identify any nesting sites of sensitive species. Thus, onshore construction, operation, and decommissioning activities are not expected to affect the populations of breeding or migratory birds.

Table 4-5: Species potentially present in the BL England Study Corridor

Group	Common Name	Scientific Name	Brady 1980	BBS (BL England)	eBird - Corson's Inlet SP (BL England)	Galloway Township Resource Inventory (BL England)	eBird - Beesley's Point, BL England Generating Station	eBird - Ocean City Preserve (BL England)	eBird - Ocean City Golf Course (BL England)
Galliformes	Ruffed Grouse	*Bonasa umbellus*	x						
Galliformes	Northern Bobwhite	*Colinus virginianus*	x						
Galliformes	Wild Turkey	*Meleagris gallopavo*						x	
Galliformes	Ring-necked Pheasant	*Phasianus colchicus*	x						
Marine Bird	Cory's Shearwater	*Calonectris diomedea*			x				
Marine Bird	Black Tern	*Chlidonias niger*	x						
Marine Bird	Bonaparte's Gull	*Chroicocephalus philadelphia*	x		x			x	
Marine Bird	Black-headed Gull	*Chroicocephalus ridibundus*	x						
Marine Bird	Gull-billed Tern	*Gelochelidon nilotica*	x		x			x	
Marine Bird	Little Gull	*Hydrocoloeus minutus*	x						
Marine Bird	Caspian Tern	*Hydroprogne caspia*	x		x			x	
Marine Bird	Herring Gull	*Larus argentatus*	x	x	x	x	x	x	x
Marine Bird	Ring-billed Gull	*Larus delawarensis*	x		x			x	x
Marine Bird	Lesser Black-backed Gull	*Larus fuscus*	x		x				
Marine Bird	Iceland Gull	*Larus glaucoides*	x		x				
Marine Bird	Glaucous Gull	*Larus hyperboreus*	x						
Marine Bird	Great Black-backed Gull	*Larus marinus*	x	x	x	x	x	x	x
Marine Bird	Laughing Gull	*Leucophaeus atricilla*	x	x	x	x	x	x	x
Marine Bird	Northern Gannet	*Morus bassanus*			x				
Marine Bird	Brown Pelican	*Pelecanus occidentalis*			x			x	
Marine Bird	Black Skimmer	*Rynchops niger*	x	x	x	x	x	x	x
Marine Bird	Roseate Tern	*Sterna dougallii*	x						
Marine Bird	Forster's Tern	*Sterna forsteri*	x	x	x		x	x	x
Marine Bird	Common Tern	*Sterna hirundo*	x	x	x	x		x	
Marine Bird	Least Tern	*Sternula antillarum*	x	x	x			x	x
Marine Bird	Royal Tern	*Thalasseus maximus*	x		x				
Nightjar	Chuck-will's Widow	*Antrostomus carolinensis*	x		x				
Nightjar	Eastern Whip-poor-will	*Antrostomus vociferus*	x						
Nightjar	Common Nighthawk	*Chordeiles minor*	x		x				
Raptor	Coopers Hawk	*Accipiter cooperii*	x		x		x	x	x
Raptor	Northern Goshawk	*Accipiter gentilis*	x						
Raptor	Sharp-shinned Hawk	*Accipiter striatus*	x		x		x		
Raptor	Northern Saw-whet Owl	*Aegolius acadicus*	x						
Raptor	Golden Eagle	*Aquila chrysaetos*	x						
Raptor	Short-eared Owl	*Asio flammeus*	x			x			
Raptor	Long-eared Owl	*Asio otus*	x						
Raptor	Great Horned Owl	*Bubo virginianus*	x		x				
Raptor	Red-tailed Hawk	*Buteo jamaicensis*	x	x	x		x	x	x
Raptor	Rough-legged Hawk	*Buteo lagopus*	x						
Raptor	Red-shouldered Hawk	*Buteo lineatus*	x						
Raptor	Broad-winged Hawk	*Buteo platypterus*	x		x			x	x
Raptor	Turkey Vulture	*Cathartes aura*	x	x	x		x	x	x
Raptor	Northern Harrier	*Circus hudsonius*	x		x	x	x	x	
Raptor	Black Vulture	*Coragyps atratus*	x		x			x	
Raptor	Merlin	*Falco columbarius*	x		x	x		x	
Raptor	Peregrine Falcon	*Falco peregrinus*	x	x	x		x	x	
Raptor	American Kestrel	*Falco sparverius*	x	x	x		x		
Raptor	Bald Eagle	*Haliaeetus leucocephalus*	x		x	x	x	x	x
Raptor	Eastern Screech Owl	*Megascops asio*	x						
Raptor	Osprey	*Pandion haliaetus*	x	x	x	x	x	x	x
Raptor	Barred Owl	*Strix varia*	x			x			
Raptor	Barn Owl	*Tyto alba*	x						
Shorebird	Spotted Sandpiper	*Actitis macularius*	x		x			x	
Shorebird	Ruddy Turnstone	*Arenaria interpres*	x		x			x	
Shorebird	Upland Sandpiper	*Bartramia longicauda*	x						
Shorebird	Cedar Waxwing	*Bombycilla cedrorum*	x	x	x		x	x	
Shorebird	Sanderling	*Calidris alba*	x		x			x	x
Shorebird	Dunlin	*Calidris alpina*	x		x			x	x
Shorebird	Baird's Sandpiper	*Calidris bairdii*	x						
Shorebird	Red Knot	*Calidris canutus*	x		x			x	

Group	Common Name	Scientific Name	Brady 1980	BBS (BL England)	eBird - Corson's Inlet SP (BL England)	Galloway Township Resource Inventory (BL England)	eBird - Beesley's Point, BL England Generating Station	eBird - Ocean City Preserve (BL England)	eBird - Ocean City Golf Course (BL England)
Shorebird	Curlew Sandpiper	*Calidris ferruginea*	x						
Shorebird	White-rumped Sandpiper	*Calidris fuscicollis*	x		x			x	
Shorebird	Stilt Sandpiper	*Calidris himantopus*	x					x	
Shorebird	Western Sandpiper	*Calidris mauri*	x		x			x	
Shorebird	Pectoral Sandpiper	*Calidris melanotos*	x					x	
Shorebird	Least Sandpiper	*Calidris minutilla*	x		x			x	x
Shorebird	Ruff	*Calidris pugnax*	x						
Shorebird	Semipalmated Sandpiper	*Calidris pusilla*	x		x			x	x
Shorebird	Buff-breasted Sandpiper	*Calidris subruficollis*	x						
Shorebird	Piping Plover	*Charadrius melodus*	x	x	x	x			
Shorebird	Semipalmated Plover	*Charadrius semipalmatus*	x		x			x	x
Shorebird	Killdeer	*Charadrius vociferus*	x	x	x		x	x	x
Shorebird	Wilson's Snipe	*Gallinago delicata*			x			x	
Shorebird	American Oystercatcher	*Haematopus palliatus*	x	x	x		x	x	x
Shorebird	Black-necked Stilt	*Himantopus mexicanus*	x		x				
Shorebird	Short-billed Dowitcher	*Limnodromus griseus*	x		x			x	x
Shorebird	Long-billed Dowitcher	*Limnodromus scolopaceus*	x						
Shorebird	Marbled Godwit	*Limosa fedoa*	x		x				
Shorebird	Hudsonian Godwit	*Limosa haemastica*	x					x	
Shorebird	Whimbrel	*Numenius phaeopus*	x		x				
Shorebird	Red Phalarope	*Phalaropus fulicarius*	x						
Shorebird	Red-necked Phalarope	*Phalaropus lobatus*	x						
Shorebird	Wilson's Phalarope	*Phalaropus tricolor*	x						
Shorebird	American Golden Plover	*Pluvialis dominica*	x		x				
Shorebird	Black-bellied Plover	*Pluvialis squatarola*	x	x	x				x
Shorebird	American Avocet	*Recurvirostra americana*	x						
Shorebird	American Woodcock	*Scolopax minor*	x						
Shorebird	Lesser Yellowlegs	*Tringa flavipes*	x		x		x	x	x
Shorebird	Greater Yellowlegs	*Tringa melanoleuca*	x		x		x	x	x
Shorebird	Willet	*Tringa semipalmata*	x	x	x			x	x
Shorebird	Solitary Sandpiper	*Tringa solitaria*	x		x			x	x
Songbird	Common Redpoll	*Acanthis flammea*	x						
Songbird	Red-winged Blackbird	*Agelaius phoeniceus*	x	x	x		x	x	x
Songbird	Grasshopper Sparrow	*Ammodramus savannarum*	x						
Songbird	Saltmarsh Sparrow	*Ammospiza caudacuta*		x	x			x	
Songbird	Seaside Sparrow	*Ammospiza maritima*	x	x	x			x	x
Songbird	Ruby-throated Hummingbird	*Archilochus colubris*	x		x				x
Songbird	Tufted Titmouse	*Baeolophus bicolor*	x		x		x	x	x
Songbird	Lapland Longspur	*Calcarius lapponicus*	x						
Songbird	Purple Sandpiper	*Calidris maritima*			x				
Songbird	Canada Warbler	*Cardellina canadensis*	x		x				
Songbird	Wilson's Warbler	*Cardellina pusilla*	x		x				x
Songbird	Northern Cardinal	*Cardinalis cardinalis*	x	x	x		x	x	x
Songbird	Veery	*Catharus fuscescens*	x		x				
Songbird	Hermit Thrush	*Catharus guttatus*	x		x				
Songbird	Gray-cheeked Thrush	*Catharus minimus*	x						
Songbird	Swainson's Thrush	*Catharus ustulatus*	x		x				
Songbird	Henslow's Sparrow	*Centronyx henslowii*	x						
Songbird	Brown Creeper	*Certhia americana*	x		x				
Songbird	Chimney Swift	*Chaetura pelagica*	x	x	x		x	x	
Songbird	Lark Sparrow	*Chondestes grammacus*	x						
Songbird	Marsh Wren	*Cistothorus palustris*	x	x	x	x		x	
Songbird	Evening Grosbeak	*Coccothraustes vespertinus*	x						
Songbird	Yellow-billed Cuckoo	*Coccyzus americanus*	x	x	x				
Songbird	Black-billed Cuckoo	*Coccyzus erythropthalamus*	x		x				
Songbird	Northern Flicker	*Colaptes auratus*	x	x	x			x	
Songbird	Rock Dove	*Columba livia*	x	x	x		x	x	x
Songbird	Olive-sided Flycatcher	*Contopus cooperi*	x						
Songbird	Eastern Wood-pewee	*Contopus virens*	x		x	x			x
Songbird	American Crow	*Corvus brachyrhynchos*	x	x	x			x	x
Songbird	Common Raven	*Corvus corax*					x		
Songbird	Fish Crow	*Corvus ossifragus*	x	x	x		x	x	x

Group	Common Name	Scientific Name	Brady 1980	BBS (BL England)	eBird - Corson's Inlet SP (BL England)	Galloway Township Resource Inventory (BL England)	eBird - Beesley's Point, BL England Generating Station	eBird - Ocean City Preserve (BL England)	eBird - Ocean City Golf Course (BL England)
Songbird	Yellow Rail	*Coturnicops noveboracensis*	x		x				
Songbird	Blue Jay	*Cyanocitta cristata*	x	x	x		x	x	
Songbird	Bobolink	*Dolichonyx oryzivorus*	x						
Songbird	Downy Woodpecker	*Dryobates pubescens*	x		x		x	x	
Songbird	Hairy Woodpecker	*Dryobates villosus*	x		x				
Songbird	Pileated Woodpecker	*Dryocopus pileatus*	x						
Songbird	Gray Catbird	*Dumetella carolinensis*	x	x	x	x	x	x	x
Songbird	Yellow-bellied Flycatcher	*Empidonax flaviventris*	x						
Songbird	Least Flycatcher	*Empidonax minimus*	x		x				
Songbird	Willow Flycatcher	*Empidonax traillii*	x	x	x				
Songbird	Acadian Flycatcher	*Empidonax virescens*	x		x				
Songbird	Horned Lark	*Eremophila alpestris*	x		x				
Songbird	Rusty Blackbird	*Euphagus carolinus*	x		x			x	
Songbird	Kentucky Warbler	*Geothlypis formosa*	x						
Songbird	Mourning Warbler	*Geothlypis philadelphia*	x						
Songbird	Common Yellowthroat	*Geothlypis trichas*	x	x	x		x	x	x
Songbird	House Finch	*Haemorhous mexicanus*	x	x	x		x	x	x
Songbird	Purple Finch	*Haemorhous purpureus*	x		x				
Songbird	Worm-eating Warbler	*Helmitheros vermivorum*	x		x				
Songbird	Barn Swallow	*Hirundo rustica*	x	x	x		x	x	
Songbird	Wood Thrush	*Hylocichla mustelina*	x		x	x			
Songbird	Yellow-breasted Chat	*Icteria virens*	x		x				
Songbird	Baltimore Oriole	*Icterus galbula*	x		x		x		x
Songbird	Orchard Oriole	*Icterus spurius*	x		x			x	
Songbird	Dark-eyed Junco	*Junco hyemalis*	x		x		x	x	
Songbird	Northern Shrike	*Lanius borealis*	x						
Songbird	Loggerhead Shrike	*Lanius ludovicianus*	x						
Songbird	Swainson's Warbler	*Limnothlypis swainsonii*	x						
Songbird	Red Crossbill	*Loxia curvirostra*	x						
Songbird	White-winged Crossbill	*Loxia leucoptera*	x						
Songbird	Belted Kingfisher	*Megaceryle alcyon*	x	x	x		x	x	
Songbird	Red-bellied Woodpecker	*Melanerpes carolinus*	x		x			x	
Songbird	Red-headed Woodpecker	*Melanerpes erythrocephalus*	x		x				
Songbird	Swamp Sparrow	*Melospiza georgiana*	x		x			x	
Songbird	Lincoln's Sparrow	*Melospiza lincolnii*	x						
Songbird	Song Sparrow	*Melospiza melodia*	x	x	x		x	x	x
Songbird	Northern Mockingbird	*Mimus polyglottos*	x	x	x		x	x	x
Songbird	Black-and-white Warbler	*Mniotilta varia*	x		x	x		x	x
Songbird	Brown-headed Cowbird	*Molothrus ater*	x	x	x		x	x	
Songbird	Great Crested Flycatcher	*Myiarchus crinitus*	x		x		x		
Songbird	Connecticut Warbler	*Oporornis agilis*	x						
Songbird	Orange-crowned Warbler	*Oreothlypis celata*	x		x				
Songbird	Tennessee Warbler	*Oreothlypis peregrina*	x		x				
Songbird	Nashville Warbler	*Oreothlypis ruficapilla*	x		x				
Songbird	Louisiana Waterthrush	*Parkesia motacilla*	x		x				
Songbird	Northern Waterthrush	*Parkesia noveboracensis*	x		x			x	
Songbird	House Sparrow	*Passer domesticus*	x	x	x		x	x	x
Songbird	Savannah Sparrow	*Passerculus sandwichensis*	x		x		x		x
Songbird	Ipswich Sparrow	*Passerculus sandwichensis princeps*	x						
Songbird	Fox Sparrow	*Passerella iliaca*	x		x				
Songbird	Blue Grosbeak	*Passerina caerulea*	x		x				
Songbird	Indigo Bunting	*Passerina cyanea*	x		x		x		x
Songbird	Cliff Swallow	*Petrochelidon pyrrhonota*	x		x			x	
Songbird	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	x		x				
Songbird	Pine Grosbeak	*Pinicola enucleator*	x						
Songbird	Eastern Towhee	*Pipilo erythrophthalmus*	x	x	x	x			
Songbird	Scarlet Tanager	*Piranga olivacea*	x		x				x
Songbird	Summer Tanager	*Piranga rubra*	x						
Songbird	Snow Bunting	*Plectrophenax nivalis*	x		x				
Songbird	Black-capped Chickadee	*Poecile atricapillus*	x						
Songbird	Carolina Chickadee	*Poecile carolinensis*	x	x	x		x	x	

Group	Common Name	Scientific Name	Brady 1980	BBS (BL England)	eBird - Corson's Inlet SP (BL England)	Galloway Township Resource Inventory (BL England)	eBird - Beesley's Point, BL England Generating Station	eBird - Ocean City Preserve (BL England)	eBird - Ocean City Golf Course (BL England)
Songbird	Blue-gray Gnatcatcher	*Polioptila caerulea*	x		x		x	x	x
Songbird	Vesper Sparrow	*Pooecetes gramineus*	x		x				
Songbird	Purple Martin	*Progne subis*		x	x			x	x
Songbird	Prothonotary Warbler	*Protonotaria citrea*	x		x				
Songbird	Boat-tailed Grackle	*Quiscalus major*	x	x	x		x	x	x
Songbird	Common Grackle	*Quiscalus quiscula*	x	x	x		x	x	x
Songbird	Ruby-crowned Kinglet	*Regulus calendula*	x		x			x	
Songbird	Golden-crowned Kinglet	*Regulus satrapa*	x		x		x	x	
Songbird	Bank Swallow	*Riparia riparia*	x		x			x	x
Songbird	Eastern Phoebe	*Sayornis phoebe*	x		x			x	
Songbird	Ovenbird	*Seiurus aurocapilla*	x		x	x			
Songbird	Northern Parula	*Setophaga americana*	x		x			x	x
Songbird	Black-throated Blue Warbler	*Setophaga caerulescens*	x		x				x
Songbird	Bay-breasted Warbler	*Setophaga castanea*	x		x				
Songbird	Cerulean Warbler	*Setophaga cerulea*	x						
Songbird	Hooded Warbler	*Setophaga citrina*	x		x				
Songbird	Yellow-rumped Warbler	*Setophaga coronata*	x		x			x	x
Songbird	Prairie Warbler	*Setophaga discolor*	x		x	x		x	
Songbird	Yellow-throated Warbler	*Setophaga dominica*	x		x			x	
Songbird	Blackburnian Warbler	*Setophaga fusca*	x		x				
Songbird	Magnolia Warbler	*Setophaga magnolia*	x		x				
Songbird	Palm Warbler	*Setophaga palmarum*	x		x			x	
Songbird	Chestnut-sided Warbler	*Setophaga pensylvanica*	x		x				
Songbird	Yellow Warbler	*Setophaga petechia*	x	x	x	x	x		x
Songbird	Pine Warbler	*Setophaga pinus*	x		x	x		x	
Songbird	American Redstart	*Setophaga ruticilla*	x		x				x
Songbird	Blackpoll Warbler	*Setophaga striata*	x		x				
Songbird	Cape May Warbler	*Setophaga tigrina*	x		x				
Songbird	Black-throated Green Warbler	*Setophaga virens*	x		x				
Songbird	Eastern Bluebird	*Sialia sialis*	x				x		
Songbird	Red-breasted Nuthatch	*Sitta canadensis*	x		x				
Songbird	White-breasted Nuthatch	*Sitta carolinensis*	x		x				
Songbird	Yellow-bellied Sapsucker	*Sphyrapicus varius*	x		x				
Songbird	Pine Siskin	*Spinus pinus*	x						
Songbird	American Goldfinch	*Spinus tristis*	x	x	x		x	x	
Songbird	Dickcissel	*Spiza americana*	x						
Songbird	Clay-colored Sparrow	*Spizella pallida*	x						
Songbird	Chipping Sparrow	*Spizella passerina*	x	x	x		x	x	
Songbird	Field Sparrow	*Spizella pusilla*	x		x			x	x
Songbird	American Tree Sparrow	*Spizelloides arborea*	x		x				
Songbird	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	x		x		x	x	
Songbird	Eastern Meadowlark	*Sturnella magna*	x		x				
Songbird	European Starling	*Sturnus vulgaris*		x	x		x	x	x
Songbird	Tree Swallow	*Tachycineta bicolor*	x	x	x		x	x	x
Songbird	Carolina Wren	*Thryothorus ludovicianus*	x	x	x		x	x	x
Songbird	Brown Thrasher	*Toxostoma rufum*	x	x	x			x	
Songbird	House Wren	*Troglodytes aedon*	x	x	x			x	x
Songbird	Winter Wren	*Troglodytes hiemalis*	x		x				
Songbird	American Robin	*Turdus migratorius*	x	x	x		x	x	x
Songbird	Eastern Kingbird	*Tyrannus tyrannus*	x	x	x				
Songbird	Western Kingbird	*Tyrannus verticalis*	x						
Songbird	Golden-winged Warbler	*Vermivora chrysoptera*	x						
Songbird	Blue-winged Warbler	*Vermivora cyanoptera*	x		x				
Songbird	Yellow-throated Vireo	*Vireo flavifrons*			x				
Songbird	Warbling Vireo	*Vireo gilvus*	x		x				
Songbird	White-eyed Vireo	*Vireo griseus*	x	x	x				x
Songbird	Red-eyed Vireo	*Vireo olivaceus*	x		x	x		x	
Songbird	Philadelphia Vireo	*Vireo philadelphicus*	x						
Songbird	Blue-headed Vireo	*Vireo solitarius*			x				
Songbird	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*						x	
Songbird	White-winged Dove	*Zenaida asiatica*			x				

Group	Common Name	Scientific Name	Brady 1980	BBS (BL England)	eBird - Corson's Inlet SP (BL England)	Galloway Township Resource Inventory (BL England)	eBird - Beesley's Point, BL England Generating Station	eBird - Ocean City Preserve (BL England)	eBird - Ocean City Golf Course (BL England)
Songbird	Mourning Dove	*Zenaida macroura*	x	x	x		x	x	x
Songbird	White-throated Sparrow	*Zonotrichia albicollis*	x		x		x	x	x
Songbird	White-crowned Sparrow	*Zonotrichia leucophrys*	x		x			x	
Songbird	Brewster's Warbler		x						
Wading Bird	Great Egret	*Ardea alba*	x	x	x	x	x	x	x
Wading Bird	Great Blue Heron	*Ardea herodias*	x	x	x		x	x	
Wading Bird	American Bittern	*Botaurus lentiginosus*	x		x			x	
Wading Bird	Cattle Egret	*Bubulcus ibis*	x	x	x	x	x		
Wading Bird	Green Heron	*Butorides virescens*	x	x	x	x		x	x
Wading Bird	Little Blue Heron	*Egretta caerulea*	x	x	x			x	x
Wading Bird	Snowy Egret	*Egretta thula*	x	x	x		x	x	x
Wading Bird	Tricolored Heron	*Egretta tricolor*	x	x	x		x	x	x
Wading Bird	White Ibis	*Eudocimus albus*	x	x					
Wading Bird	Least Bittern	*Ixobrychus exilis*	x		x				
Wading Bird	Black Rail	*Laterallus jamaicensis*	x						
Wading Bird	Yellow-crowned Night-heron	*Nyctanassa violacea*	x	x	x	x		x	x
Wading Bird	Black-crowned Night-heron	*Nycticorax nycticorax*	x	x	x	x		x	x
Wading Bird	White-faced Ibis	*Plegadis chihi*							x
Wading Bird	Glossy Ibis	*Plegadis falcinellus*	x	x	x	x	x	x	x
Wading Bird	Sora	*Porzana carolina*	x			x			
Wading Bird	Clapper Rail	*Rallus crepitans*	x	x	x	x		x	x
Wading Bird	King Rail	*Rallus elegans*	x						
Wading Bird	Virginia Rail	*Rallus limicola*	x			x			x
Waterbird	Wood Duck	*Aix sponsa*	x		x	x		x	
Waterbird	Northern Pintail	*Anas acuta*	x		x	x		x	
Waterbird	Green-winged Teal	*Anas crecca*	x		x	x		x	
Waterbird	Mallard	*Anas platyrhynchos*	x	x	x	x	x	x	x
Waterbird	American Black Duck	*Anas rubripes*	x	x	x	x	x	x	x
Waterbird	Snow Goose	*Anser caerulescens*	x		x				x
Waterbird	Lesser Scaup	*Aythya affinis*	x		x	x		x	
Waterbird	Redhead	*Aythya americana*	x						
Waterbird	Ring-necked Duck	*Aythya collaris*	x					x	
Waterbird	Greater Scaup	*Aythya marila*	x		x	x		x	
Waterbird	Canvasback	*Aythya valisineria*	x			x			
Waterbird	Brant	*Branta bernicla*	x	x	x	x	x	x	x
Waterbird	Canada Goose	*Branta canadensis*	x	x	x	x	x	x	x
Waterbird	Snowy Owl	*Bubo scandiacus*	x		x				
Waterbird	Bufflehead	*Bucephala albeola*	x		x	x	x	x	
Waterbird	Common Goldeneye	*Bucephala clangula*	x		x	x			
Waterbird	Long-tailed Duck	*Clangula hyemalis*	x		x	x			
Waterbird	Tundra Swan	*Cygnus columbianus*				x			
Waterbird	Mute Swan	*Cygnus olor*	x					x	
Waterbird	American Coot	*Fulica americana*	x		x				
Waterbird	Common Gallinule	*Gallinula galeata*	x					x	
Waterbird	Common Loon	*Gavia immer*	x		x		x		x
Waterbird	Red-throated Loon	*Gavia stellata*	x		x				
Waterbird	Hooded Merganser	*Lophodytes cucullatus*	x		x	x		x	
Waterbird	American Wigeon	*Mareca americana*	x			x		x	
Waterbird	Eurasian Wigeon	*Mareca penelope*	x						
Waterbird	Gadwall	*Mareca strepera*	x		x	x		x	
Waterbird	Black Scoter	*Melanitta americana*	x		x				
Waterbird	White-winged Scoter	*Melanitta deglandi*	x		x				
Waterbird	Surf Scoter	*Melanitta perspicillata*	x		x				
Waterbird	Common Merganser	*Mergus merganser*	x			x			
Waterbird	Red-breasted Merganser	*Mergus serrator*	x	x	x	x	x	x	
Waterbird	Ruddy Duck	*Oxyura jamaicensis*	x					x	
Waterbird	Double-crested Cormorant	*Phalacrocorax auritus*	x	x	x		x	x	x
Waterbird	Great Cormorant	*Phalacrocorax carbo*	x	x	x		x		
Waterbird	Horned Grebe	*Podiceps auritus*	x		x				
Waterbird	Red-necked Grebe	*Podiceps grisegena*	x		x				
Waterbird	Pied-billed Grebe	*Podilymbus podiceps*	x		x			x	
Waterbird	Purple Gallinule	*Porphyrio martinica*						x	

Group	Common Name	Scientific Name	Brady 1980	BBS (BL England)	eBird - Corson's Inlet SP (BL England)	Galloway Township Resource Inventory (BL England)	eBird - Beesley's Point, BL England Generating Station	eBird - Ocean City Preserve (BL England)	eBird - Ocean City Golf Course (BL England)
Waterbird	Common Eider	*Somateria mollissima*			x				
Waterbird	Northern Shoveler	*Spatula clypeata*	x					x	
Waterbird	Blue-winged Teal	*Spatula discors*	x		x			x	x

Table 4-6: Species potentially present in the Oyster Creek Study Corridor.

Group	Common Name	Scientific Name	Brady 1980	Oyster Creek Environmental Report	eBird - Forsythe NWR, Eno's Pond (Oyster Creek)	eBird - Lacey Township (Oyster Creek)	BBS (Oyster Creek)
Galliformes	Ruffed Grouse	*Bonasa umbellus*	x				
Galliformes	Northern Bobwhite	*Colinus virginianus*	x				x
Galliformes	Wild Turkey	*Meleagris gallopavo*					x
Galliformes	Ring-necked Pheasant	*Phasianus colchicus*	x				x
Marine Bird	Black Tern	*Chlidonias niger*	x				
Marine Bird	Bonaparte's Gull	*Chroicocephalus philadelphia*	x				
Marine Bird	Black-headed Gull	*Chroicocephalus ridibundus*	x				
Marine Bird	Gull-billed Tern	*Gelochelidon nilotica*	x				
Marine Bird	Little Gull	*Hydrocoloeus minutus*	x				
Marine Bird	Caspian Tern	*Hydroprogne caspia*	x		x		
Marine Bird	Herring Gull	*Larus argentatus*	x		x	x	x
Marine Bird	Ring-billed Gull	*Larus delawarensis*	x		x	x	x
Marine Bird	Lesser Black-backed Gull	*Larus fuscus*	x				
Marine Bird	Iceland Gull	*Larus glaucoides*	x				
Marine Bird	Glaucous Gull	*Larus hyperboreus*	x				
Marine Bird	Great Black-backed Gull	*Larus marinus*	x		x	x	x
Marine Bird	Laughing Gull	*Leucophaeus atricilla*	x		x	x	x
Marine Bird	Black Skimmer	*Rynchops niger*	x	x			
Marine Bird	Roseate Tern	*Sterna dougallii*	x	x			
Marine Bird	Forster's Tern	*Sterna forsteri*	x		x		
Marine Bird	Common Tern	*Sterna hirundo*	x		x		
Marine Bird	Least Tern	*Sternula antillarum*	x	x	x		x
Marine Bird	Royal Tern	*Thalasseus maximus*	x				x
Nightjar	Chuck-will's Widow	*Antrostomus carolinensis*	x				
Nightjar	Eastern Whip-poor-will	*Antrostomus vociferus*	x				x
Nightjar	Common Nighthawk	*Chordeiles minor*	x				x
Raptor	Coopers Hawk	*Accipiter cooperii*	x	x	x	x	
Raptor	Northern Goshawk	*Accipiter gentilis*	x				
Raptor	Sharp-shinned Hawk	*Accipiter striatus*	x		x		
Raptor	Northern Saw-whet Owl	*Aegolius acadicus*	x				
Raptor	Golden Eagle	*Aquila chrysaetos*	x				
Raptor	Short-eared Owl	*Asio flammeus*	x				
Raptor	Long-eared Owl	*Asio otus*	x				
Raptor	Great Horned Owl	*Bubo virginianus*	x		x		
Raptor	Red-tailed Hawk	*Buteo jamaicensis*	x		x	x	x
Raptor	Rough-legged Hawk	*Buteo lagopus*	x		x		
Raptor	Red-shouldered Hawk	*Buteo lineatus*	x		x		
Raptor	Broad-winged Hawk	*Buteo platypterus*	x				x
Raptor	Turkey Vulture	*Cathartes aura*	x		x	x	x
Raptor	Northern Harrier	*Circus hudsonius*	x	x	x		
Raptor	Black Vulture	*Coragyps atratus*	x		x	x	x
Raptor	Merlin	*Falco columbarius*	x		x		
Raptor	Peregrine Falcon	*Falco peregrinus*	x	x	x		x
Raptor	American Kestrel	*Falco sparverius*	x			x	x
Raptor	Bald Eagle	*Haliaeetus leucocephalus*	x	x	x	x	

Group	Common Name	Scientific Name	Brady 1980	Oyster Creek Environmental Report	eBird - Forsythe NWR, Eno's Pond (Oyster Creek)	eBird - Lacey Township (Oyster Creek)	BBS (Oyster Creek)
Raptor	Eastern Screech Owl	*Megascops asio*	x				
Raptor	Osprey	*Pandion haliaetus*	x	x	x	x	x
Raptor	Barred Owl	*Strix varia*	x	x			
Raptor	Barn Owl	*Tyto alba*	x				
Shorebird	Spotted Sandpiper	*Actitis macularius*	x				
Shorebird	Ruddy Turnstone	*Arenaria interpres*	x				
Shorebird	Upland Sandpiper	*Bartramia longicauda*	x	x			
Shorebird	Cedar Waxwing	*Bombycilla cedrorum*	x		x		x
Shorebird	Sanderling	*Calidris alba*	x				
Shorebird	Dunlin	*Calidris alpina*	x		x		
Shorebird	Baird's Sandpiper	*Calidris bairdii*	x				
Shorebird	Red Knot	*Calidris canutus*	x	x			
Shorebird	Curlew Sandpiper	*Calidris ferruginea*	x				
Shorebird	White-rumped Sandpiper	*Calidris fuscicollis*	x				
Shorebird	Stilt Sandpiper	*Calidris himantopus*	x				
Shorebird	Western Sandpiper	*Calidris mauri*	x		x		
Shorebird	Pectoral Sandpiper	*Calidris melanotos*	x		x		
Shorebird	Least Sandpiper	*Calidris minutilla*	x		x		
Shorebird	Ruff	*Calidris pugnax*	x				
Shorebird	Semipalmated Sandpiper	*Calidris pusilla*	x		x		
Shorebird	Buff-breasted Sandpiper	*Calidris subruficollis*	x				
Shorebird	Piping Plover	*Charadrius melodus*	x	x			
Shorebird	Semipalmated Plover	*Charadrius semipalmatus*	x		x		
Shorebird	Killdeer	*Charadrius vociferus*	x		x	x	x
Shorebird	Wilson's Snipe	*Gallinago delicata*			x		
Shorebird	American Oystercatcher	*Haematopus palliatus*	x				
Shorebird	Black-necked Stilt	*Himantopus mexicanus*	x				
Shorebird	Short-billed Dowitcher	*Limnodromus griseus*	x				
Shorebird	Long-billed Dowitcher	*Limnodromus scolopaceus*	x				
Shorebird	Marbled Godwit	*Limosa fedoa*	x				
Shorebird	Hudsonian Godwit	*Limosa haemastica*	x				
Shorebird	Whimbrel	*Numenius phaeopus*	x				
Shorebird	Red Phalarope	*Phalaropus fulicarius*	x				
Shorebird	Red-necked Phalarope	*Phalaropus lobatus*	x				
Shorebird	Wilson's Phalarope	*Phalaropus tricolor*	x				
Shorebird	American Golden Plover	*Pluvialis dominica*	x				
Shorebird	Black-bellied Plover	*Pluvialis squatarola*	x		x		
Shorebird	American Avocet	*Recurvirostra americana*	x				
Shorebird	American Woodcock	*Scolopax minor*	x				
Shorebird	Lesser Yellowlegs	*Tringa flavipes*	x		x		
Shorebird	Greater Yellowlegs	*Tringa melanoleuca*	x		x		
Shorebird	Willet	*Tringa semipalmata*	x		x		
Shorebird	Solitary Sandpiper	*Tringa solitaria*	x				
Songbird	Common Redpoll	*Acanthis flammea*	x				
Songbird	Red-winged Blackbird	*Agelaius phoeniceus*	x		x	x	x
Songbird	Grasshopper Sparrow	*Ammodramus savannarum*	x	x			x
Songbird	Saltmarsh Sparrow	*Ammospiza caudacuta*			x		
Songbird	Seaside Sparrow	*Ammospiza maritima*	x		x		
Songbird	Ruby-throated Hummingbird	*Archilochus colubris*	x		x	x	
Songbird	Tufted Titmouse	*Baeolophus bicolor*	x		x	x	x
Songbird	Lapland Longspur	*Calcarius lapponicus*	x				
Songbird	Canada Warbler	*Cardellina canadensis*	x				
Songbird	Wilson's Warbler	*Cardellina pusilla*	x				
Songbird	Northern Cardinal	*Cardinalis cardinalis*	x		x	x	x
Songbird	Veery	*Catharus fuscescens*	x				x
Songbird	Hermit Thrush	*Catharus guttatus*	x		x		
Songbird	Gray-cheeked Thrush	*Catharus minimus*	x				
Songbird	Swainson's Thrush	*Catharus ustulatus*	x				
Songbird	Henslow's Sparrow	*Centronyx henslowii*	x				
Songbird	Brown Creeper	*Certhia americana*	x		x		
Songbird	Chimney Swift	*Chaetura pelagica*	x		x	x	x
Songbird	Lark Sparrow	*Chondestes grammacus*	x				
Songbird	Marsh Wren	*Cistothorus palustris*	x		x		

Group	Common Name	Scientific Name	Brady 1980	Oyster Creek Environmental Report	eBird - Forsythe NWR, Eno's Pond (Oyster Creek)	eBird - Lacey Township (Oyster Creek)	BBS (Oyster Creek)
Songbird	Sedge Wren	*Cistothorus platensis*		x			
Songbird	Evening Grosbeak	*Coccothraustes vespertinus*	x				
Songbird	Yellow-billed Cuckoo	*Coccyzus americanus*	x				x
Songbird	Black-billed Cuckoo	*Coccyzus erythropthalamus*	x				x
Songbird	Northern Flicker	*Colaptes auratus*	x		x		x
Songbird	Rock Dove	*Columba livia*	x		x	x	x
Songbird	Olive-sided Flycatcher	*Contopus cooperi*	x				
Songbird	Eastern Wood-pewee	*Contopus virens*	x				x
Songbird	American Crow	*Corvus brachyrhynchos*	x		x	x	x
Songbird	Fish Crow	*Corvus ossifragus*	x		x	x	x
Songbird	Yellow Rail	*Coturnicops noveboracensis*	x				
Songbird	Blue Jay	*Cyanocitta cristata*	x		x	x	x
Songbird	Bobolink	*Dolichonyx oryzivorus*	x				
Songbird	Downy Woodpecker	*Dryobates pubescens*	x		x	x	x
Songbird	Hairy Woodpecker	*Dryobates villosus*	x		x		x
Songbird	Pileated Woodpecker	*Dryocopus pileatus*	x				
Songbird	Gray Catbird	*Dumetella carolinensis*	x		x	x	x
Songbird	Yellow-bellied Flycatcher	*Empidonax flaviventris*	x				
Songbird	Least Flycatcher	*Empidonax minimus*	x				
Songbird	Willow Flycatcher	*Empidonax traillii*	x		x		x
Songbird	Acadian Flycatcher	*Empidonax virescens*	x				
Songbird	Horned Lark	*Eremophila alpestris*	x			x	
Songbird	Rusty Blackbird	*Euphagus carolinus*	x			x	
Songbird	Kentucky Warbler	*Geothlypis formosa*	x				
Songbird	Mourning Warbler	*Geothlypis philadelphia*	x				
Songbird	Common Yellowthroat	*Geothlypis trichas*	x		x		x
Songbird	House Finch	*Haemorhous mexicanus*	x		x		x
Songbird	Purple Finch	*Haemorhous purpureus*	x				
Songbird	Worm-eating Warbler	*Helmitheros vermivorum*	x				
Songbird	Barn Swallow	*Hirundo rustica*	x		x	x	x
Songbird	Wood Thrush	*Hylocichla mustelina*	x		x		x
Songbird	Yellow-breasted Chat	*Icteria virens*	x				
Songbird	Baltimore Oriole	*Icterus galbula*	x				x
Songbird	Orchard Oriole	*Icterus spurius*	x				x
Songbird	Dark-eyed Junco	*Junco hyemalis*	x		x		
Songbird	Northern Shrike	*Lanius borealis*	x				
Songbird	Loggerhead Shrike	*Lanius ludovicianus*	x				
Songbird	Swainson's Warbler	*Limnothlypis swainsonii*	x				
Songbird	Red Crossbill	*Loxia curvirostra*	x				
Songbird	White-winged Crossbill	*Loxia leucoptera*	x				
Songbird	Belted Kingfisher	*Megaceryle alcyon*	x		x	x	
Songbird	Red-bellied Woodpecker	*Melanerpes carolinus*	x		x	x	x
Songbird	Red-headed Woodpecker	*Melanerpes erythrocephalus*	x	x			x
Songbird	Swamp Sparrow	*Melospiza georgiana*	x		x		
Songbird	Lincoln's Sparrow	*Melospiza lincolnii*	x				
Songbird	Song Sparrow	*Melospiza melodia*	x		x	x	x
Songbird	Northern Mockingbird	*Mimus polyglottos*	x		x	x	x
Songbird	Black-and-white Warbler	*Mniotilta varia*	x		x		x
Songbird	Brown-headed Cowbird	*Molothrus ater*	x		x	x	x
Songbird	Great Crested Flycatcher	*Myiarchus crinitus*	x		x		x
Songbird	Connecticut Warbler	*Oporornis agilis*	x				
Songbird	Orange-crowned Warbler	*Oreothlypis celata*	x		x		
Songbird	Tennessee Warbler	*Oreothlypis peregrina*	x				
Songbird	Nashville Warbler	*Oreothlypis ruficapilla*	x				
Songbird	Louisiana Waterthrush	*Parkesia motacilla*	x				
Songbird	Northern Waterthrush	*Parkesia noveboracensis*	x		x		
Songbird	House Sparrow	*Passer domesticus*	x		x	x	x
Songbird	Savannah Sparrow	*Passerculus sandwichensis*	x		x	x	
Songbird	Ipswich Sparrow	*Passerculus sandwichensis princeps*	x				
Songbird	Fox Sparrow	*Passerella iliaca*	x				
Songbird	Blue Grosbeak	*Passerina caerulea*	x				
Songbird	Indigo Bunting	*Passerina cyanea*	x				x
Songbird	Cliff Swallow	*Petrochelidon pyrrhonota*	x				

Group	Common Name	Scientific Name	Brady 1980	Oyster Creek Environmental Report	eBird - Forsythe NWR, Eno's Pond (Oyster Creek)	eBird - Lacey Township (Oyster Creek)	BBS (Oyster Creek)
Songbird	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	x				
Songbird	Pine Grosbeak	*Pinicola enucleator*	x				
Songbird	Eastern Towhee	*Pipilo erythrophthalmus*	x		x		x
Songbird	Scarlet Tanager	*Piranga olivacea*	x				x
Songbird	Summer Tanager	*Piranga rubra*	x				
Songbird	Snow Bunting	*Plectrophenax nivalis*	x				
Songbird	Black-capped Chickadee	*Poecile atricapillus*	x				
Songbird	Carolina Chickadee	*Poecile carolinensis*	x		x	x	x
Songbird	Blue-gray Gnatcatcher	*Polioptila caerulea*	x		x		x
Songbird	Vesper Sparrow	*Pooecetes gramineus*	x	x			
Songbird	Purple Martin	*Progne subis*			x	x	x
Songbird	Prothonotary Warbler	*Protonotaria citrea*	x				
Songbird	Boat-tailed Grackle	*Quiscalus major*	x		x		x
Songbird	Common Grackle	*Quiscalus quiscula*	x		x	x	x
Songbird	Ruby-crowned Kinglet	*Regulus calendula*	x		x		
Songbird	Golden-crowned Kinglet	*Regulus satrapa*	x		x		
Songbird	Bank Swallow	*Riparia riparia*	x				x
Songbird	Eastern Phoebe	*Sayornis phoebe*	x		x		x
Songbird	Ovenbird	*Seiurus aurocapilla*	x		x		x
Songbird	Northern Parula	*Setophaga americana*	x		x		x
Songbird	Black-throated Blue Warbler	*Setophaga caerulescens*	x				
Songbird	Bay-breasted Warbler	*Setophaga castanea*	x				
Songbird	Cerulean Warbler	*Setophaga cerulea*	x				
Songbird	Hooded Warbler	*Setophaga citrina*	x				
Songbird	Yellow-rumped Warbler	*Setophaga coronata*	x		x	x	
Songbird	Prairie Warbler	*Setophaga discolor*	x		x	x	x
Songbird	Yellow-throated Warbler	*Setophaga dominica*	x				
Songbird	Blackburnian Warbler	*Setophaga fusca*	x		x		
Songbird	Magnolia Warbler	*Setophaga magnolia*	x				
Songbird	Palm Warbler	*Setophaga palmarum*	x		x		
Songbird	Chestnut-sided Warbler	*Setophaga pensylvanica*	x				x
Songbird	Yellow Warbler	*Setophaga petechia*	x		x		x
Songbird	Pine Warbler	*Setophaga pinus*	x		x		x
Songbird	American Redstart	*Setophaga ruticilla*	x		x		
Songbird	Blackpoll Warbler	*Setophaga striata*	x				x
Songbird	Cape May Warbler	*Setophaga tigrina*	x				
Songbird	Black-throated Green Warbler	*Setophaga virens*	x				x
Songbird	Eastern Bluebird	*Sialia sialis*	x		x		x
Songbird	Red-breasted Nuthatch	*Sitta canadensis*	x		x		
Songbird	White-breasted Nuthatch	*Sitta carolinensis*	x		x		x
Songbird	Yellow-bellied Sapsucker	*Sphyrapicus varius*	x				
Songbird	Pine Siskin	*Spinus pinus*	x				
Songbird	American Goldfinch	*Spinus tristis*	x		x	x	x
Songbird	Dickcissel	*Spiza americana*	x				
Songbird	Clay-colored Sparrow	*Spizella pallida*	x				
Songbird	Chipping Sparrow	*Spizella passerina*	x		x	x	x
Songbird	Field Sparrow	*Spizella pusilla*	x				x
Songbird	American Tree Sparrow	*Spizelloides arborea*	x		x	x	
Songbird	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	x		x		x
Songbird	Eastern Meadowlark	*Sturnella magna*	x				x
Songbird	European Starling	*Sturnus vulgaris*			x	x	x
Songbird	Tree Swallow	*Tachycineta bicolor*	x		x		x
Songbird	Carolina Wren	*Thryothorus ludovicianus*	x		x		x
Songbird	Brown Thrasher	*Toxostoma rufum*	x			x	x
Songbird	House Wren	*Troglodytes aedon*	x		x		x
Songbird	Winter Wren	*Troglodytes hiemalis*	x				
Songbird	American Robin	*Turdus migratorius*	x		x	x	x
Songbird	Eastern Kingbird	*Tyrannus tyrannus*	x		x	x	x
Songbird	Western Kingbird	*Tyrannus verticalis*	x				
Songbird	Golden-winged Warbler	*Vermivora chrysoptera*	x				
Songbird	Blue-winged Warbler	*Vermivora cyanoptera*	x				x
Songbird	Yellow-throated Vireo	*Vireo flavifrons*					x
Songbird	Warbling Vireo	*Vireo gilvus*	x				x

Group	Common Name	Scientific Name	Brady 1980	Oyster Creek Environmental Report	eBird - Forsythe NWR, Eno's Pond (Oyster Creek)	eBird - Lacey Township (Oyster Creek)	BBS (Oyster Creek)
Songbird	White-eyed Vireo	*Vireo griseus*	x				x
Songbird	Red-eyed Vireo	*Vireo olivaceus*	x		x		x
Songbird	Philadelphia Vireo	*Vireo philadelphicus*	x				
Songbird	Mourning Dove	*Zenaida macroura*	x		x	x	x
Songbird	White-throated Sparrow	*Zonotrichia albicollis*	x		x		
Songbird	White-crowned Sparrow	*Zonotrichia leucophrys*	x				
Songbird	Brewster's Warbler		x				
Wading Bird	Great Egret	*Ardea alba*	x		x		x
Wading Bird	Great Blue Heron	*Ardea herodias*	x		x	x	x
Wading Bird	American Bittern	*Botaurus lentiginosus*	x	x			
Wading Bird	Cattle Egret	*Bubulcus ibis*	x				
Wading Bird	Green Heron	*Butorides virescens*	x		x	x	x
Wading Bird	Little Blue Heron	*Egretta caerulea*	x		x		x
Wading Bird	Snowy Egret	*Egretta thula*	x		x		
Wading Bird	Tricolored Heron	*Egretta tricolor*	x				
Wading Bird	White Ibis	*Eudocimus albus*	x				
Wading Bird	Least Bittern	*Ixobrychus exilis*	x				
Wading Bird	Black Rail	*Laterallus jamaicensis*	x	x			
Wading Bird	Yellow-crowned Night-heron	*Nyctanassa violacea*	x	x			
Wading Bird	Black-crowned Night-heron	*Nycticorax nycticorax*	x	x			x
Wading Bird	Glossy Ibis	*Plegadis falcinellus*	x		x	x	x
Wading Bird	Sora	*Porzana carolina*	x				
Wading Bird	Clapper Rail	*Rallus crepitans*	x				
Wading Bird	King Rail	*Rallus elegans*	x				
Wading Bird	Virginia Rail	*Rallus limicola*	x				
Waterbird	Wood Duck	*Aix sponsa*	x		x		x
Waterbird	Northern Pintail	*Anas acuta*	x				
Waterbird	Green-winged Teal	*Anas crecca*	x		x	x	
Waterbird	Mallard	*Anas platyrhynchos*	x		x	x	x
Waterbird	American Black Duck	*Anas rubripes*	x		x	x	x
Waterbird	Snow Goose	*Anser caerulescens*	x				
Waterbird	Lesser Scaup	*Aythya affinis*	x			x	
Waterbird	Redhead	*Aythya americana*	x				
Waterbird	Ring-necked Duck	*Aythya collaris*	x		x		
Waterbird	Greater Scaup	*Aythya marila*	x			x	
Waterbird	Canvasback	*Aythya valisineria*	x			x	
Waterbird	Brant	*Branta bernicla*	x			x	
Waterbird	Canada Goose	*Branta canadensis*	x		x	x	x
Waterbird	Snowy Owl	*Bubo scandiacus*	x				
Waterbird	Bufflehead	*Bucephala albeola*	x		x	x	
Waterbird	Common Goldeneye	*Bucephala clangula*	x		x	x	
Waterbird	Long-tailed Duck	*Clangula hyemalis*	x			x	
Waterbird	Tundra Swan	*Cygnus columbianus*				x	
Waterbird	Mute Swan	*Cygnus olor*	x		x	x	x
Waterbird	American Coot	*Fulica americana*	x			x	
Waterbird	Common Gallinule	*Gallinula galeata*	x				
Waterbird	Common Loon	*Gavia immer*	x				
Waterbird	Red-throated Loon	*Gavia stellata*	x		x		
Waterbird	Hooded Merganser	*Lophodytes cucullatus*	x		x	x	
Waterbird	American Wigeon	*Mareca americana*	x			x	
Waterbird	Eurasian Wigeon	*Mareca penelope*	x				
Waterbird	Gadwall	*Mareca strepera*	x		x		
Waterbird	Black Scoter	*Melanitta americana*	x				
Waterbird	White-winged Scoter	*Melanitta deglandi*	x				
Waterbird	Surf Scoter	*Melanitta perspicillata*	x				
Waterbird	Common Merganser	*Mergus merganser*	x		x		
Waterbird	Red-breasted Merganser	*Mergus serrator*	x		x	x	
Waterbird	Ruddy Duck	*Oxyura jamaicensis*	x		x	x	
Waterbird	Double-crested Cormorant	*Phalacrocorax auritus*	x		x		x
Waterbird	Great Cormorant	*Phalacrocorax carbo*	x				
Waterbird	Horned Grebe	*Podiceps auritus*	x				
Waterbird	Red-necked Grebe	*Podiceps grisegena*	x				
Waterbird	Pied-billed Grebe	*Podilymbus podiceps*	x	x		x	

Group	Common Name	Scientific Name	Brady 1980	Oyster Creek Environmental Report	eBird - Forsythe NWR, Eno's Pond (Oyster Creek)	eBird - Lacey Township (Oyster Creek)	BBS (Oyster Creek)
Waterbird	Northern Shoveler	*Spatula clypeata*	x		x		
Waterbird	Blue-winged Teal	*Spatula discors*	x				

Table 4-7. Federally- and state-listed species potentially present in the Oyster Creek and BL England Study Corridors (E = Endangered, T = Threatened, SC = Special Concern, Br = breeding, NBr = non-breeding, BCC = Birds of Conservation Concern).

Group	Common Name	Scientific Name	NJ Status	Federal Status	BL England	Oyster Creek
Shorebirds	American Oystercatcher	*Haematopus palliatus*	SC - Br + NBr	BCC	x	x
Shorebirds	Lesser Yellowlegs	*Tringa flavipes*	-	BCC - NBr	x	x
Shorebirds	Whimbrel	*Numenius phaeopus*	SC - NBr	BCC - NBr	x	x
Shorebirds	Willet	*Tringa semipalmata*	-	BCC	x	x
Shorebirds	Hudsonian Godwit	*Limosa haemastica*	-	BCC - NBr	x	x
Shorebirds	Marbled Godwit	*Limosa fedoa*	-	BCC - NBr	x	x
Shorebirds	Short-billed Dowitcher	*Limnodromus griseus*	-	BCC - NBr	x	x
Shorebirds	Piping Plover	*Charadrius melodus*	E - Br + NBr	T	x	x
Shorebirds	Purple Sandpiper	*Calidris maritima*	-	BCC - NBr	x	x
Shorebirds	Semipalmated Sandpiper	*Calidris pusilla*	SC - NBr	BCC - NBr	x	x
Shorebirds	Spotted Sandpiper	*Actitis macularius*	SC - Br	-	x	x
Shorebirds	Buff-breasted Sandpiper	*Calidris subruficollis*	-	BCC - NBr	x	x
Shorebirds	Upland Sandpiper	*Batramia longicauda*	E - Br + NBr	BCC	x	x
Shorebirds	Solitary Sandpiper	*Tringa solitaria*	-	BCC - NBr	x	x
Shorebirds	Sanderling	*Calidris alba*	SC - NBr	-	x	x
Shorebirds	Red Knot	*Calidris canutus rufa*	E - NBr	T - NBr	x	x
Raptors	Bald Eagle	*Haliaeetus leucocephalus*	E - Br, T - NBr	BCC	x	x
Raptors	Peregrine Falcon	*Falco peregrinus*	E - Br, SC - NBb	BCC	x	x
Raptors	American Kestrel	*Falco sparverius*	T - Br + NBr	-	x	x
Raptors	Northern Goshawk	*Accipiter gentilis*	E - Br, SC - NBr	-	x	x
Raptors	Northern Harrier	*Circus cyaneus*	E - Br, SC - NBr	-	x	x
Raptors	Red-shouldered Hawk	*Buteo lineatus*	E - Br, SC - NBr	-	x	x
Raptors	Broad-winged Hawk	*Buteo platypterus*	SC - Br	-	x	x
Raptors	Cooper's Hawk	*Accipiter cooperii*	SC - Br	-	x	x
Raptors	Sharp-shinned Hawk	*Accipiter striatus*	SC - Br + NBr	-	x	x
Raptors	Osprey	*Pandion haliaetus*	T - Br	-	x	x
Raptors	Snowy Owl	*Bubo scandiacus*	-	BCC	x	x
Raptors	Short-eared Owl	*Asio flammeus*	E - Br, SC - NBr	BCC - NBr	x	x
Raptors	Barred Owl	*Strix varia*	T - Br + NBr	-	x	x
Raptors	Long-eared Owl	*Asio otus*	T - Br + NBr	-	x	x
Raptors	Barn Owl	*Tyto alba*	SC - Br + NBr	-	x	x
Wading Birds	Black Rail	*Laterallus jamaicensis*	E - Br, T - NBr	BCC	x	x
Wading Birds	King Rail	*Rallus elegans*	-	BCC	x	x
Wading Birds	American Bittern	*Botaurus lentiginosos*	E - Br, SC - NBr	BCC	x	x
Wading Birds	Least Bittern	*Ixobrychus exilis*	SC - Br + NBr	BCC	x	x
Wading Birds	Cattle Egret	*Bubulcus ibis*	T - Br, SC - NBr	-	x	x
Wading Birds	Snowy Egret	*Egretta thula*	SC - Br	BCC	x	x
Wading Birds	Black-crowned Night-heron	*Nycticorax nycticorax*	T - Br, SC - NBr	-	x	x
Wading Birds	Yellow-crowned Night-Heron	*Nyctanassa violacea*	T - Br + NBr	-	x	x
Wading Birds	Great Blue Heron	*Ardea herodias*	SC - Br	-	x	x
Wading Birds	Tricolored Heron	*Egretta tricolor*	SC - Br + NBr	-	x	x
Wading Birds	Little Blue Heron	*Egretta caerulea*	SC - Br + NBr	-	x	x
Wading Birds	Glossy Ibis	*Plegadis falcinellus*	SC - Br	-	x	x
Waterbirds	Pied-billed Grebe	*Podilymbus podiceps*	E - Br, SC - NBr	BCC	x	x
Waterbirds	Horned Grebe	*Pidiceps auritus*	-	BCC - NBr	x	x
Songbirds	Black-billed Cuckoo	*Coccyzus erythropthalmus*	SC - Br	BCC	x	x
Songbirds	Blue-headed Vireo	*Vireo solitarius*	SC - Br	-	x	
Songbirds	Bobolink	*Dolichonyx oryzivorus*	T - Br, SC - NBr	BCC	x	x
Songbirds	Brown Thrasher	*Toxostoma rufum*	SC - Br	-	x	x
Songbirds	Canada Warbler	*Cardellina canadensis*	SC - Br	BCC	x	x
Songbirds	Cerulean Warbler	*Dendroica cerulea*	SC - Br + NBr	BCC	x	x
Songbirds	Prairie Warbler	*Dendroica discolor*	-	BCC	x	x

Group	Common Name	Scientific Name	NJ Status	Federal Status	BL England	Oyster Creek
Songbirds	Blackburnian Warbler	*Dendroica fusca*	SC - Br	-	x	x
Songbirds	Black-throated Blue Warbler	*Dendroica caerulescens*	SC - Br	-	x	x
Songbirds	Black-throated Green Warbler	*Dendroica virens*	SC - Br	-	x	x
Songbirds	Prothonotary Warbler	*Protonotaria citrea*	-	BCC	x	x
Songbirds	Hooded Warbler	*Wilsonia citrina*	SC - Br	-	x	x
Songbirds	Nashville Warbler	*Oreothlypis ruficapilla*	SC - Br	-	x	x
Songbirds	Northern Parula	*Parula americana*	SC - Br	-	x	x
Songbirds	Worm-eating Warbler	*Helmitheros vermivorum*	SC - Br	BCC	x	x
Songbirds	Yellow-breasted Chat	*Icteria virens*	SC - Br	-	x	x
Songbirds	Kentucky Warbler	*Oporornis formosus*	SC - Br + NBr	BCC	x	x
Songbirds	Golden-winged Warbler	*Vermivora chrysoptera*	E - Br, SC - NBr	BCC	x	x
Songbirds	Blue-winged Warbler	*Vermivora cyanoptera*	-	BCC	x	x
Songbirds	Saltmarsh Sparrow	*Ammodramus caudacutus*	SC - Br	BCC	x	x
Songbirds	Seaside Sparrow	*Ammodramus maritimus*	-	BCC	x	x
Songbirds	Ipswich Sparrow	*Passerculus sandwichensis princeps*	SC - NBr	-	x	x
Songbirds	Nelson's Sparrow	*Ammodramus nelsoni*	-	BCC		x
Songbirds	Grasshopper Sparrow	*Ammodramus savannarum*	T - Br, SC - NBr	-	x	x
Songbirds	Savannah Sparrow	*Passerculus sandwichensis*	T - Br	-	x	x
Songbirds	Henslow's Sparrow	*Ammodramus henslowii*	E - Br + NBr	BCC	x	x
Songbirds	Vesper Sparrow	*Pooecetes gramineus*	E - Br, SC - NBr	-	x	x
Songbirds	Winter Wren	*Troglodytes hiemalis*	SC - Br	-	x	x
Songbirds	Sedge Wren	*Cistothorus platensis*	E - Br + NBr	BCC		x
Songbirds	Cliff Swallow	*Petrochelidon pyrrhonota*	SC - Br	-	x	x
Songbirds	Eastern Meadowlark	*Stunella magna*	SC - Br + NBr	-	x	x
Songbirds	Evening Grosbeak	*Coccothraustes vespertinus*	-	BCC	x	x
Songbirds	Red-headed Woodpecker	*Melanerpes erythrochephalus*	T - Br + NBr	BCC	x	x
Songbirds	Rusty Blackbird	*Euphagus carolinus*	-	BCC - NBr	x	x
Songbirds	Wood Thrush	*Hylocichla mustelina*	SC - Br	BCC	x	x
Songbirds	Gray-cheeked Thrush	*Catharus minimus*	SC - NBr	-	x	x
Songbirds	Veery	*Catharus fuscescens*	SC - Br	-	x	x
Songbirds	Least Flycatcher	*Empidonax minimus*	SC - Br	-	x	x
Songbirds	Loggerhead Shrike	*Lanius ludovicianus*	E - NBr	BCC	x	x
Songbirds	Horned Lark	*Eremophila alpestris*	T - Br, SC - NBr	-	x	x
Nightjars	Eastern Whip-poor-will	*Antrostomus vociferus*	SC - Br	BCC	x	x
Nightjars	Common Nighthawk	*Chordeiles minor*	SC - Br + NBr	-	x	x
Marine Birds	Black Skimmer	*Rynchops niger*	E - Br + NBr	BCC	x	x
Marine Birds	Common Tern	*Sterna hirundo*	SC - Br	-	x	x
Marine Birds	Gull-billed Tern	*Gelochelidon nilotica*	SC - Br + NBr	BCC	x	x
Marine Birds	Least Tern	*Sterna antillarum*	E - Br + NBb	BCC	x	x
Marine Birds	Roseate Tern	*Sterna dougallii*	E - Br + NBr	E	x	x
Marine Birds	Caspian Tern	*Hydroprogne caspia*	SC - Br	-	x	x
Water Birds	Red-throated Loon	*Gavia stellata*	-	BCC - NBr	x	x

5 References

[AWWI] American Wind Wildlife Institute (2016). Wind turbine interactions with wildlife and their habitats: a summary of research results and priority questions. (Updated June 2016). Washington, DC. Available at www.awwi.org.

[BOEM] Bureau of Ocean Energy Management (2012). Commercial Wind Lease Issuance and Site Characterization Activities on the Atlantic Outer Continental Shelf Offshore New Jersey , Delaware , Maryland , and Virginia Draft Environmental Assessment.

[BOEM] Bureau of Ocean Energy Management (2014). Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Revised Environmental Assessment.

[BOEM] Bureau of Ocean Energy Management (2016a). Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York: Revised Environmental Assessment. OCS EIS/EA BOEM 2016-070.

[BOEM] Bureau of Ocean Energy Management (2016b). Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (COP), Version 3.0. Bureau of Ocean Energy Management, Sterling, VA. 62 pp.

[BOEM] Bureau of Ocean Energy Management (2018). Vineyard Wind Offshore Wind Energy Project Draft Environmental Impact Statement. OCS EIS/EA BOEM 2018-060. [Online.] Available at https://www.boem.gov/Vineyard-Wind-EIS/.

[MMS] Minerals Management Service (2008a). Cape Wind Energy Project Nantucket Sound Biological Assessment (Appendix G). In Cape Wind Energy Project Final EIS. p. 296.

[MMS] Minerals Management Service (2008b). Cape Wind Energy Project Nantucket Sound Biological Assessment (Appendix G). In Cape Wind Energy Project Final EIS. p. 296.

[NJDEP] New Jersey Department of Environmental Protection (2017). New Jersey Bald Eagle Project, 2017.

[PPA] Pinelands Preservation Alliance (2018). Plants of the Pine Barrens.

[USFWS] U.S. Fish and Wildlife (2018). IPaC.

[USFWS] U.S. Fish and Wildlife Service (1994). Final Environmental Assessment and Land Protection Plan Proposal to Expand the Boundary of the Edwin B. Forsythe National Wildlife Refuge, Ocean County, New Jersey.

[USFWS] U.S. Fish and Wildlife Service (2001). Piping Plover Fact Sheet.

[USFWS] U.S. Fish and Wildlife Service (2009). Piping Plover 5-Year Review: Summary and Evaluation. In. Hadley, Massachusetts and East Lansing, Michigan.

[USFWS] U.S. Fish and Wildlife Service (2010). Caribbean Roseate Tern and North Atlantic Roseate Tern (Sterna dougallii dougallii) 5-Year Review: Summary and Evaluation.

[USFWS] U.S. Fish and Wildlife Service (2015). Status of the Species - Red Knot.

[USFWS] U.S. Fish and Wildlife Service (2019). All About Piping Plovers.

Adams, E. M., P. B. Chilson, and K. A. Williams (2015). Chapter 27 : Using WSR-88 weather radar to identify patterns of nocturnal avian migration in the offshore environment.

Ahlén, I., H. J. Baagøe, and L. Bach (2009). Behavior of Scandinavian Bats during Migration and Foraging at Sea. Journal of Mammalogy 90:1318–1323. doi: 10.1644/09-MAMM-S-223R.1

Alerstam, T. (1985). Strategies of migratory flight, illustrated by Arctic and Common Terns, Sterna paradisaea and Sterna hirundo. Contributions in Marine Science 27:580–603.

AmerGen (2005). Oyster Creek Generating Station Applicant's Environmental Report – Operating License Renewal Stage.

APEM (2016). Assessment of Displacement Impacts of Offshore Windfarms and Other Human Activities on Red-throated Divers and Alcids. Natural England Commissioned Reports, Number 227.

Atlantic County (1973). Atlantic County Environmental Inventory. Prepared by John G. Reutters Associates.

Baker, A., P. Gonzalez, R. I. G. Morrison, and B. A. Harrington (2013). Red Knot (Calidris canutus). In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York. doi: 10.2173/bna.563

Baldassarre, G. A., and E. G. Bolen (2006). Waterfowl Ecology and Management. In. 2nd edition. Krieger, Malabar FL.

Barbour, R. W., and W. H. Davis (1969). Bats of America: Lexington.

Barnegat Bay Partnership. 2018. Tidal Wetlands Habitat. Retrieved from: https://www.barnegatbaypartnership.org/learn/barnegat-bay-101/habitats-and-plants/tidal-wetlands-habitat/.

Biodiversity Research Institute. 2019. Assessment of the Potential Effects of the Ocean Wind Offshore Wind Farm on Birds & Bats: Lease Area OCS-A-0498. Report to HDR. Biodiversity Research Institute, Portland, ME. 166 pp.

Bivand, R., and C. Rundel (2017). rgeos: Interface to Geometry Engine - Open Source ('GEOS'). R package version 0.3-25.

Brady, S. A. (1980). An assessment of the birdlife of the Pinelands National Reserve/Pinelands area. doi: https://doi.org/doi:10.7282/T3X9296R

Broders, H. G., and G. J. Forbes (2004). Interspecific and Intersexual Variation in Roost-Site Selection of Northern Long-Eared and Little Brown Bats in the Greater Fundy National Park Ecosystem Author (s): Hugh G . Broders and Graham J . Forbes Published by : Wiley on behalf of the Wildlife S. The Journal of Wildlife Management 68:602–610.

Brooks, R. T., and W. M. Ford (2005). Bat activity in a forest landscape of central Massachusetts. Northeastern Naturalistaturalist 12:447–462. doi: 10.1656/1092-6194(2005)012[0447:BAIAFL]2.0.CO;2

Bruderer, B., and F. Lietchi (1999). Bird migration across the Mediterranean. In Proceedings of the 22nd International Ornithological Congress (N. J. Adams and R. H. Slotow, Editors). Durban, Johannesburg, South Africa, pp. 1983–1999.

Buehler, D. A. (2000). Bald Eagle (Haliaeetus leucocephalus). In The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America Inc., Philadelphia, PA.

Bull, L. S., S. Fuller, and D. Sim (2013). Post-construction avian mortality monitoring at Project West Wind. New Zealand Journal of Zoology 40:28–46. doi: 10.1080/03014223.2012.757242

Burger, J. (1990). Foraging behavior and the effect of human disturbance on the Piping Plover (*Charadrius melodus*). Journal of Coastal Research 7:39–52.

Burger, J. (2015). Laughing Gull (Leucophaeus atricilla), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/laugul.

Burger, J., C. Gordon, J. Lawrence, J. Newman, G. Forcey, and L. Vlietstra (2011). Risk evaluation for federally listed (roseate tern, piping plover) or candidate (red knot) bird species in offshore waters: A first step for managing the potential impacts of wind facility development on the Atlantic Outer Continental Shelf. Renewable Energy 36:338–351. doi: 10.1016/j.renene.2010.06.048

Burger, J., L. J. Niles, R. R. Porter, A. D. Dey, S. Kock, and C. Gordon (2012). Migration and Over-Wintering of Red Knots (Calidris canutus rufa) along the Atlantic Coast of the United States. The Condor 114:302–313. doi: 10.1525/cond.2012.110077

Carter, T. C., and G. A. Feldhamer (2005). Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest Ecology and Management 219:259–268. doi: 10.1016/j.foreco.2005.08.049

Cleasby, I. R., E. D. Wakefield, S. Bearhop, T. W. Bodey, S. C. Votier, and K. C. Hamer (2015). Three-dimensional tracking of a wide-ranging marine predator: Flight heights and vulnerability to offshore wind farms. Journal of Applied Ecology 52:1474–1482. doi: 10.1111/1365-2664.12529

Cochran, W. W. (1985). Ocean migration of Peregrine Falcons: is the adult male pelagic? In Proceedings of Hawk Migration Conference IV (M. Harwood, Editor). Hawk Migration Association of North America, Rochester, NY, pp. 223–237.

Cook, A. S. C. P., A. Johnston, L. J. Wright, and N. H. K. Burton (2012). A Review of Flight Heights and Avoidance Rates of Birds in Relation to Offshore Wind Farms. *Report prepared on behalf of The Crown Estate*. [Online.] Available at http://www.bto.org/sites/default/files/u28/downloads/Projects/Final_Report_SOSS02_BTO Review.pdf.

Le Corre, M., A. Ollivier, S. Ribes, P. Jouventin, and Anonymous (2002). Light-induced mortality of petrels: A 4-year study from Rèunion Island (Indian Ocean). Biological Conservation 105:93–102.

Cranmer, A., J. R. Smetzer, L. Welch, and E. Baker (2017). A Markov model for planning and permitting offshore wind energy: A case study of radio-tracked terns in the Gulf of Maine, USA. Journal of Environmental Management 193:400–409.

Cryan, P. M. (2008). Mating behavior as a Possible Cause of Bat Fatalities at Wind Turbines. The Journal of Wildlife Management 72:845–849. doi: 10.2193/2007-371

Cryan, P. M., and R. M. R. Barclay (2009). Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions. Journal of Mammalogy 90:1330–1340. doi: 10.1644/09-MAMM-S-076R1.1

Cryan, P. M., and A. C. Brown (2007). Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. Biological Conservation 139:1–11.

Cryan, P. M., P. M. Gorresen, C. D. Hein, M. R. Schirmacher, R. H. Diehl, M. M. Huso, D. T. S. Hayman, P. D. Fricker, F. J. Bonaccorso, D. H. Johnson, K. Heist, and D. C. Dalton (2014). Behavior of bats at wind turbines. Proceedings of the National Academy of Sciences 111:15126–15131. doi: 10.1073/pnas.1406672111

Curtice, C., J. Cleary, E. Shumchenia, and P. Halpin (2016). Marine-life Data and Analysis Team (MDAT) technical report on the methods and development of marine-life data to support regional ocean planning and management. Prepared on behalf of the Marine-life Data and Analysis Team (MDAT).

Cuviello, T. A. (2011). Environmental Resource Inventory Galloway Township, Atlantic County. [Online.] Available at http://www.gtnj.org/index.php/sustainability-home/environmental-resource-inventory/file.

CWF (2012). NJ Mobile Acoustic Bat Survey, 2012 Summary. Conserve Wildlife Foundation of New Jersey.

CWF (2014). 2014 Mobile Acoustic Bat Surveys and Summer Bat Count Results. Conserve Wildlife Foundation of New Jersey.

CWF (2018). Northern Long-Eared Bat Mist Netting and Radio Telemetry Study. http://www.conservewildlifenj.org/protecting/projects/bat/northern-long-eared-bat/.

DeLuca, W. V, B. K. Woodworth, C. C. Rimmer, P. P. Marra, P. D. Taylor, K. P. McFarland, S. A. Mackenzie, and D. R. Norris (2015a). Transoceanic migration by a 12 g songbird. Biology Letters 11.

DeLuca, W. V, B. K. Woodworth, C. C. Rimmer, P. P. Marra, P. D. Taylor, K. P. McFarland, S. A. Mackenzie, and D. R. Norris (2015b). Transoceanic migration by a 12 g songbird. Biology Letters 11.

Desholm, M. (2009). Avian sensitivity to mortality: Prioritising migratory bird species for assessment at proposed wind farms. Journal of Environmental Management 90:2672–2679.

Desholm, M., and J. Kahlert (2005). Avian collision risk at an offshore wind farm. Biology Letters 1:296–298.

DeSorbo, C. R., L. Gilpatrick, C. Persico, and W. Hanson (2018a). Pilot Study: Establishing a migrant raptor research station at the Naval and Telecommunications Area Master Station Atlantic Detachment Cutler, Cutler Maine. Biodiversity Research Institute, Portland, Maine. 6 pp.

DeSorbo, C. R., R. B. Gray, J. Tash, C. E. Gray, K. A. Williams, and D. Riordan (2015). Offshore migration of Peregrine Falcons (Falco peregrinus) along the Atlantic Flyway. In Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Outer Continental Shelf: Final Report to the Department of Energy EERE Wind.

DeSorbo, C. R., C. Martin, A. Gravel, J. Tash, R. Gray, C. Persico, L. Gilpatrick, and W. Hanson (2018b). Documenting home range, migration routes and wintering home range of breeding Peregrine Falcons in New Hampshire. [Online.] Available at http://www.briloon.org/breedingperegrines.

DeSorbo, C. R., C. Persico, and L. Gilpatrick (2018c). Studying migrant raptors using the Atlantic Flyway. Block Island Raptor Research Station, Block Island, RI: 2017 season.

DeSorbo, C. R., K. G. Wright, and R. Gray (2012). Bird migration stopover sites: ecology of nocturnal and diurnal raptors at Monhegan Island. [Online.] Available at http://www.briloon.org/raptors/monhegan.

Dierschke, V., R. W. Furness, and S. Garthe (2016). Seabirds and offshore wind farms in European waters: Avoidance and attraction. Biological Conservation 202:59–68. doi: 10.1016/j.biocon.2016.08.016

Dierschke, V., S. Garthe, B. Mendel, J. KÃller, J. KÃppel, and W. Peters (2006). Possible Conflicts between Offshore Wind Farms and Seabirds in the German Sectors of North Sea and Baltic Sea. In (Anonymous, Editor). Springer, Berlin, Germany, pp. 121–143.

DiGaudio, R., and G. R. Geupel (2014). Assessing Bird and Bat Mortality at the McEvoy Ranch Wind Turbine in Marin County, California, 2009-2012. Point Blue Conservation Science.

Dorr, B. S., J. J. Hatch, and D. V. Weseloh (2014). Double-crested Cormorant (Phalacrocorax auritus). In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY. doi: 10.2173/bna.441

Douglas, D. C., R. Weinzierl, S. C. Davidson, R. Kays, M. Wikelski, and G. Bohrer (2012). Moderating Argos location errors in animal tracking data. Methods in Ecology and Evolution 3:999–1007. doi: 10.1111/j.2041-210X.2012.00245.x

Dowling, Z. R., and D. I. O'Dell (2018). Bat Use of an Island off the Coast of Massachusetts. Northeastern Naturalist 25:362–382. doi: 10.1656/045.025.0302

Dowling, Z., P. R. Sievert, E. Baldwin, L. Johnson, S. von Oettingen, and J. Reichard (2017). Flight Activity and Offshore Movements of Nano-Tagged Bats on Martha's Vineyard, MA. US Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, Virginia. OCS Study BOEM 2017-054. 39 pp.

Drewitt, A. L., and R. H. W. Langston (2006). Assessing the Impacts of Wind Farms on Birds. Ibis 148:29–42. doi: 10.1111/j.1474-919X.2006.00516.x

Dürr, T. (2011). Bird loss of wind turbines in Germany: data from the central register of the National Fund Ornithological Station State Office for Environment Office, Health and Consumer Protection, Brandenburg, Germany.

EBird (2018). eBird: An online database of bird distribution and abundance [web application]. Cornell Lab of Ornithology, Ithaca, New York. [Online.] Available at http://www.ebird.org.

Elliott-Smith, E., and S. M. Haig (2004). Piping Plover (Charadrius melodus). In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York. doi: DOI: 10.2173/bna.2

Epsilon Associates Inc. (2018). Draft Construction and Operations Plan. Vineyard Wind Project. October 22, 2018. Accessed November 4, 2018. Retrieved from: https://www.boem.gov/Vineyard-Wind/.

Erickson, W. P., J. D. Jeffrey, and V. K. Poulton (2008). Puget Sound Energy Wild Horse Wind Facility Post-Construction Avian and Bat Monitoring. First Annual Report. January - December 2007. *A report prepated for Puget Sound Energy, Ellensburg, Washington and the Wild Horse Wind Facility Technical Advisory Committee, Kittatas County, Washington*.

Erickson, W. P., M. M. Wolfe, K. J. Bay, D. H. Johnson, and J. L. Gehring (2014). A comprehensive analysis of small-passerine fatalities from collision with turbines at wind energy facilities. PLoS ONE 9. doi: 10.1371/journal.pone.0107491

Everaert, J., E. Stienen, and Anonymous (2007). Impact of wind turbines on birds in Zeebrugge (Belgium). Biodiversity and Conservation 16:3345–3359.

Faaborg, J., R. T. Holmes, A. D. Anders, K. L. Bildstein, K. M. Dugger, S. A. Gauthreaux, P. Heglund, K. A. Hobson, A. E. Jahn, D. H. Johnson, S. C. Latta, et al. (2010). Recent advances in understanding migration systems of New World land birds. Ecological Monographs 80:3–48. doi: 10.1890/09-0395.1

Fox, A. D., M. Desholm, J. Kahlert, T. K. Christensen, and I. K. Petersen (2006). Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds. Ibis 148:129–144. doi: 10.1111/j.1474-919X.2006.00510.x

Furness, R. W., H. M. Wade, and E. A. Masden (2013). Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management 119:56–66. doi: 10.1016/j.jenvman.2013.01.025

Garthe, S., N. Guse, W. A. Montevecchi, J. F. Rail, and F. Grégoire (2014). The daily catch: Flight altitude and diving behavior of northern gannets feeding on Atlantic mackerel. Journal of Sea Research 85:456–462. doi: 10.1016/j.seares.2013.07.020

Garthe, S., and O. Hüppop (2004). Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology 41:724–734. doi: 10.1111/j.0021-8901.2004.00918.x

Garthe, S., N. Markones, and A. M. Corman (2017). Possible impacts of offshore wind farms on seabirds: a pilot study in Northern Gannets in the southern North Sea. Journal of Ornithology 158:345–349. doi: 10.1007/s10336-016-1402-y

Gaston, A. J., and I. L. Jones (1998). The Auks: Alcidae. Bird Families of the World, vol. 5. In. Oxford: Oxford University Press.

Gauthreaux, S. A., and C. G. Belser (1999). Bird migration in the region of the Gulf of Mexico. In Proceedings of the 22nd International Ornithological Congress (N. J. Adams and R. H. Slotow, Editors). BirdLife South Africa, Durban, Johannesburg, South Africa, pp. 1931–1947.

Good, T. P. (1998). Great Black-backed Gull(Larus marinus). The Birds of North America:32.

Goodale, M. W., and A. Milman (2016). Cumulative adverse effects of offshore wind energy development on wildlife. Journal of Environmental Planning and Management 59:1–21. doi: 10.1080/09640568.2014.973483

Goodale, M. W., and I. J. Stenhouse (2016). A conceptual model for determining the vulnerability of wildlife populations to offshore wind energy development. Human-Wildlife Interactions 10:53–61.

Grady, F. V, and S. L. Olson (2006). Fossil bats from quaternary deposits on Bermuda (chiroptera: vespertilionidae). Journal of Mammalogy 87:148–152.

Gray, C. E., A. T. Gilbert, I. J. Stenhouse, and A. M. Berlin (2016). Occurrence patterns and migratory pathways of Red-throated Loons wintering in the offshore Mid-Atlantic U. S., 2012-2016. In Determining Fine-scale Use and Movement Patterns of Diving Bird Species in Federal Waters of the Mid-Atlantic United States Using Satellite Telemetry (C. S. Spiegel, A. M. Berlin, A. T. Gilbert, C. O. Gray, W. A. Montevecchi, I. J. Stenhouse, S. L. Ford, G. H. Olsen, J. L. Fiely, L. Savoy, M. W. Goodale and C. M. Burke, Editors). Department of the Interior, Bureau of Ocean Energy Management . OCS Study BOEM 2017-069, pp. 2012–2016.

Griffin, D. R. (1945). Travels of Banded Cave Bats. Journal of Mammalogy 26:15–23.

Hartman, J. C., K. L. Krijgsveld, M. J. M. Poot, R. C. Fijn, M. F. Leopold, and S. Dirksen (2012). Effects on birds of Offshore Wind farm Egmond aan Zee (OWEZ). An overview and integration of insights obtained. Report 12-005.

Hatch, J. J., K. M. Brown, G. G. Hogan, and R. D. Morris (2000). Great cormorant(Phalacrocorax carbo). The Birds of North America:32.

Hatch, S. K., E. E. Connelly, T. J. Divoll, I. J. Stenhouse, and K. A. Williams (2013). Offshore Observations of Eastern Red Bats (Lasiurus borealis) in the Mid-Atlantic United States Using Multiple Survey Methods. PLoS ONE 8:e83803. doi: 10.1371/journal.pone.0083803

Hayes, M. A. (2013). Bats Killed in Large Numbers at United States Wind Energy Facilities. BioScience 63:975–979. doi: 10.1093/biosci/biu056

Hein, C. D., A. Prichard, T. Mabee, and M. R. Schirmacher (2013). Avian and Bat Post-construction Monitoring at the Pinnacle Wind Farm, Mineral County, West Virginia: 2012 Final Report. *An annual report submitted to the Bats and Wind Energy Cooperative*.

Hill, R., K. Hill, R. Aumuller, A. Schulz, T. Dittmann, C. Kulemeyer, and T. Coppack (2014). Of birds, blades, and barriers: Detecting and analysing mass migration events at alpha ventus. In Ecological Research at the Offshore Windfarm alpha ventus - Challenges, Results, and Perspectives (Federal Maritime and Hydrographic Agency (BSH), Federal Ministry of the Environment Nature Conservation and Nuclear Safety (BMU), A. Beiersdorf and K. Wollny-Goerke, Editors). Springer Spektrum, Hamburg and Berlin, Germany, pp. 111–132. doi: 10.1007/978-3-658-02462-8

Horn, J. W., E. B. Arnett, and T. H. Kunz (2008). Behavioral Responses of Bats to Operating Wind Turbines. Journal of Wildlife Management 72:123–132. doi: 10.2193/2006-465

Hötker, H., K. Thomsen, and H. Jeromin (2006). Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation.

Hüppop, O., J. Dierschke, K.-M. Exo, E. Fredrich, and R. Hill (2006). Bird migration studies and potential collision risk with offshore wind turbines. Ibis 148:90–109. doi: 10.1111/j.1474-919X.2006.00536.x

Huppop, O., and G. Hilgerloh (2012). Flight call rates of migrating thrushes: effects of wind conditions, humidity and time of day at an illuminated offshore platform. Journal of Avian Biology:85.

Imber, M. J. (1975). Behaviour of petrels in relation to the moon and artificial lights. Journal of the Ornithological Society of New Zealand 22:302–306.

Jacobsen, E. M., F. P. Jensen, and J. Blew (2019). Avoidance Behaviour of Migrating Raptors Approaching an Offshore Wind Farm. In Wind Energy and Wildlife Impacts : Balancing Energy Sustainability with Wildlife Conservation (R. Bispo, J. Bernardino, H. Coelho and J. Lino Costa, Editors). Springer International Publishing, Cham, pp. 43–50. doi: 10.1007/978-3-030-05520-2_3

Jensen, F., M. Laczny, W. Piper, and T. Coppack (2014). Horns Rev 3 Offshore Wind Farm - Migratory Birds. [Online.] Available at http://www.4coffshore.com/windfarms/horns-rev-1-denmark-dk03.html.

Johnson, G. D., and E. B. Arnett (2004). A Bibliography of Bat Fatality, Activity, and interactions with Wind Turbines. [Online.] Available at http://www.batsandwind.org/pdf/BWEC BIBLIOGRAPHY_February 2014.pdf.

Johnson, J. A., J. Storrer, K. Fahy, and B. Reitherman (2011a). Determining the potential effects of artificial lighting from Pacific Outer Continental Shelf (POCS) region oil and gas facilities on migrating birds. Prepared by Applied Marine Sciences, Inc. and Storrer Environmental Services for the U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulations and Enforcement. Camarillo, CA. OCS Study BOEMRE 2011-047:29 pp.

Johnson, J. B., J. E. Gates, and N. P. Zegre (2011b). Monitoring seasonal bat activity on a coastal barrier island in Maryland, USA. Environmental Monitoring and Assessment 173:685–699. doi: 10.1007/s10661-010-1415-6

Johnston, A., A. S. C. P. Cook, L. J. Wright, E. M. Humphreys, and N. H. K. Burton (2014a). Modelling Flight Heights of Marine Birds to More Accurately Assess Collision Risk with Offshore Wind Turbines. Journal of Applied Ecology 51:31–41. doi: 10.1111/1365-2664.12191

Johnston, A., A. S. C. P. Cook, L. J. Wright, E. M. Humphreys, and N. H. K. Burton (2014b). Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. Journal of Applied Ecology 51:31–41. doi: 10.1111/1365-2664.12191

Jongbloed, R. H. (2016). Flight height of seabirds. A literature study IMARES. Report C024/16.

Kahlert, I., A. Fox, M. Desholm, I. Clausager, and J. Petersen (2004). Investigations of Birds During Construction and Operation of Nysted Offshore Wind Farm at Rødsand. Report by National Environmental Research Institute (NERI). pp 88.

Katzner, T., B. W. Smith, T. A. Miller, D. Brandes, J. Cooper, M. Lanzone, D. Brauning, C. Farmer, S. Harding, D. E. Kramar, C. Koppie, et al. (2012). Status, biology, and conservation priorities for North America’s eastern Golden Eagle (Aquila chrysaetos) population. Auk 129:168–176. doi: 10.1525/auk.2011.11078

Kerlinger, P. (1985). Water-crossing behavior of raptors during migration. Wilson Bulletin 97:109–113.

Krijgsveld, K. L., R. C. Fljn, M. Japink, P. W. van Horssen, C. Heunks, M. P. Collier, M. J. M. Poot, D. Beuker, and S. Birksen (2011). Effect Studies Offshore Wind Farm Egmond aan Zee: Final report on fluxes, flight altitudes and behaviour of flying birds. *Report commissioned by NoordzeeWind*.

Kunz, T. H., E. B. Arnett, B. M. Cooper, W. P, R. P. Larkin, T. Mabee, M. L. Morrison, M. D. Strickland, and J. M. Szewczak (2007). Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats : A Guidance Document. 71:2449–2486.

Kushlan, J. A., and H. Hafner (2000). Heron Conservation. In. Academic, London, UK.

Langston, R. H. W. (2013). Birds and wind projects across the pond: A UK perspective. Wildlife Society Bulletin 37:5–18. doi: 10.1002/wsb.262

Larsen, J. K., and M. Guillemette (2007). Effects of wind turbines on flight behaviour of wintering common eiders : implications for habitat use and collision risk. Journal of Applied Ecology 44:516–522. doi: 10.1111/j.1365-2664.2007.1303.x

Leonhard, S. B., J. Pedersen, P. N. Gron, H. Skov, J. Jansen, C. Topping, and I. K. Petersen (2013). Wind farms affect common scoter and red-throated diver behaviour. In Danish Offshore Wind: Key Environmental Issues - A Follow-up. The Environment Group: The Danish Energy Agency. The Danish Nature Agency, DONG Energy and Vattenfall, pp. 70–93.

Lindeboom, H. J., H. J. Kouwenhoven, M. J. N. Bergman, S. Bouma, S. Brasseur, R. Daan, R. C. Fijn, D. de Haan, S. Dirksen, R. van Hal, R. Hille Ris Lambers, et al. (2011). Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. Environmental Research Letters 6:035101. doi: 10.1088/1748-9326/6/3/035101

Loring, P., H. Goyert, C. Griffin, P. Sievert, and P. Paton (2017). Tracking Movements of Common Terns, Endangered Roseate Terns, and Threatened Piping Plovers in the Northwest Atlantic: 2017 Annual Report to the Bureau of Ocean Energy Management (BOEM). In. Interagency Agreement No. M13PG00012 to U.S. Fish and Wildlife Service Northeast Region Division of Migratory Birds, Hadley, Massachusetts.

Loring, P. H., P. W. C. Paton, J. D. McLaren, H. Bai, R. Janaswamy, H. F. Goyert, C. R. Griffin, and P. R. Sievert (2019). Tracking Offshore Occurrence of Common Terns, Endangered Roseate Terns, and Threatened Piping Plovers with VHF Arrays. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2019-017. 140 p. [Online.] Available at https://espis.boem.gov/final reports/BOEM_2019-017.pdf.

Loring, P., J. McLaren, P. Smith, L. Niles, S. Koch, H. Goyert, and Bai (2018). Tracking movements of threatened migratory rufa Red Knots in U.S. Atlantic Outer Continental Shelf Waters. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-046. 145 p.

Martin, C. M., E. B. Arnett, R. D. Stevens, and M. C. Wallace (2017). Reducing bat fatalities at wind facilities while improving the economic efficiency of operational mitigation. Journal of Mammalogy 98:378–385.

Maslo, B., and K. Leu (2013). The Facts About Bats in New Jersey.

McGrady, M. J., G. S. Young, and W. S. Seegar (2006). Migration of a Peregrine Falcon Falco peregrinus over water in the vicinity of a hurricane. Ringing and Migration 23:80–84.

McNicholl, M. K., P. E. Lowther, and J. A. Hall (2001). Forster's Tern (Sterna forsteri). The Birds of North America Online. doi: 10.2173/bna.595

Meek, E. R., J. B. Ribbands, W. G. Christer, P. R. Davy, and I. Higginson (1993). The effects of aero-generators on moorland bird populations in the Orkney Islands, Scotland. Bird Study 40:140–143. doi: 10.1080/00063659309477139

Mendel, B., P. Schwemmer, V. Peschko, S. Müller, H. Schwemmer, M. Mercker, and S. Garthe (2019). Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of Loons (Gavia spp.). Journal of Environmental Management 231:429–438. doi: 10.1016/j.jenvman.2018.10.053

Menzel, M. A., T. C. Carter, J. M. Menzel, W. Mark Ford, and B. R. Chapman (2002). Effects of group selection silviculture in bottomland hardwoods on the spatial activity patterns of bats. Forest Ecology and Management 162:209–218. doi: 10.1016/S0378-1127(01)00516-3

Mizrahi, D., R. Fogg, K. A. Peters, and P. A. Hodgetts (2009). Assessing nocturnal bird and bat migration patterns on the Cape May peninsula using marine radar: potential effects of a suspension bridge spanning Middle Thoroughfare, Cape May County, New Jersey.

MMO (2018). Displacement and habituation of seabirds in response to marine activities. A report produced for the Marine Management Organisation,. MMO Project No: 1139, May 2018, 69pp. [Online.] Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/715604/Displacement_and_habituation_of_seabirds_in_response_to_marine_activities.pdf.

Mojica, E. K., B. D. Watts, and C. L. Turrin (2016). Utilization Probability Map for Migrating Bald Eagles in Northeastern North America: A Tool for Siting Wind Energy Facilities and Other Flight Hazards. Plos One 11. doi: 10.1371/journal.pone.0157807

Montevecchi, W. A. (2006). Influences of artificial light on marine birds. In Ecological Consequences of Artificial Night Lighting (C. Rich and T. Longcore, Editors). Island Press, Washington, D.C., pp. 94–113. doi: 10.1111/bph.13539

Morris, S. R., M. E. Richmond, and D. W. Holmes (1994). Patterns of stopover by warblers during spring and fall migration on Appledore Island, Maine. Wilson Bulletin 106:703–718.

Mostello, C. S., I. C. T. Nisbet, S. A. Oswald, and J. W. Fox (2014). Non-breeding season movements of six North American Roseate Terns Sterna dougallii tracked with geolocators. Seabird 27:1–21.

Mowbray, T. B. (2002). Northern Gannet (Morus bassanus). In The Birds of North America (A. Poole and F. Gill, Editors). The Birds of North America Inc., Philadelphia, PA.

National Park Service (2018). Pinelands National Reserve. [Online.] Available at https://www.nationalparks.org/explore-parks/pinelands-national-reserve.

New Jersey Division of Fish and Wildlife (2018). New Jersey's Wildlife Action Plan. [Online.] Available at https://www.state.nj.us/dep/fgw/ensp/wap/pdf/wap_plan18.pdf.

Nisbet, I. C. T. (1984). Migration and winter quarters of North American Roseate Terns as shown by banding recoveries. Journal of Field Ornithology 55:1–17.

Nisbet, I. C. T., M. Gochfeld, and J. Burger (2014). Roseate Tern (Sterna dougallii). *The Birds of North America Online*. doi: 10.2173/bna.370

Nisbet, I. C. T., R. R. Veit, S. A. Auer, and T. P. White (2013). Marine Birds of the Eastern United States and the Bay of Fundy: Distribution, Numbers, Trends, Threats, and Management. In. No. 29. Nuttall Ornithological Club, Cambridge, MA.

Nisbet, I. C. T., D. V. Weseloh, C. E. Hebert, M. L. Mallory, A. F. Poole, J. C. Ellis, P. Pyle, and M. A. Patten (2017). Herring Gull (Larus argentatus). In The Birds of North America (P. G. Rodewald, Editor). Ithaca: Cornell Lab of Ornithology.

NJ Division of Fish and Wildlife (2017). Bat Conservation in Winter.

NJDEP (2010). Technical Manual for Evaluating Wildlife Impacts of Wind Turbines Requiring Coastal Permits. 38.

Norberg, U. M., and J. M. V Rayner (1987). Ecological morphology and flight in bats (Mammalia; Chiroptera): wing adaptations, flight performance, foraging strategy and echolocation. Philosophical Transactions of the Royal Society of London B: Biological Sciences 316:335–427.

Normandeau Associates Inc. (2011). New insights and new tools regarding risk to roseate terns, piping plovers, and red knots from wind facility operations on the Atlantic Outer Continental Shelf. A Final Report for the U.S. Department of the Interior, Bureau of Ocean Energy Management, Reg.

NYSERDA (2010). Pre-development assessment of avian species for the proposed Long Island New York City offshore wind project area.

NYSERDA (2015). Advancing the Environmentally Responsible Development of Offshore Wind Energy in New York State: A Regulatory Review and Stakeholder Perceptions. NYSERDA Report 15-16.

Ocean City (2009). Conservation Plan Element: Environmental Resources and Recreation Inventory. Retrieved from: https://www.beyondpesticides.org/assets/media/documents/states/nj/documents/NJOceanCityIPM.pdf.

Orsted (2018). Hornsea Three Offshore Wind Farm Environmental Statement: Volume 2, Chapter 5 – Offshore Ornithology. Report No. A6.2.5.

Owen, M., and J. M. Black (1990). Waterfowl Ecology. In. Chapman & Hall, New York, NY.

Partnership, B. B. (2018). Tidal Wetlands Habitat. [Online.] Available at https://www.barnegatbaypartnership.org/learn/barnegat-bay-101/habitats-and-plants/tidal-wetlands-habitat/.

Pelletier, S. K., K. S. Omland, K. S. Watrous, and T. S. Peterson (2013). Information synthesis on the potential for bat interactions with offshore wind facilities: Final Report.

Percival, S. M. (2010). Kentish Flats Offshore Wind Farm: Diver Surveys 2009-10.

Perkins, S., T. Allison, A. Jones, and G. Sadoti (2004). A Survey of Tern Activity Within Nantucket Sound, Massachusetts During the 2003 Fall Staging Period. Final Report to the Massachusetts Technology Collaborative, 10 September 2004.

Petersen, I. K., T. K. Christensen, J. Kahlert, M. Desholm, and A. D. Fox (2006). Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. *Report commissioned by DONG Energy and Vattenfall A/S*.

Petersen, I. K., and A. D. Fox (2007). Changes in bird habitat utilisation around the Horns Rev 1 offshore wind farm, with particular emphasis on Common Scoter.

Peterson, T. S., S. K. Pelletier, S. A. Boyden, and K. S. Watrous (2014). Offshore acoustic monitoring of bats in the Gulf of Maine. Northeastern Naturalist 21:154–163.

Pettersson, J. (2005). The impact of offshore wind farms on bird life in Southern Kalmar Sound Sweden final report based on studies 1999-2003.

Pettersson, J., and J. Fågelvind (2011). Night Migration of Songbirds and Waterfowl at the Utgrunden Off-Shore Wind Farm: A Radar-Assisted Study in Southern Kalmar Sound.

Pettit, J. L., and J. M. O'Keefe (2017). Day of year, temperature, wind, and precipitation predict timing of bat migration. Journal of Mammalogy 98:1236–1248. doi: 10.1093/jmammal/gyx054

Pinelands Preservation Alliance (PPA).2018. Retrieved from: http://www.pinelandsalliance.org/.

Pollet, I. L., D. Shutler, J. W. Chardine, and J. P. Ryder (2012). Ring-billed Gull (Larus delawarensis), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/ribgul.

R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-9000-07-0. [Online.] Available at http://www.r-project.org/.

Radis, R. P., and C. C. Sutton (1991). Threatened and Endangered Wildlife Survey and Habitat Evaluation of the Potential U.S. Fish and Wildlife Service Land Acquisition Areas, from Goodluck Point South to the Double Creek Area.

Risley, L. S. (2015). Bat Monitoring in Area B and Other, Similar Wetlands on the FAA Technical Center Property; Summary Report, 2015.

Rodríguez, A., G. Burgan, P. Dann, R. Jessop, J. J. Negro, and A. Chiaradia (2014). Fatal attraction of short-tailed shearwaters to artificial lights. PLoS ONE 9:1–10. doi: 10.1371/journal.pone.0110114

Rodríguez, A., P. Dann, and A. Chiaradia (2017). Reducing light-induced mortality of seabirds: High pressure sodium lights decrease the fatal attraction of shearwaters. Journal for Nature Conservation 39:68–72. doi: 10.1016/j.jnc.2017.07.001

Rodríguez, A., B. Rodríguez, and J. J. Negro (2015). GPS tracking for mapping seabird mortality induced by light pollution. Scientific Reports 5:1–11. doi: 10.1038/srep10670

Rubega, M. A., D. Schamel, and D. M. Tracy (2000). Red-necked Phalarope (Phalaropus lobatus), version 2.0. In The Birds of North America (P. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca.

Rydell, J., and A. Wickman (2015). Bat Activity at a Small Wind Turbine in the Baltic Sea. Acta Chiropterologica 17:359–364. doi: 10.3161/15081109ACC2015.17.2.011

Sauer, J. R., D. K. Niven, J. E. Hines, J. Ziolkowski, D. J., K. L. Pardieck, J. E. Fallon, and W. A. Link (2017). The North American Breeding Bird Survey, Results and Analysis 1966 - 2015. Version 2.07.2017.

Silvis, A., R. W. Perry, and W. M. Ford (2016). Relationships of three species of bats impacted by white-nose syndrome to forest condition and management. USFS General Technical Report SRS–214:48.

Sjollema, A. L., J. E. Gates, R. H. Hilderbrand, and J. Sherwell (2014). Offshore Activity of Bats Along the Mid-Atlantic Coast. Northeastern Naturalist 21:154–163.

Skov, H., M. Desholm, S. Heinänen, J. A. Kahlert, B. Laubek, N. E. Jensen, R. Žydelis, and B. P. Jensen (2016). Patterns of migrating soaring migrants indicate attraction to marine wind farms. Biology Letters 12:20160804. doi: 10.1098/rsbl.2016.0804

Skov, H., S. Heinanen, T. Norman, R. M. Ward, S. Mendez-Roldan, and I. Ellis (2018). ORJIP Bird Collision and Avoidance Study. Final report - April 2018. *The Carbon Trust*.

Smallwood, K. S. (2013). Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin 37:19–33. doi: 10.1002/wsb.260

Smith, A. D., and S. R. McWilliams (2016). Bat activity during autumn relates to atmospheric conditions: Implications for coastal wind energy development. Journal of Mammalogy 97:1565–1577. doi: 10.1093/jmammal/gyw116

Somers Point City (1993). A Natural Resource Inventory of the City of Somers Point, Atlantic County, New Jersey with Special Emphasis on the City Owned Portion of Drag Island, The Steelmanville Tract, Kennedy Park. Prepared for Somers Point Environmental Commission by Amy S. Green.

Spiegel, C. S., A. M. Berlin, A. T. Gilbert, C. O. Gray, W. A. Montevecchi, I. J. Stenhouse, S. L. Ford, G. H. Olsen, J. L. Fiely, L. Savoy, M. W. Goodale, and C. M. Burke (2017). Determining Fine-scale Use and Movement Patterns of Diving Bird Species in Federal Waters of the Mid-Atlantic United States Using Satellite Telemetry.

Stenhouse, I. J., W. A. Montevecchi, C. E. Gray, A. T. Gilbert, C. M. Burke, and A. M. Berlin (2017). Occurrence and Migration of Northern Gannets Wintering in Offshore Waters of the Mid-Atlantic United States. In Determining Fine- scale Use and Movement Patterns of Diving Bird Species in Federal Waters of the Mid- Atlantic United States Using Satellite Telemetry (C. S. Spiegel, Editor). U.S. Department of the Interior, Bureau of Ocean Energy Management, Division of Environmental Sciences, Sterling, VA.

Sullivan, B. L., C. L. Wood, M. J. Iliff, R. E. Bonney, D. Fink, and S. Kelling (2009). eBird: A citizen-based bird observation network in the biological sciences. Biological Conservation 142:2282–2292. doi: 10.1016/j.biocon.2009.05.006

Taylor, D. A. R. (2006). Forest management and bats. Bat Conservation International 13.

Thaxter, C. B., V. H. Ross-Smith, and W. Bouten (2015). Seabird – wind farm interactions during the breeding season vary within and between years : A case study of lesser black-backed gull Larus fuscus in the UK. Biological Conservation 186:347–358. doi: 10.1016/j.biocon.2015.03.027

Thaxter, C. B., V. H. Ross-Smith, W. Bouten, E. A. Masden, N. A. Clark, G. J. Conway, L. Barber, G. D. Clewley, and N. H. K. Burton (2018). Dodging the blades: New insights into three-dimensional space use of offshore wind farms by lesser black-backed gulls Larus fuscus. Marine Ecology Progress Series 587:247–253. doi: 10.3354/meps12415

Tracy, D. M., D. Schamel, and J. Dale (2002). Red Phalarope (Phalaropus fulicarius), version 2.0. In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca.

Tuttle, M. D., and D. A. R. Taylor (1998). Bats and Mines. In. Revised ed. Bat Conservation International, Austin, TX.

USFWS. 1994. Final Environmental Assessment and Land Protection Plan Proposal to Expand the Boundary of the Edwin B. Forsythe National Wildlife Refuge, Ocean County, New Jersey. Hadley, MA

USFWS (2016). 4(d) Rule for the Northern Long-Eared Bat. 50 CFR Part 17, Docket No. FWS–R5–ES–2011–0024; 4500030113. RIN 1018–AY98. Federal Register 81(9): 1900-1922.

USFWS (2018). Piping Plover. New Jersey Field Office. [Online.] Available at https://www.fws.gov/northeast/njfieldoffice/endangered/plover.html.

USFWS New Jersey Field Office (2017). New Jersey Municipalities with Hibernation or Maternity Occurrence of Indiana Bat or Northern Long-eared Bat.

USFWS New Jersey Field Office (2018). Indiana Bat (Myotis sodalis).

Vanermen, N., T. Onkelinx, W. Courtens, M. Van de walle, H. Verstraete, and E. W. M. Stienen (2015). Seabird avoidance and attraction at an offshore wind farm in the Belgian part of the North Sea. Hydrobiologia 756:51–61. doi: 10.1007/s10750-014-2088-x

Vlietstra, L. S. (2007). Potential Impact of the Massachusetts Maritime Academy Wind Turbine on Common (Sterna hirundo) and Roseate (S. dougallii) Terns. 1–6.

Voous, K. H. (1961). Records of the Peregrine Falcon on the Atlantic Ocean. Ardea 49:176–177.

Wade, H. M., E. A. Masden, A. C. Jackson, and R. W. Furness (2016). Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments. Marine Policy 70:108–113. doi: 10.1016/j.marpol.2016.04.045

Wiley, R. H., and D. S. Lee (1999). Parasitic Jaeger (Stercorarius parasiticus). In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY. doi: 10.2173/bna.445

Williams, K. A., E. E. Connelly, S. M. Johnson, and I. J. Stenhouse (2015a). Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Outer Continental Shelf: Final Report to the Department of Energy EERE Wind & Water Power Technologies Office, Award Number: DE-EE0005362. Report BRI 2015-11. In. Biodiversity Research Institute, Portland, Maine.

Williams, K. A., I. J. Stenhouse, E. E. Connelly, and S. M. Johnson (2015b). Mid-Atlantic Wildlife Studies: Distribution and Abundance of Wildlife along the Eastern Seaboard 2012-2014. Biodiversity Research Institute. Portland, Maine. Science Communications Series BRI 2015-19. 32 pp.

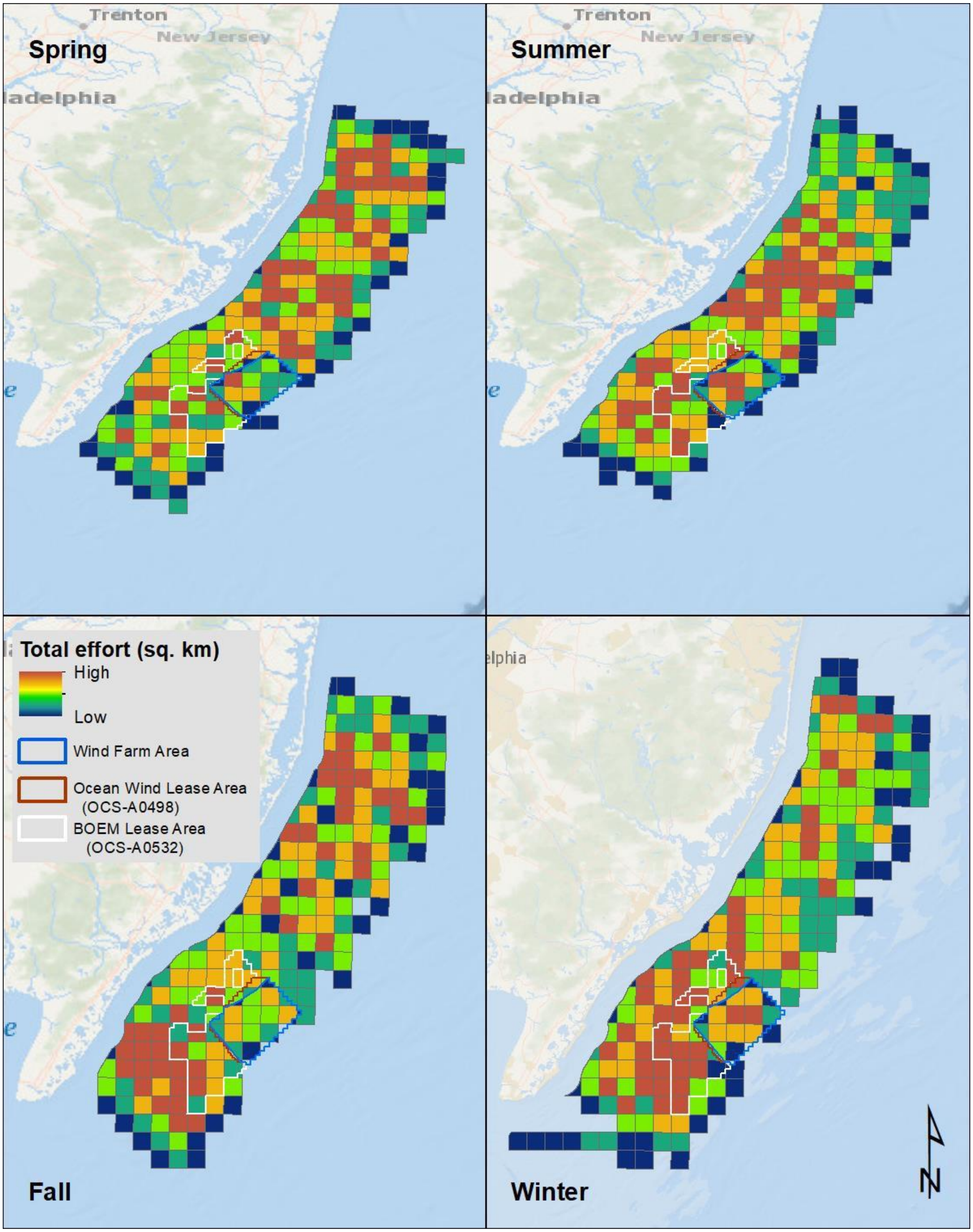
Williams, K., E. Connelly, S. Johnson, and I. Stenhouse (Editors) (2015c). Baseline Wildlife Studies in Atlantic Waters Offshore of Maryland: Final Report to the Maryland Department of Natural Resources and the Maryland Energy Administration.

Willmott, J. R., G. Forcey, and A. Kent (2013). The Relative Vulnerability of Migratory Bird Species to Offshore Wind Energy Projects on the Atlantic Outer Continental Shelf: An Assessment Method and Database. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013-207:275 pp.

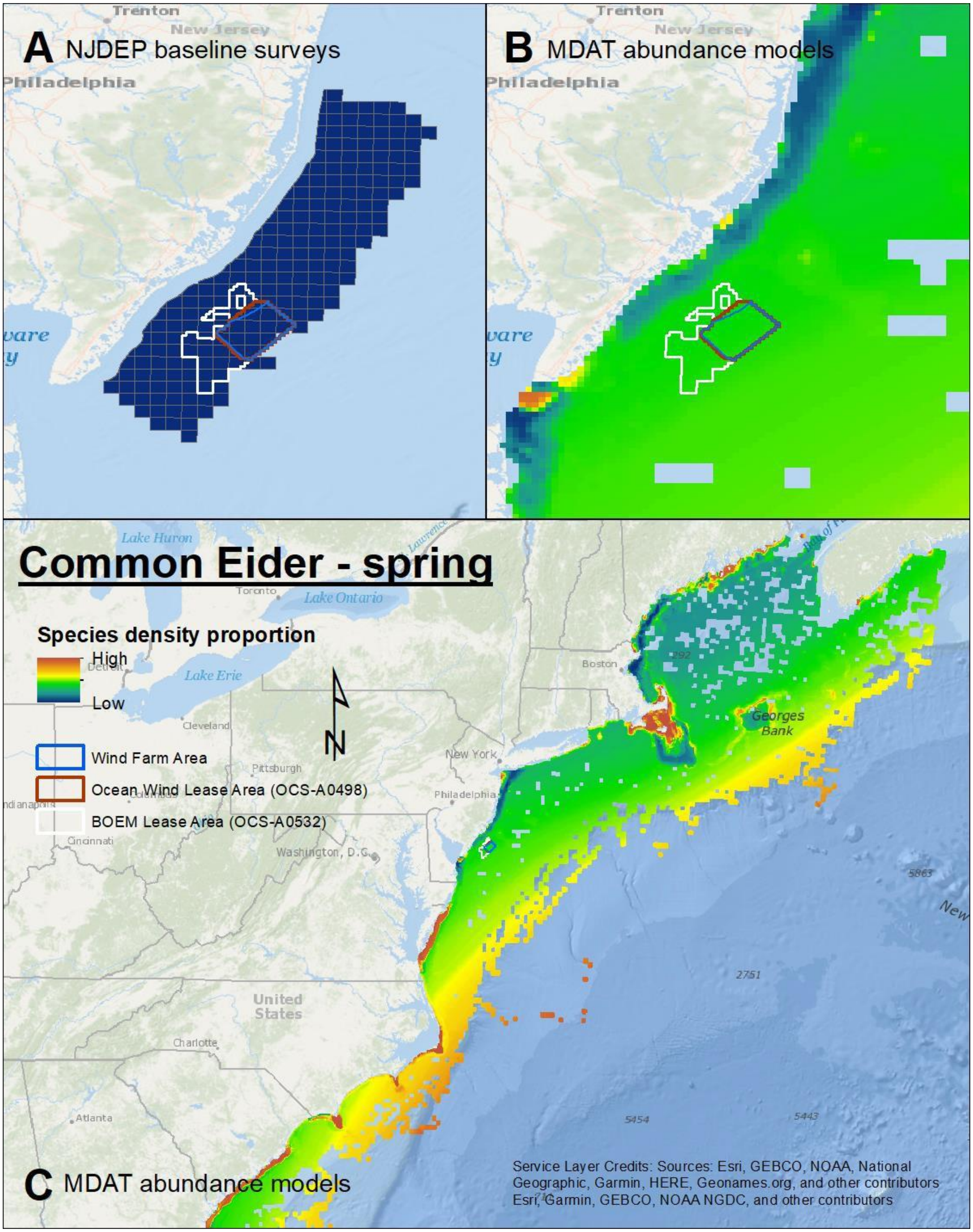
Winship, A. J., B. P. Kinlan, T. P. White, J. B. Leirness, and J. Christensen (2018). Modeling At-Sea Density of Marine Birds to Support Atlantic Marine Renewable Energy Planning: Final Report. OCS Study BOEM 2018-XXX.

Part V: Maps -Assessment of Exposure for Marine Birds for the Ocean Wind Project

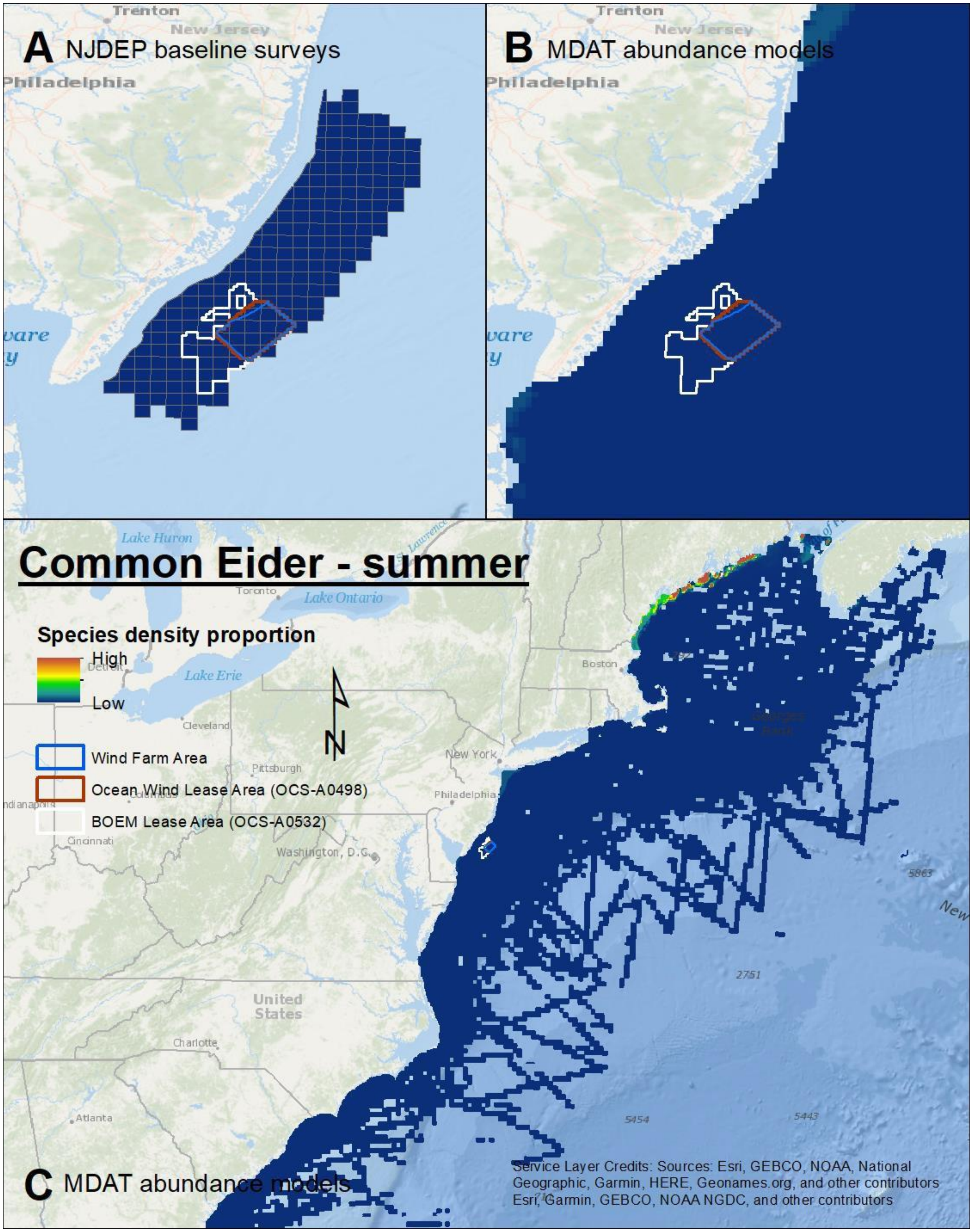
Table of Maps



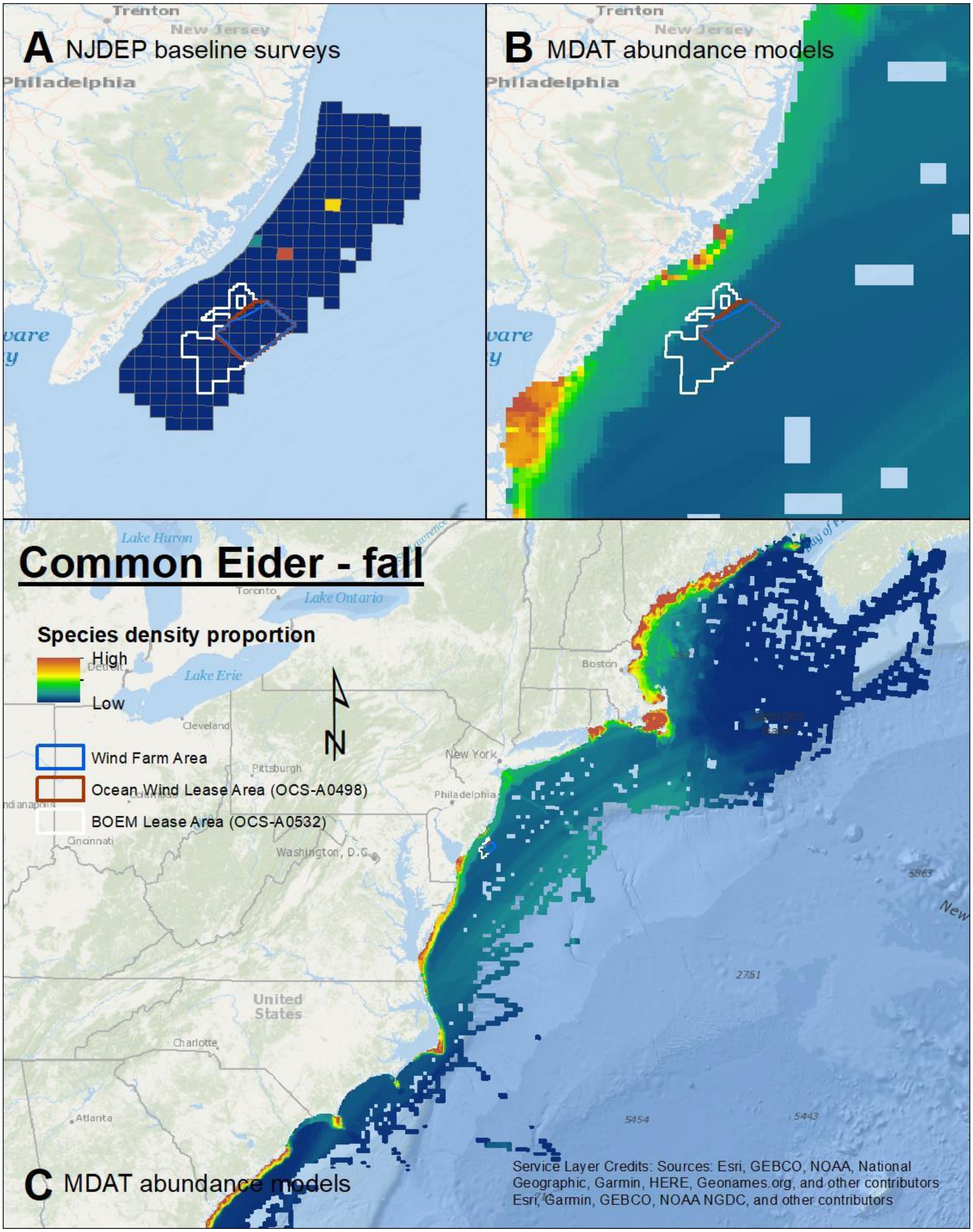
Map 1. NJDEP baseline seasonal survey effort. Mean survey effort in square km by full or partial lease block inside and outside the Wind Farm Area.



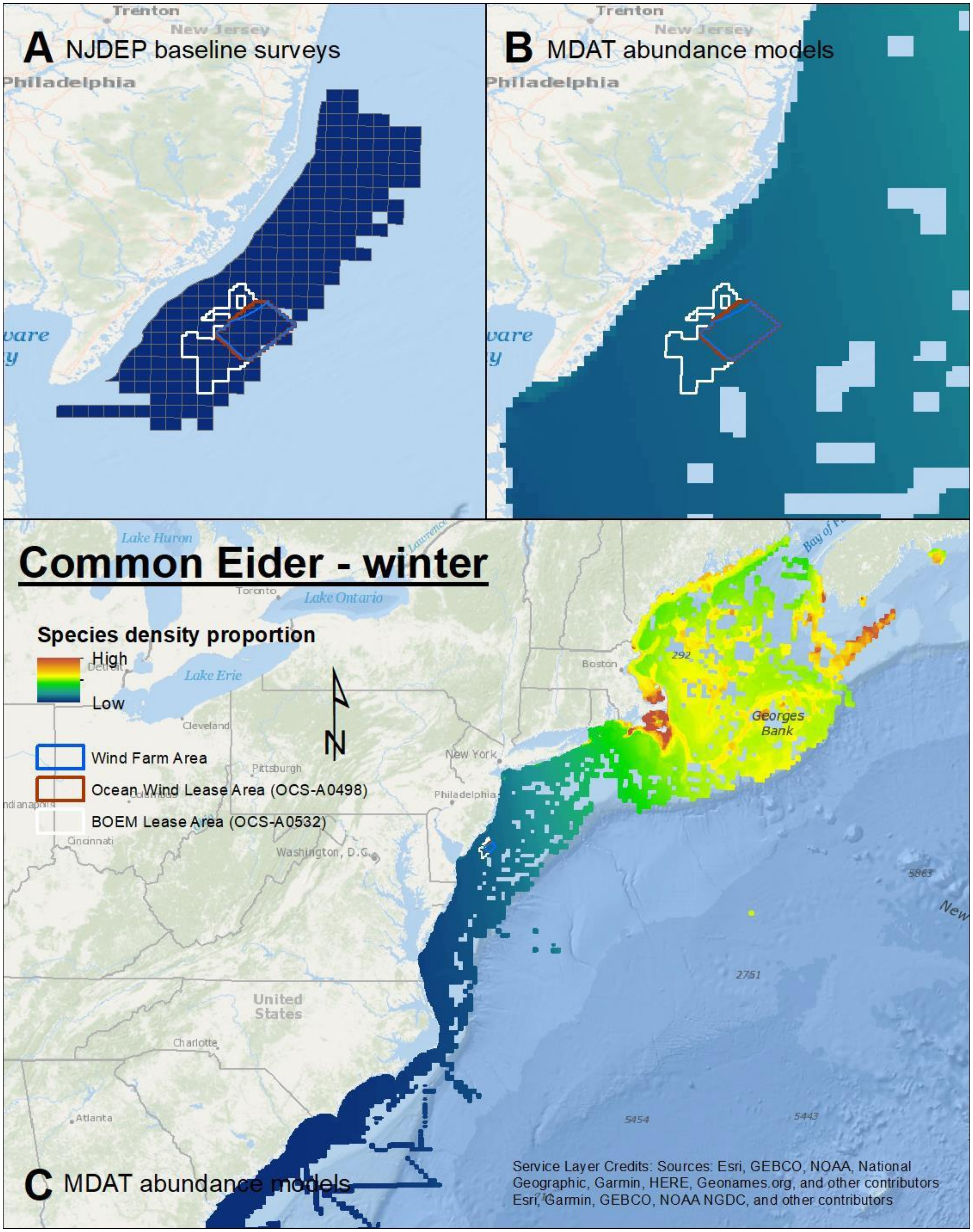
Map 2. Spring Common Eider density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



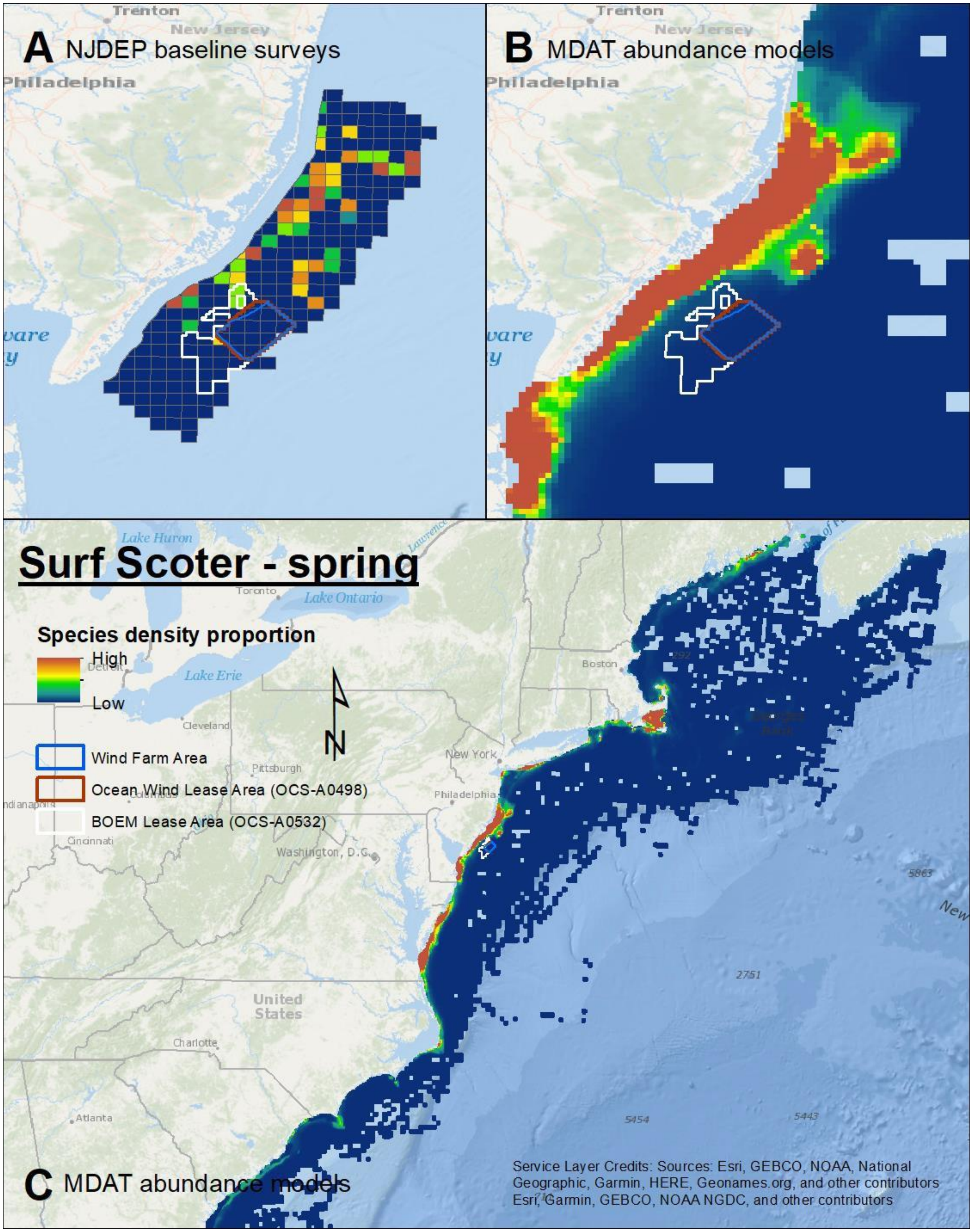
Map 3. Summer Common Eider density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



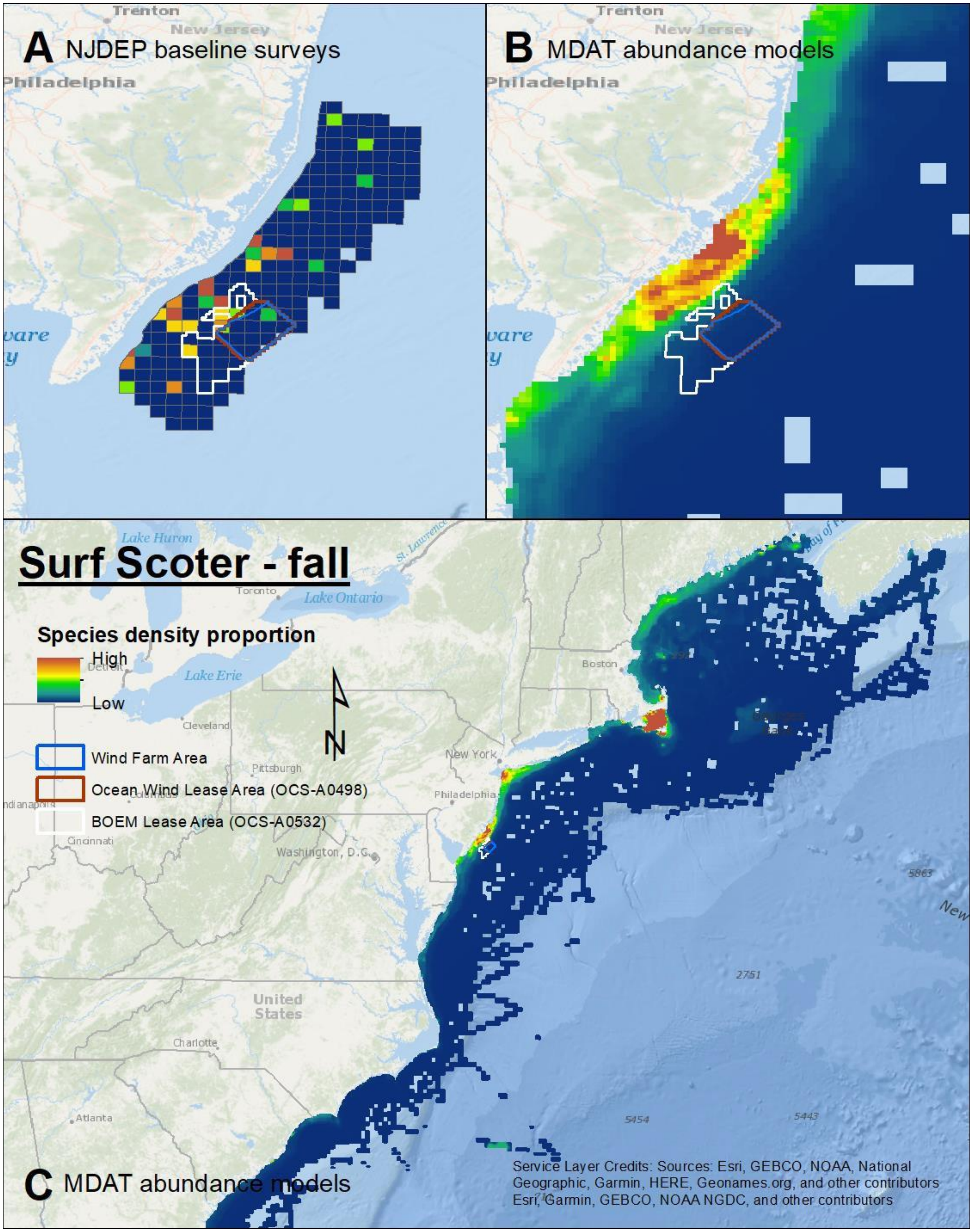
Map 4. Fall Common Eider density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



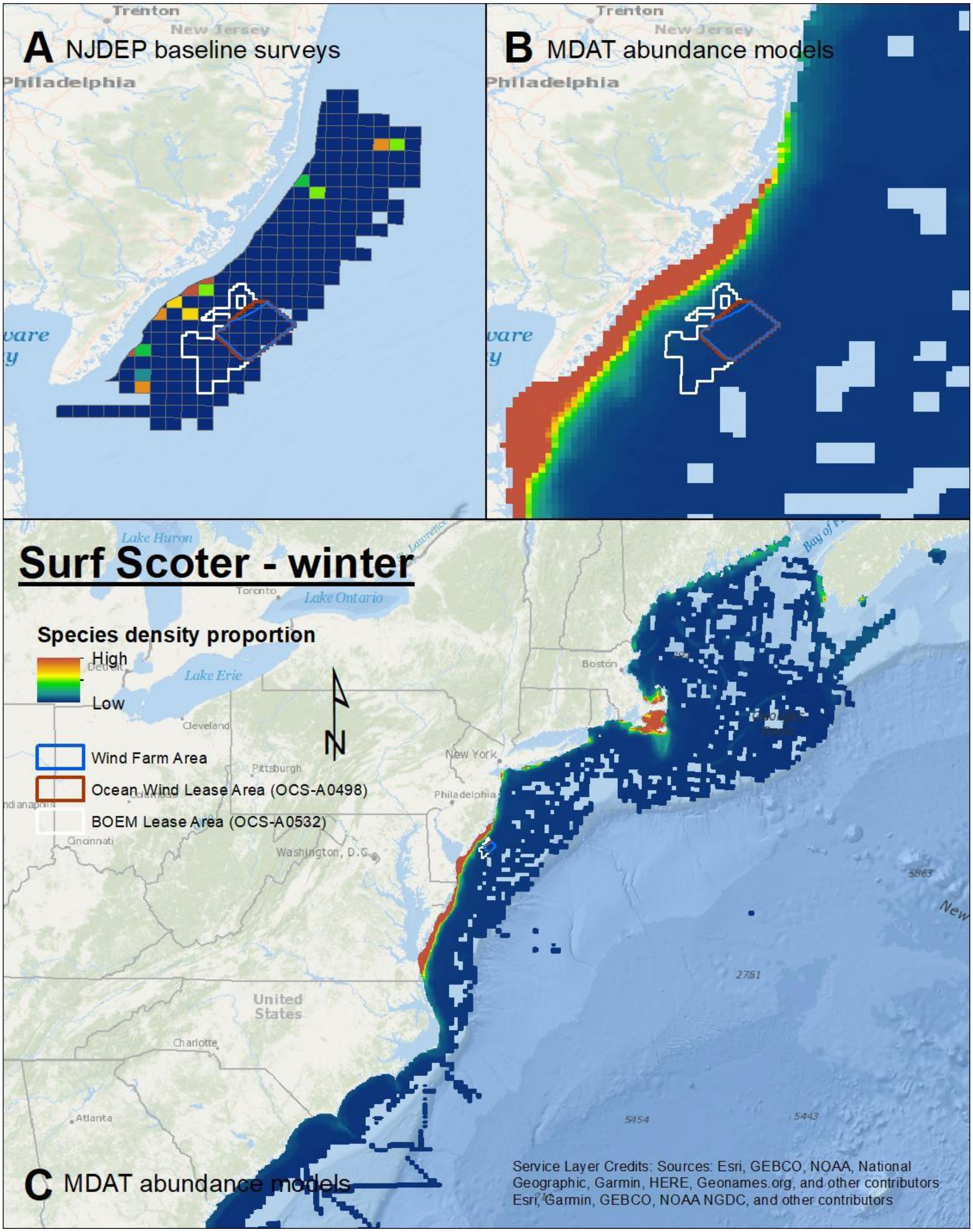
Map 5. Winter Common Eider density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



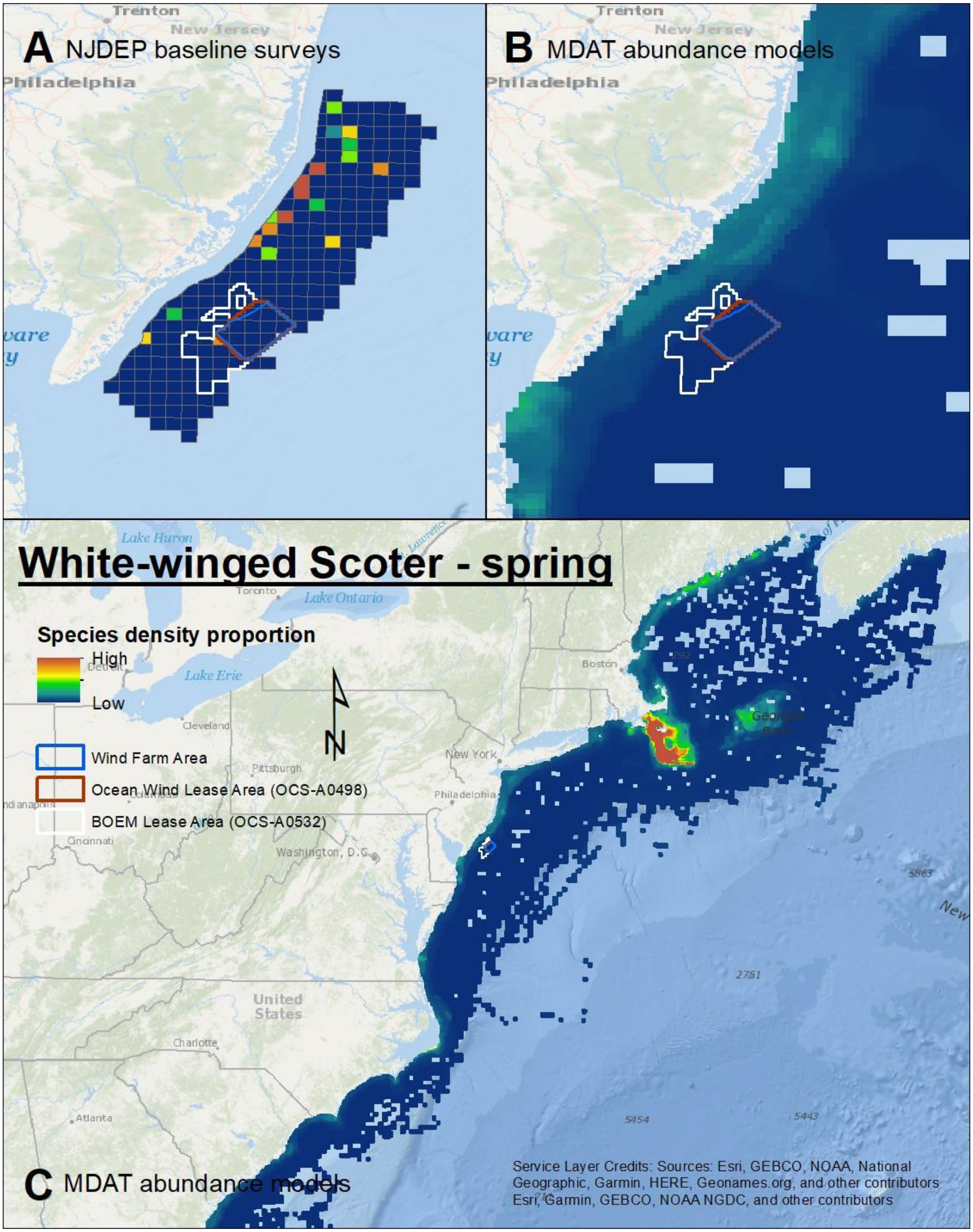
Map 6. Spring Surf Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



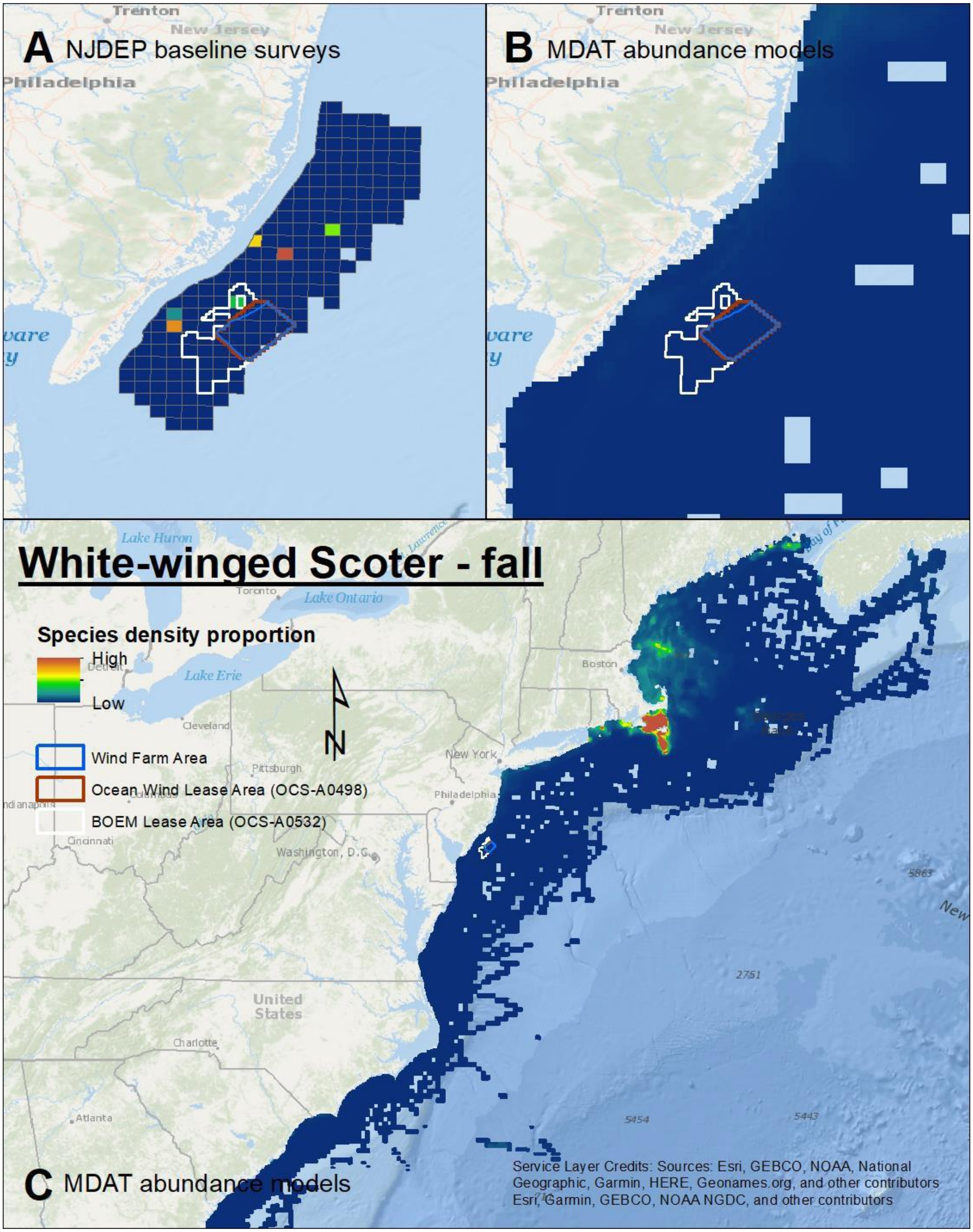
Map 7. Fall Surf Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



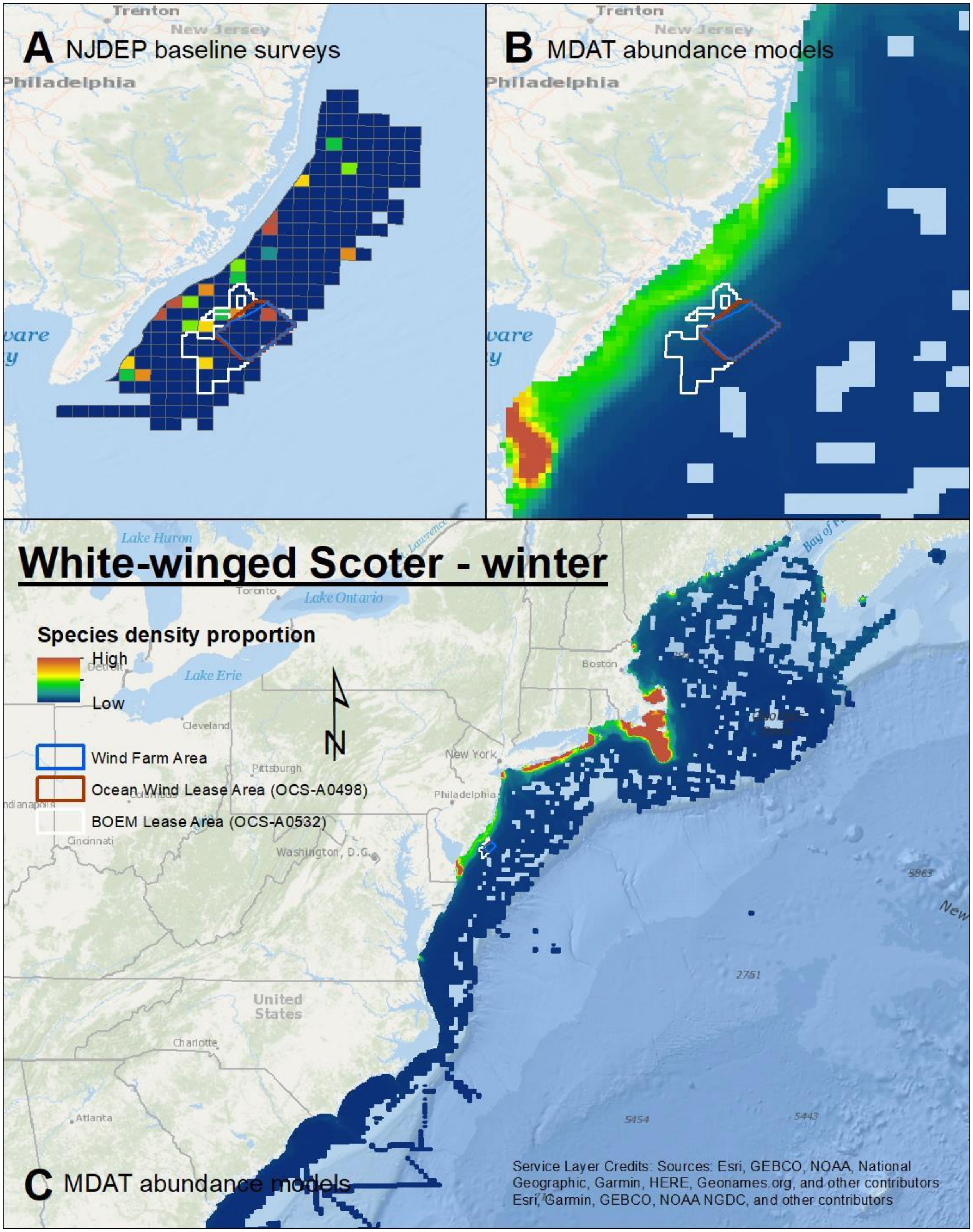
Map 8. Winter Surf Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



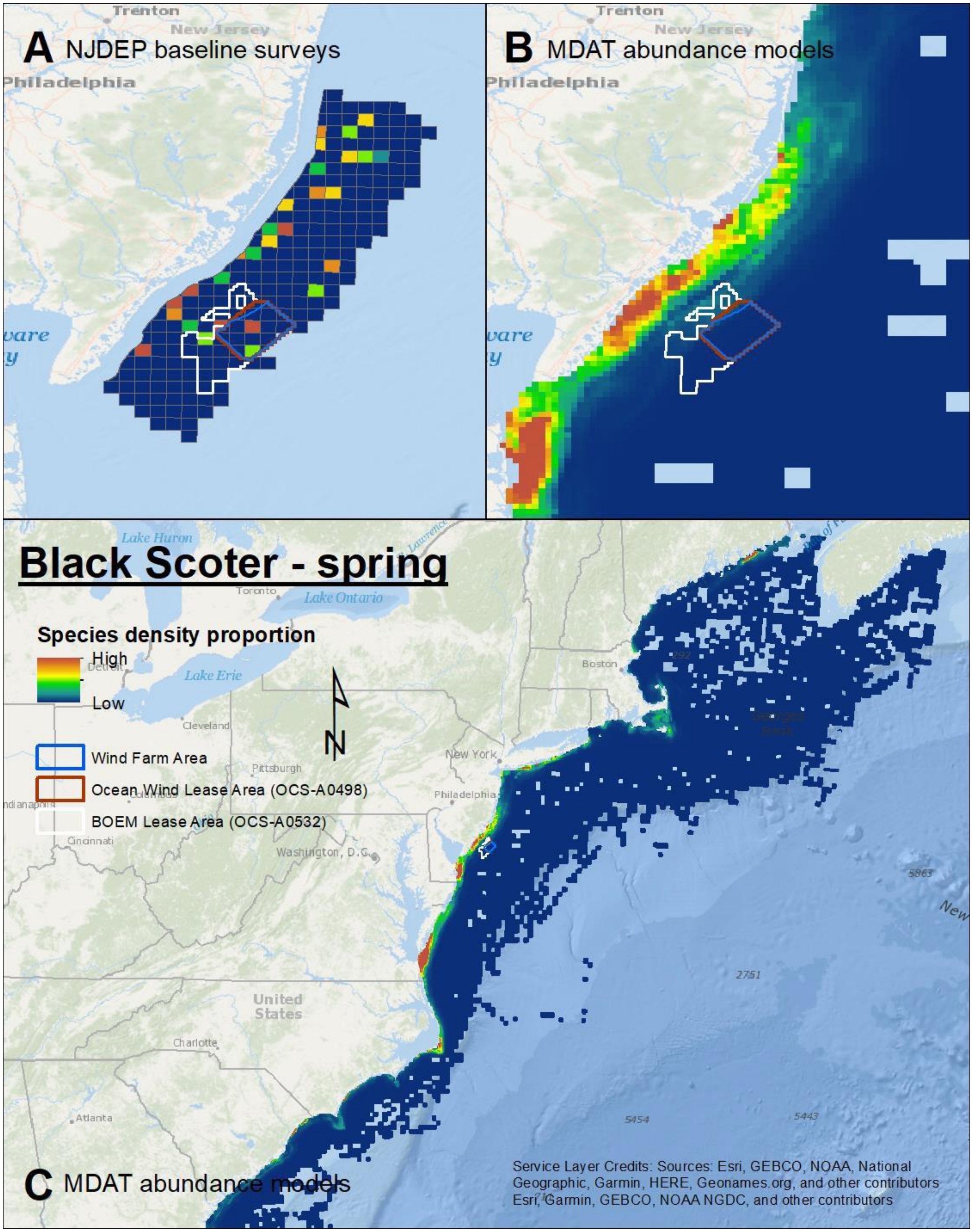
Map 9. Spring White-winged Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



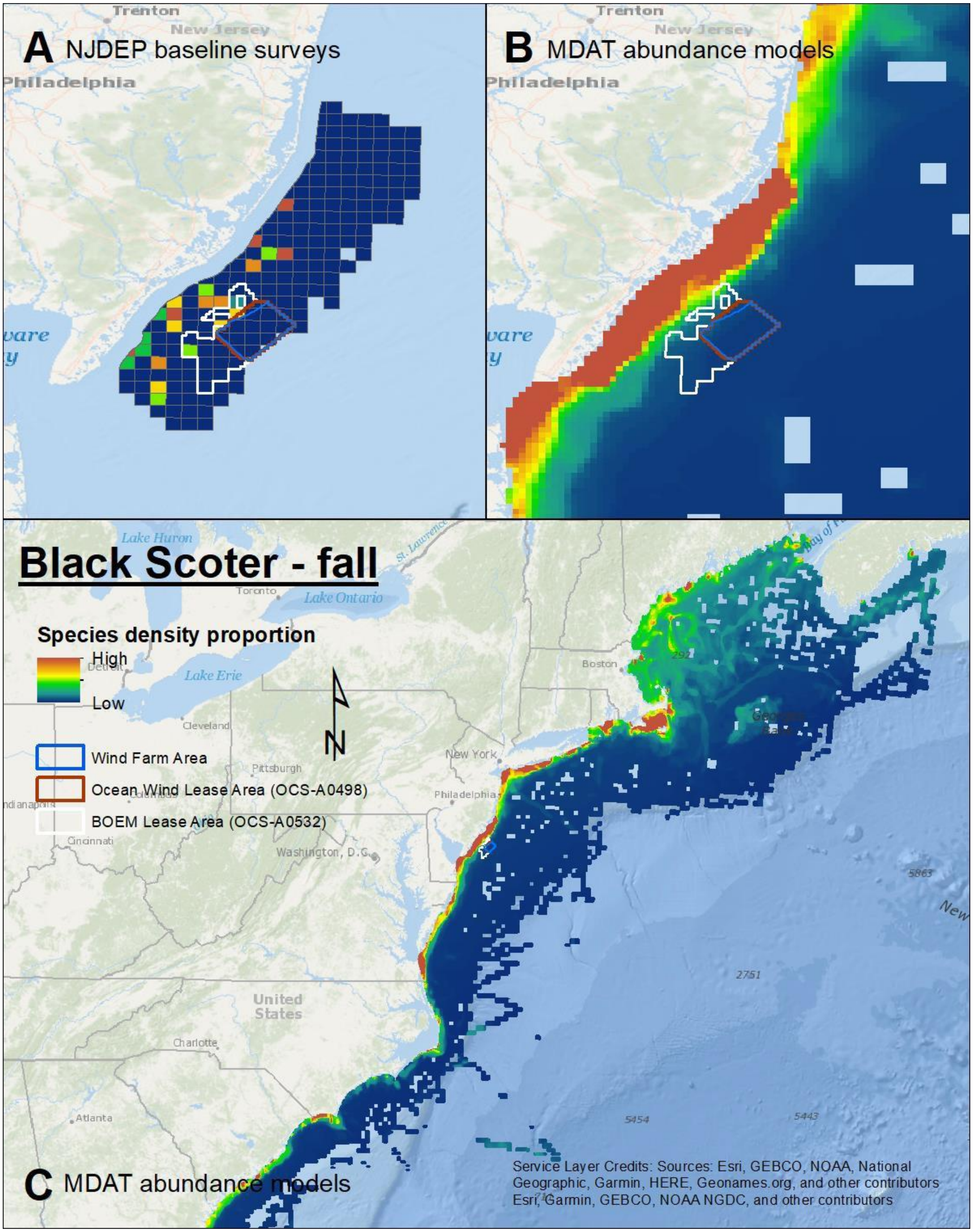
Map 10. Fall White-winged Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



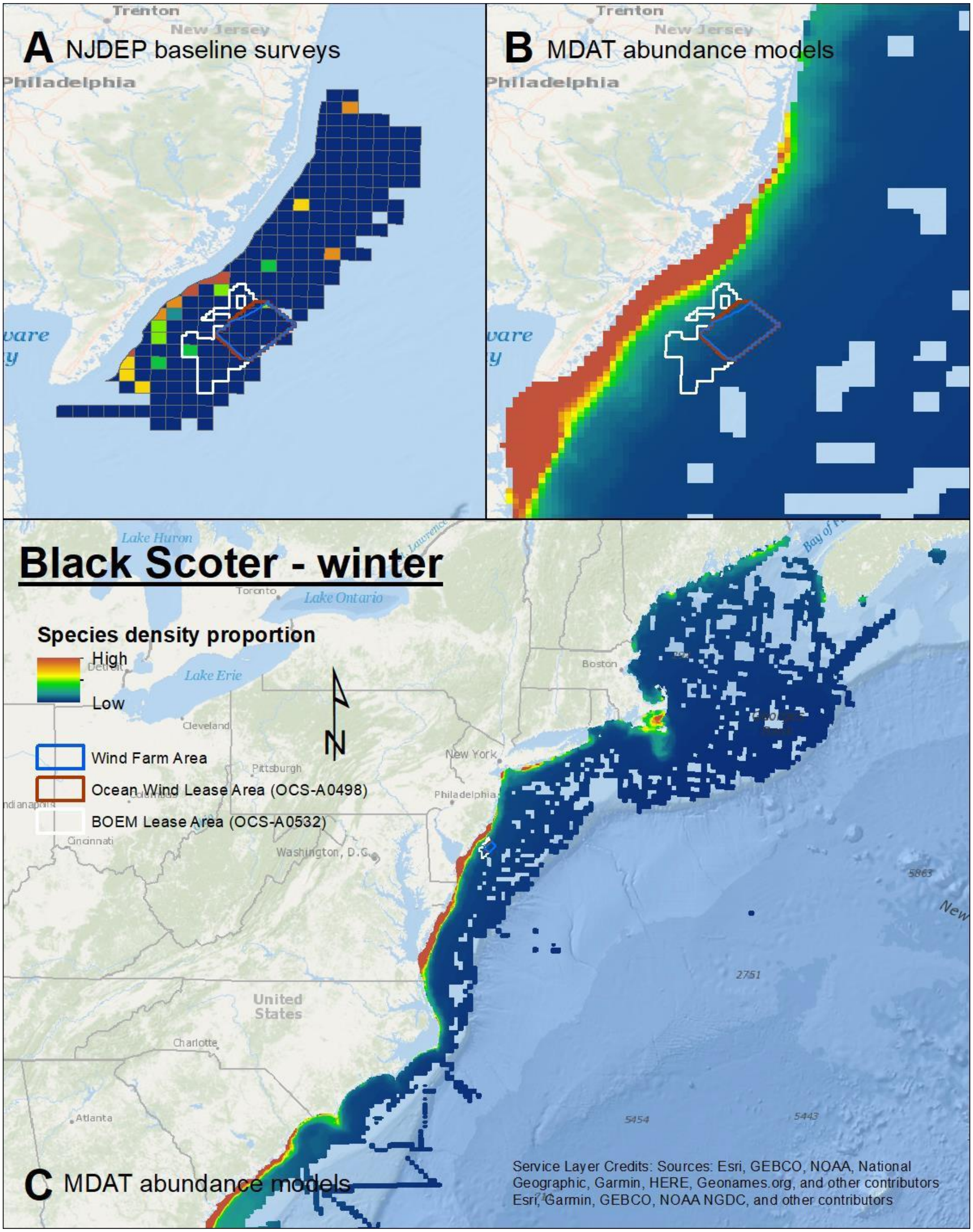
Map 11. Winter White-winged Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



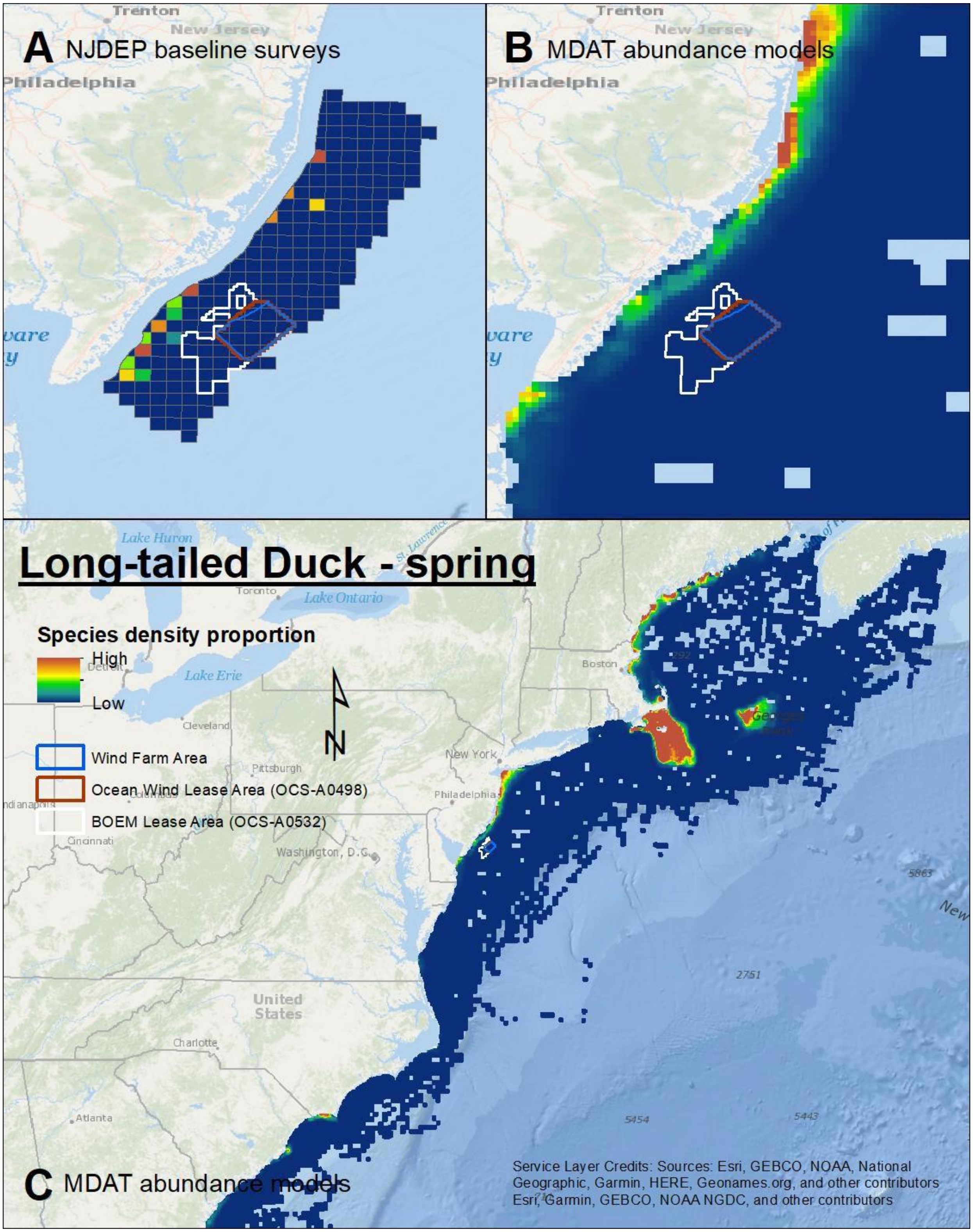
Map 12. Spring Black Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



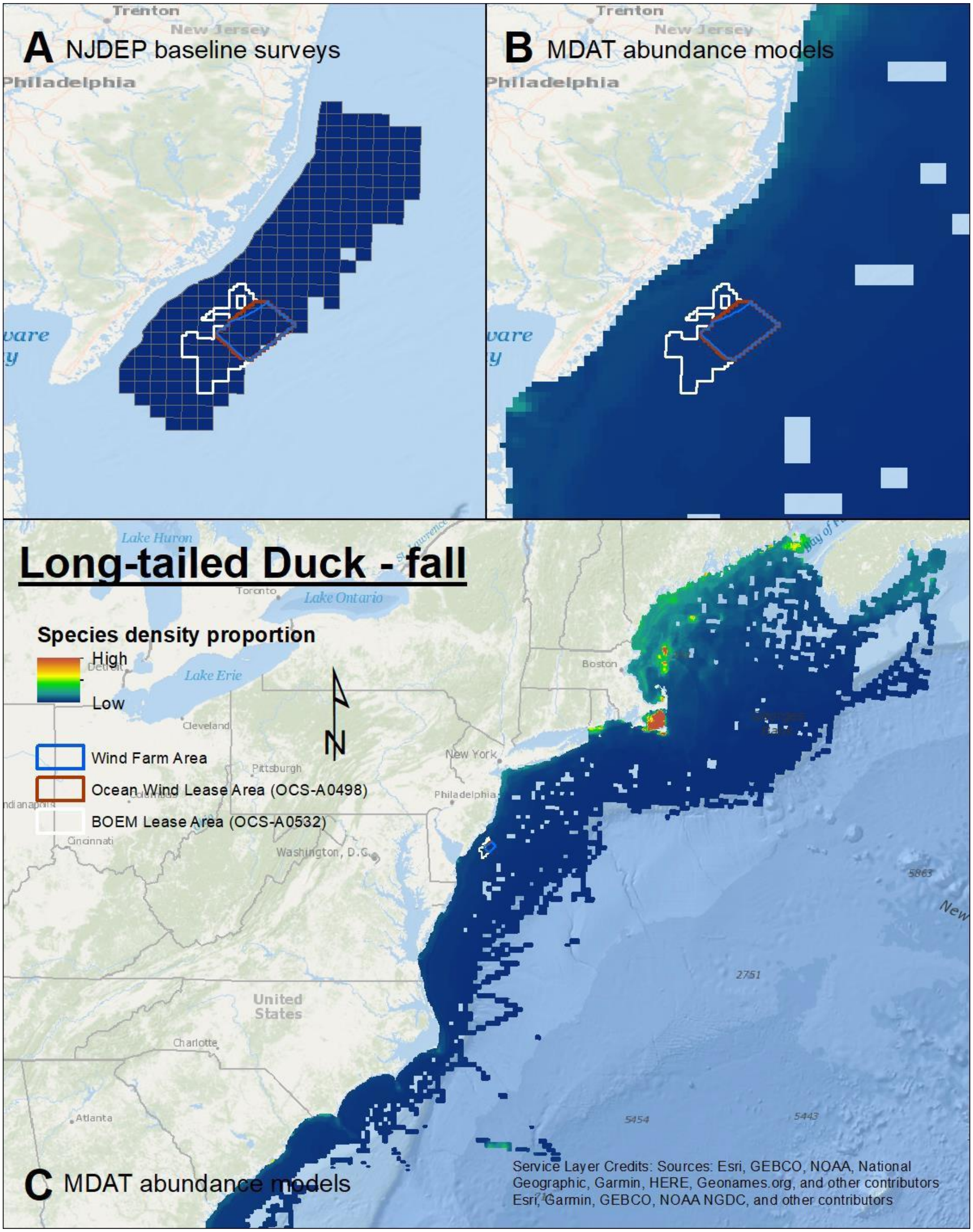
Map 13. Fall Black Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



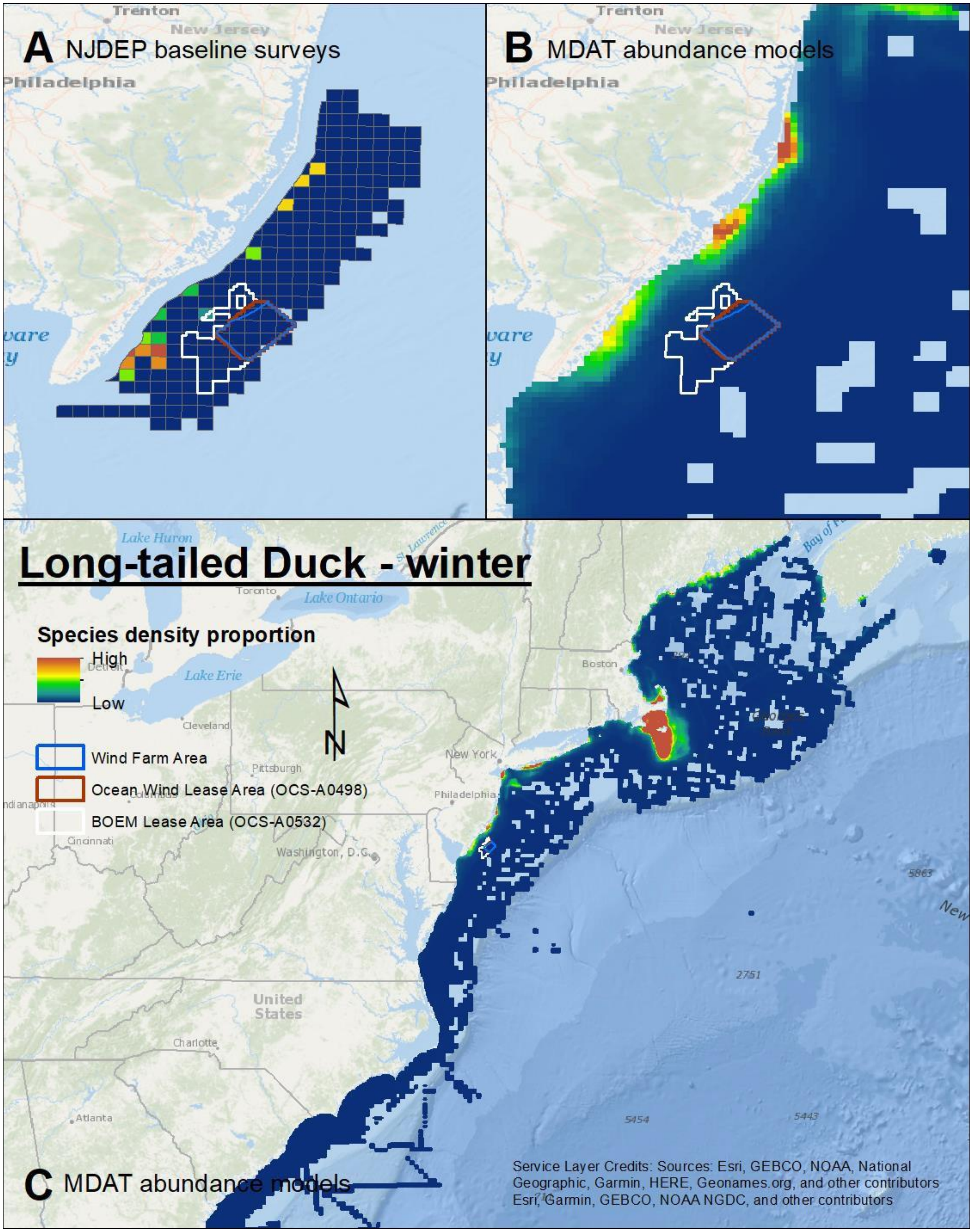
Map 14. Winter Black Scoter density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



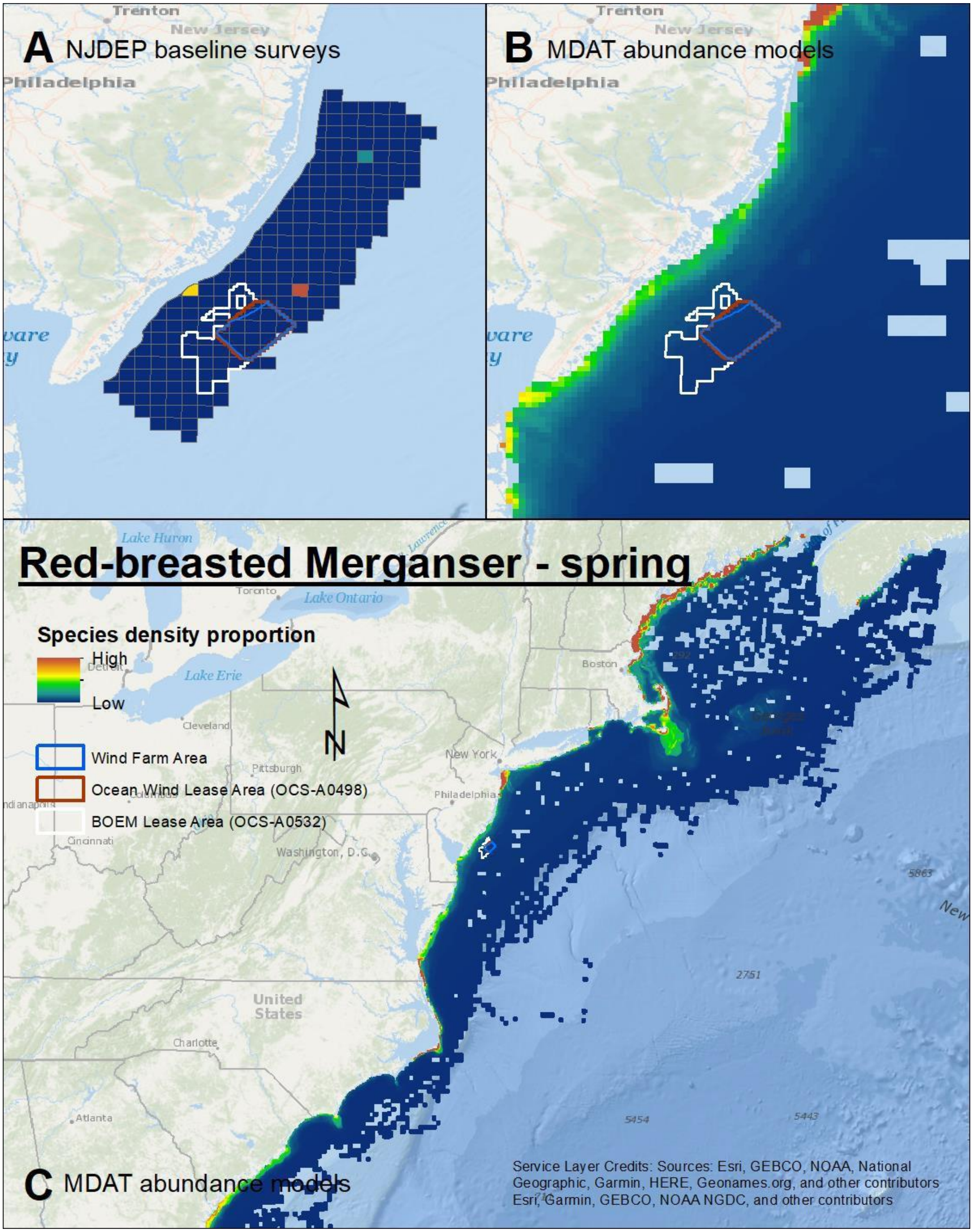
Map 15. Spring Long-tailed Duck density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



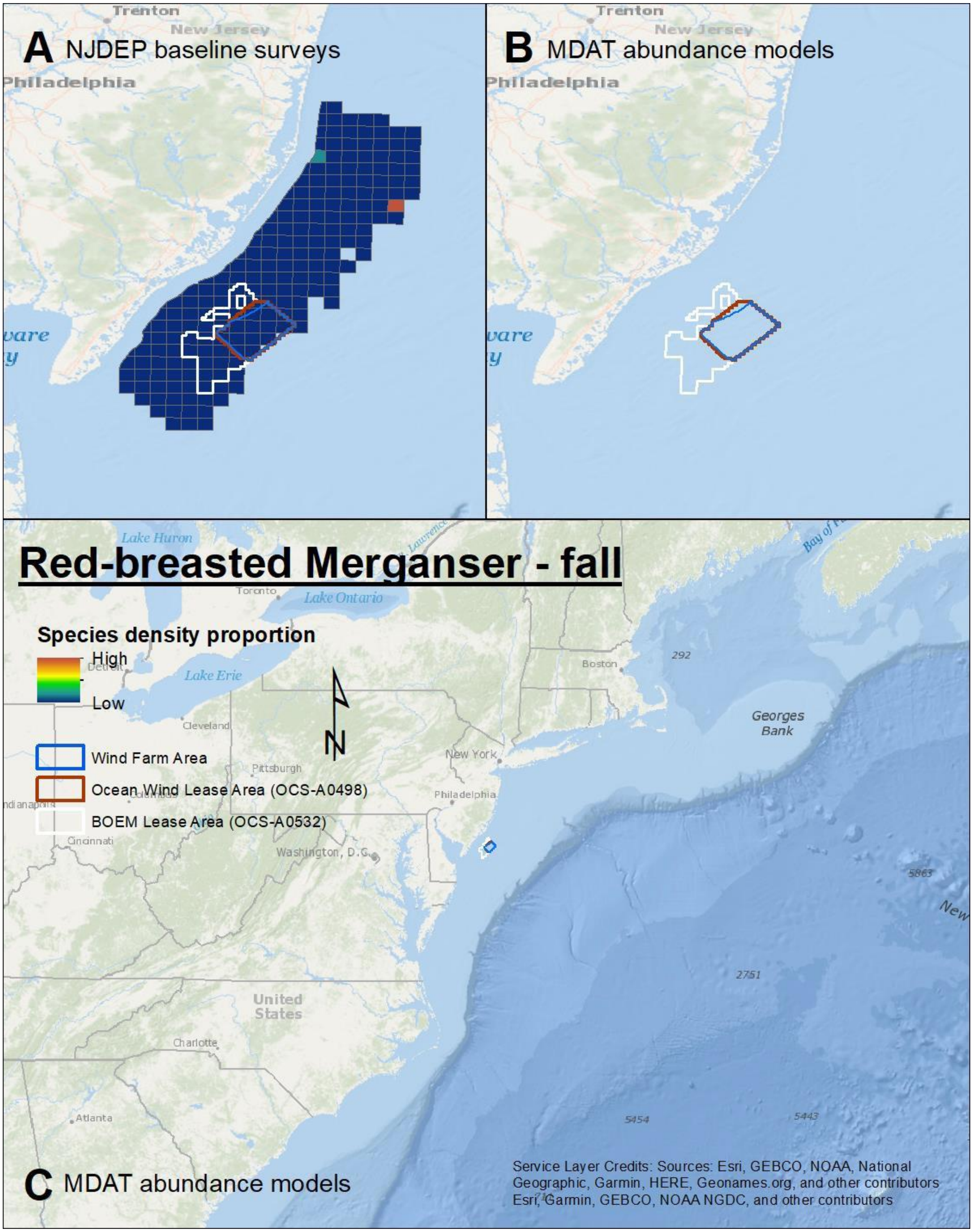
Map 16. Fall Long-tailed Duck density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



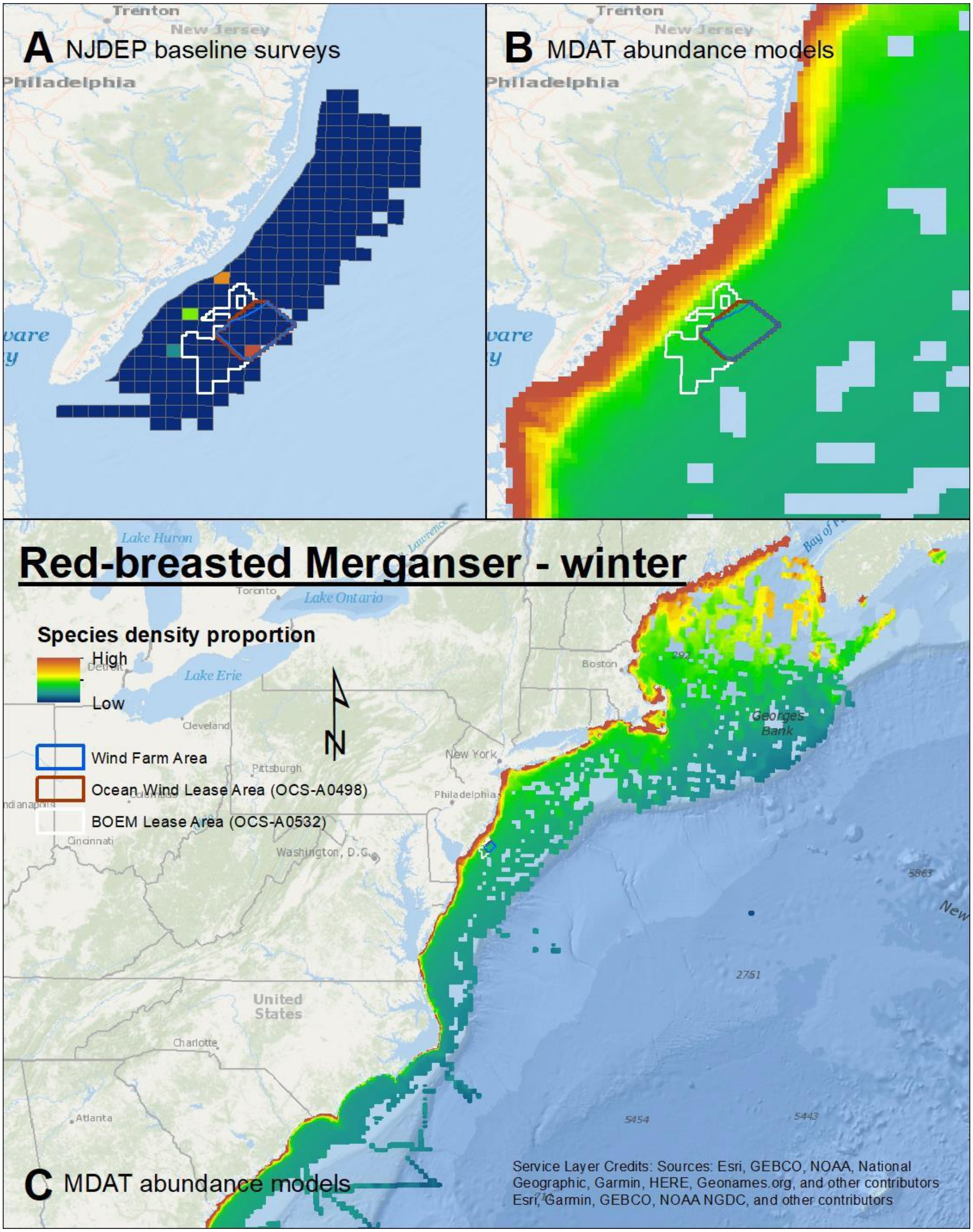
Map 17. Winter Long-tailed Duck density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



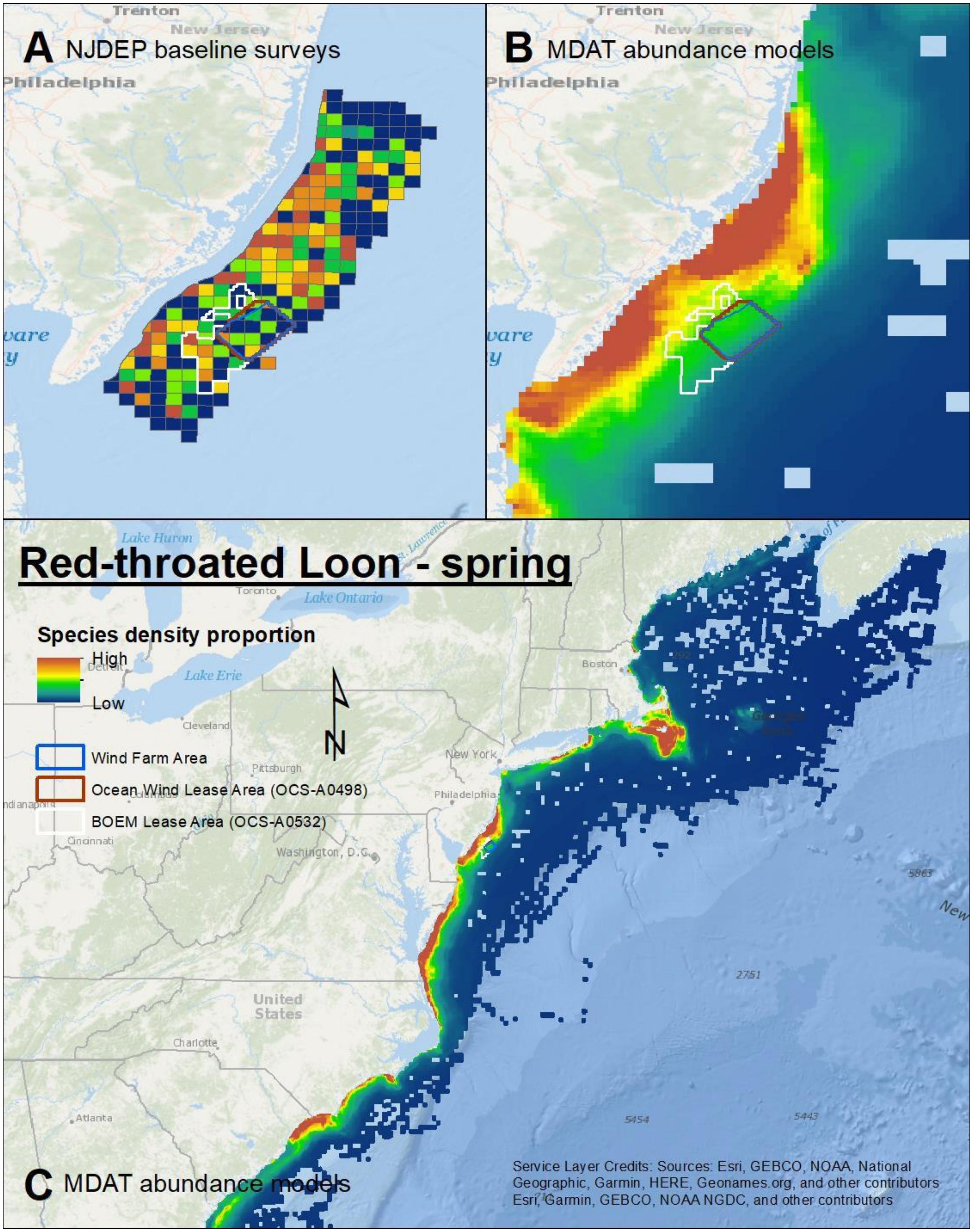
Map 18. Spring Red-breasted Merganser density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



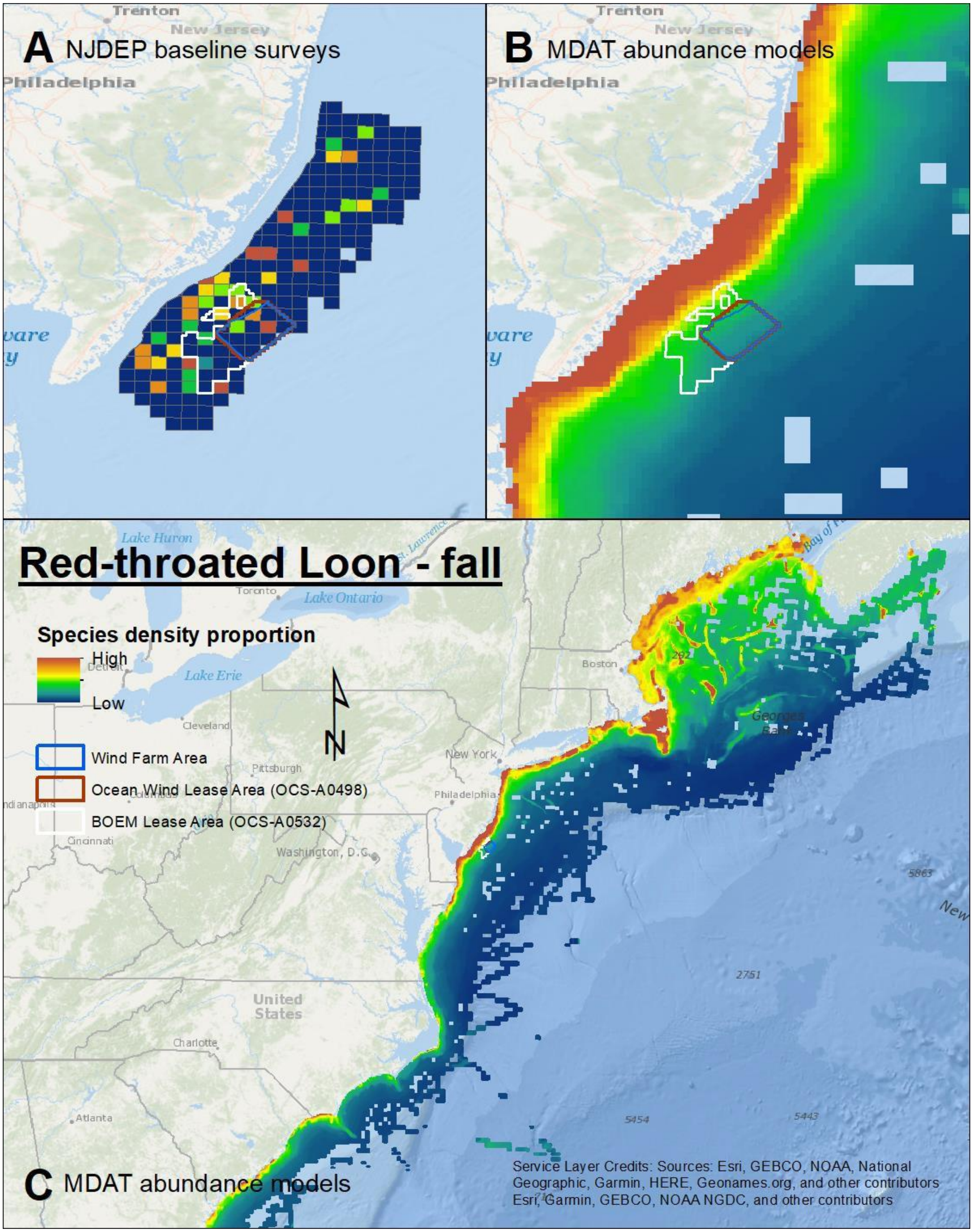
Map 19. Fall Red-breasted Merganser density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



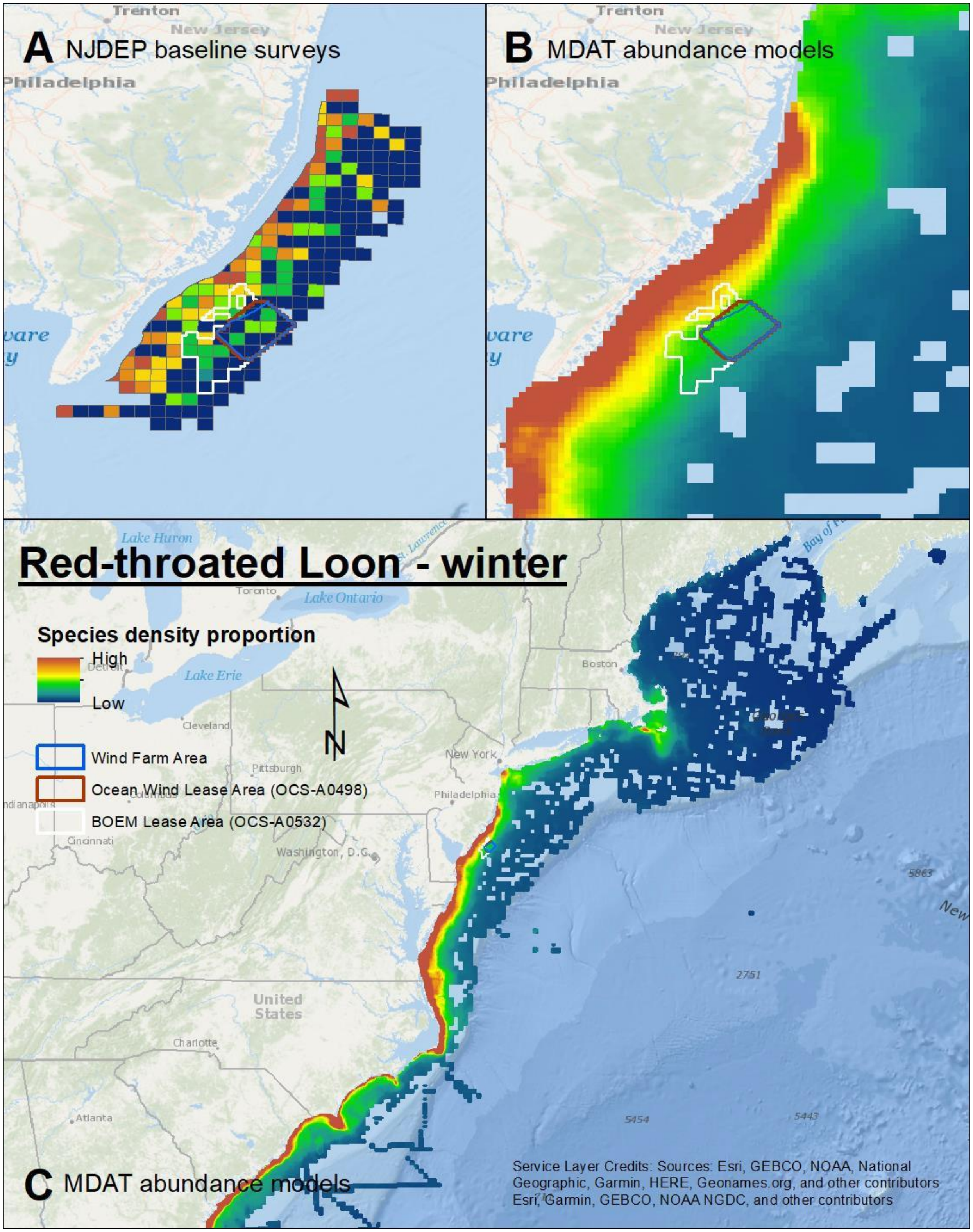
Map 20. Winter Red-breasted Merganser density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



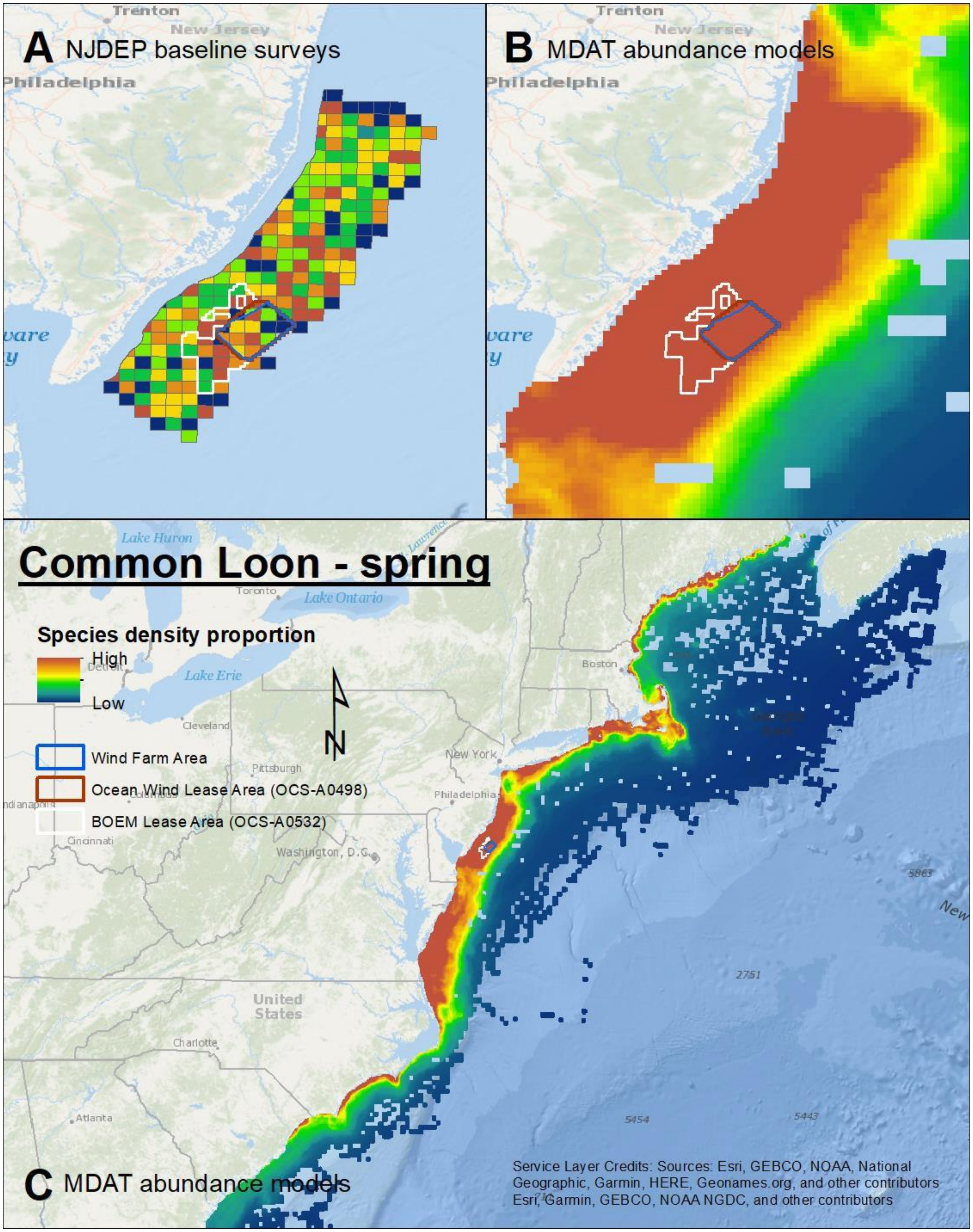
Map 21. Spring Red-throated Loon density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



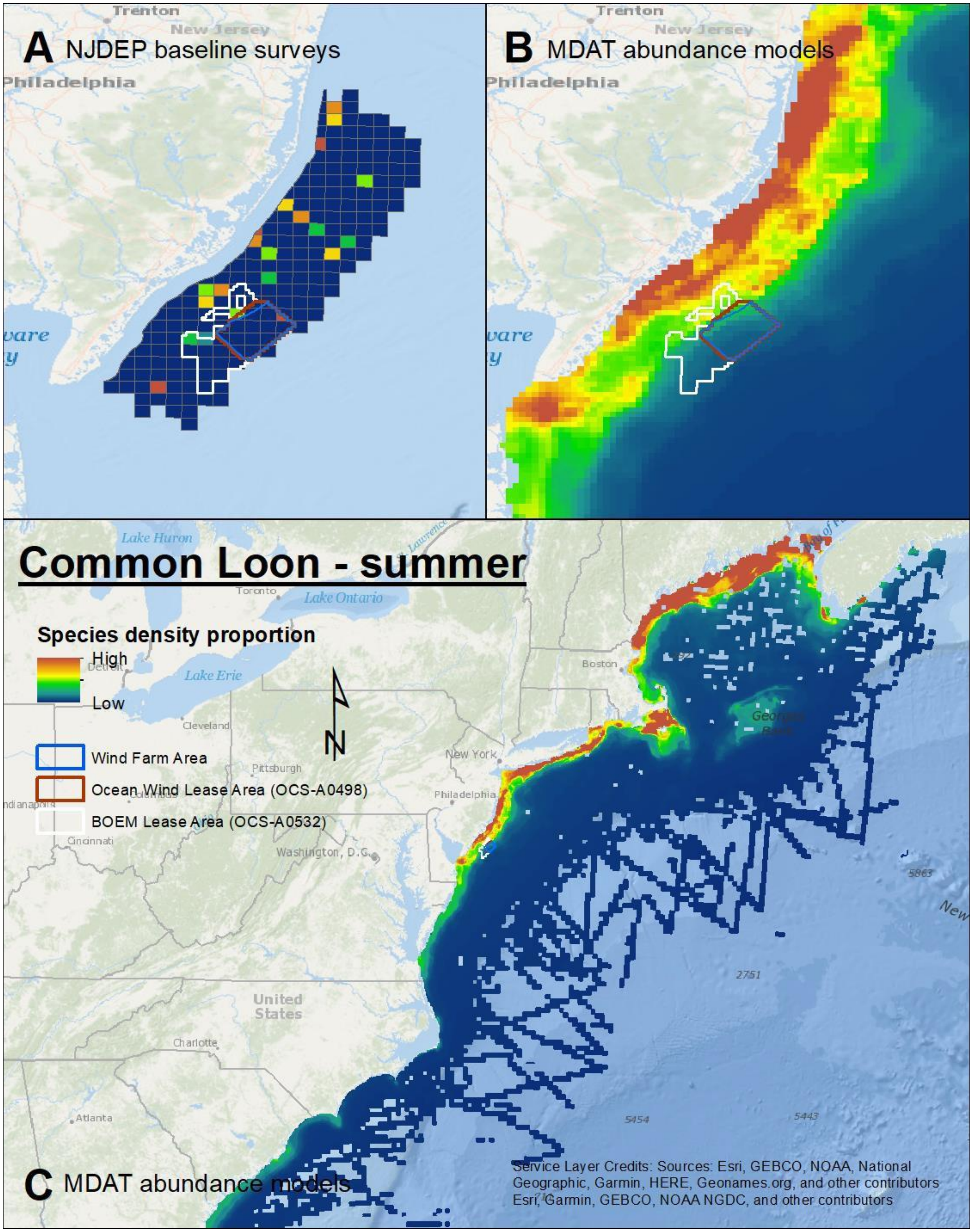
Map 22. Fall Red-throated Loon density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



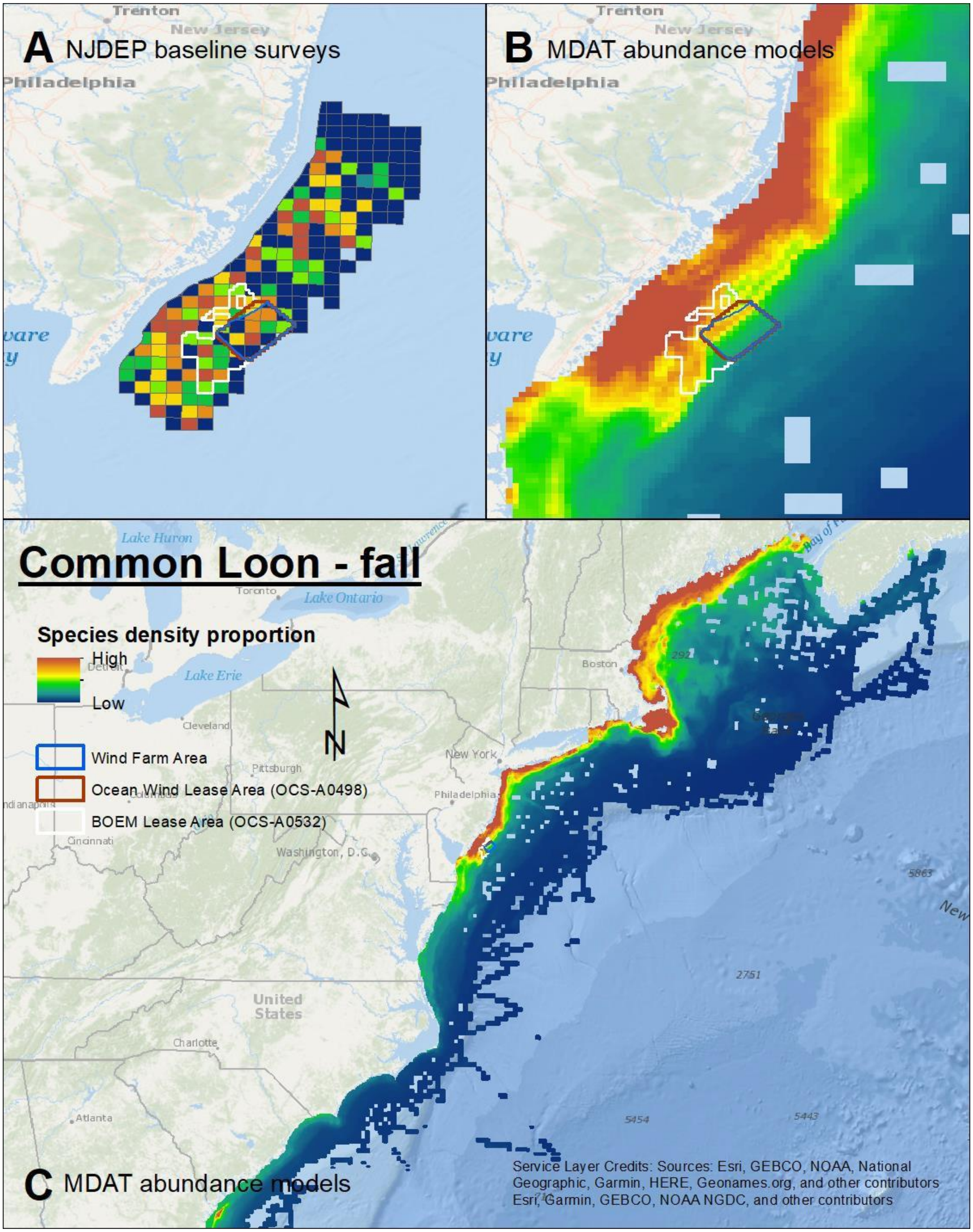
Map 23. Winter Red-throated Loon density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



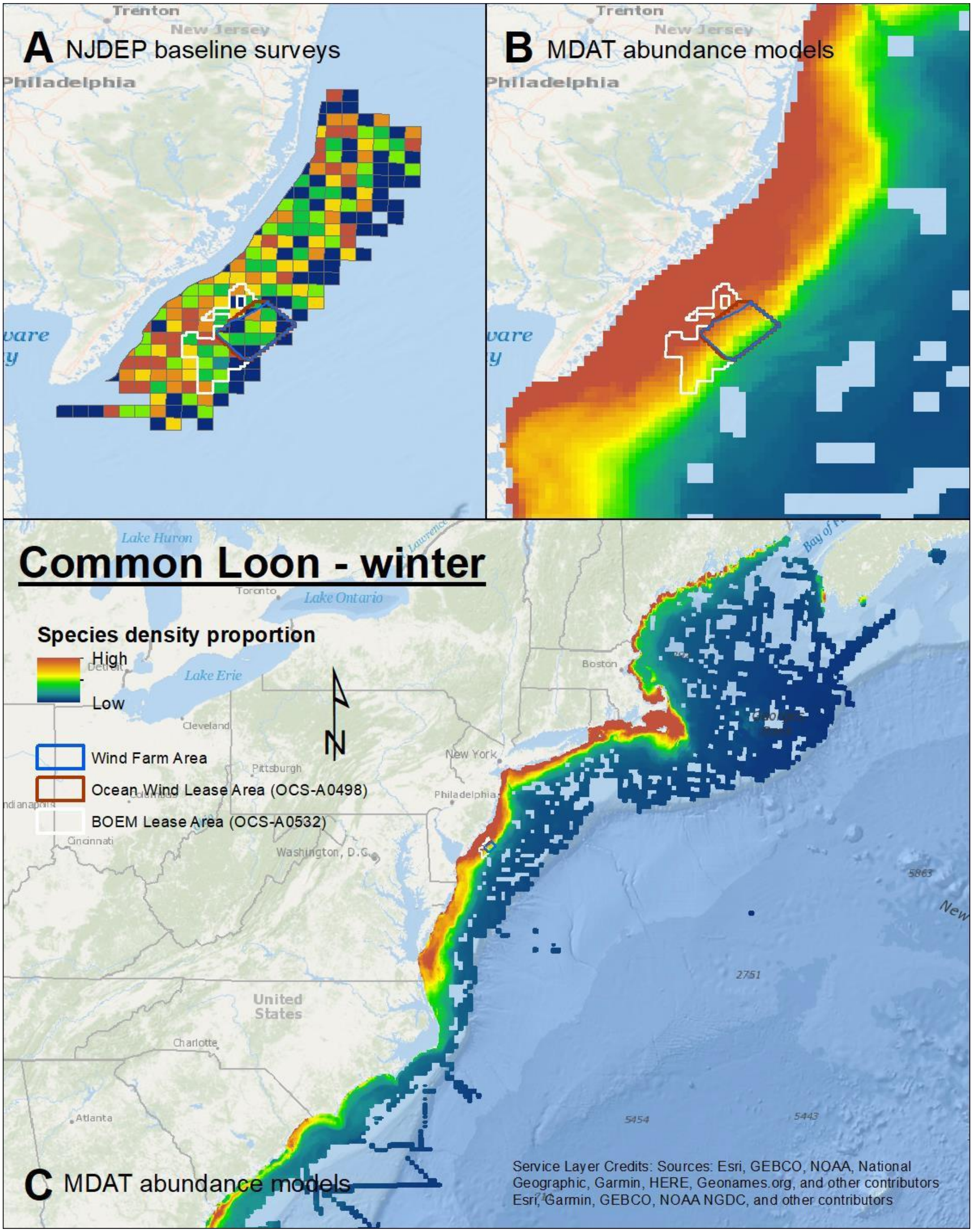
Map 24. Spring Common Loon density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



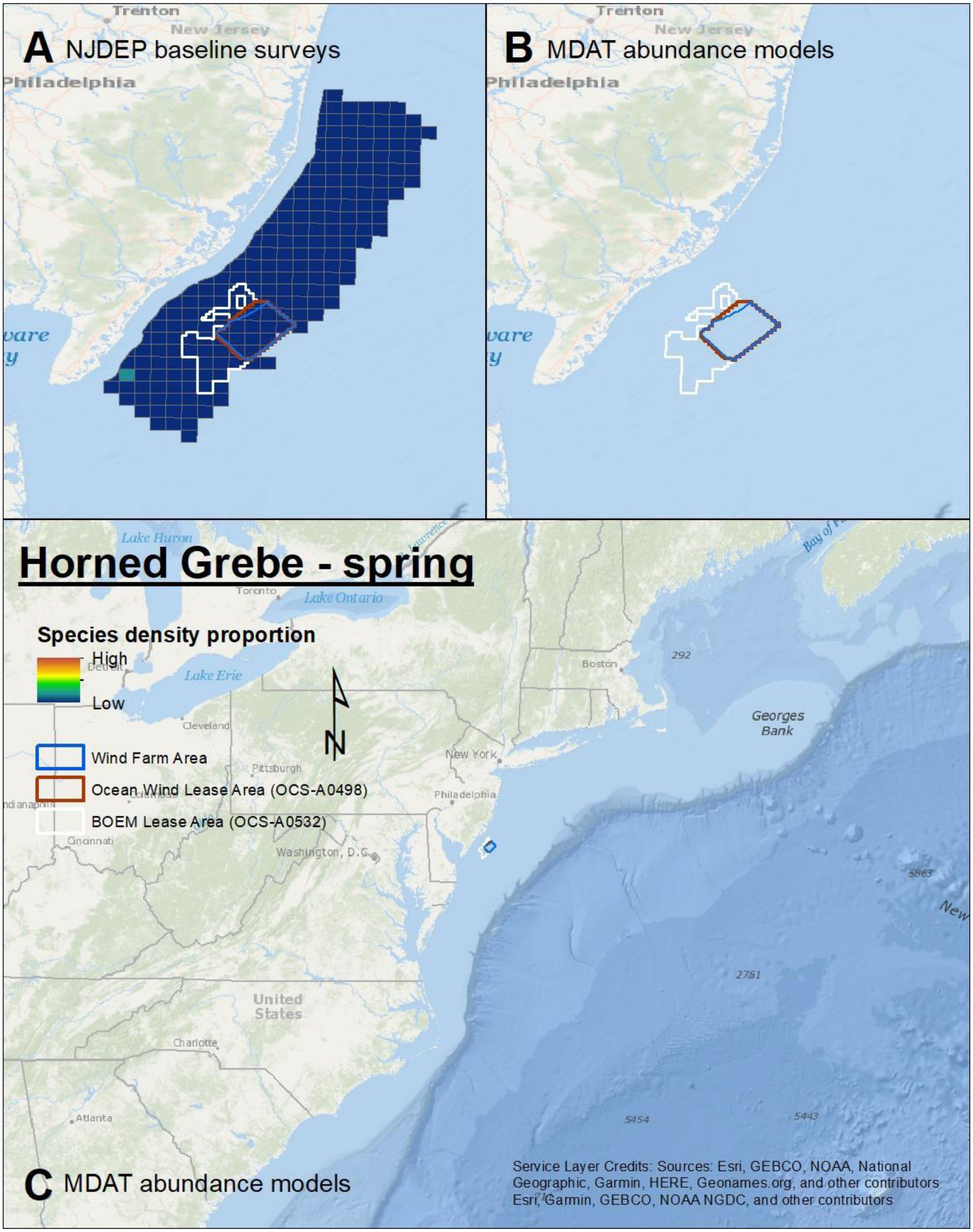
Map 25. Summer Common Loon density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



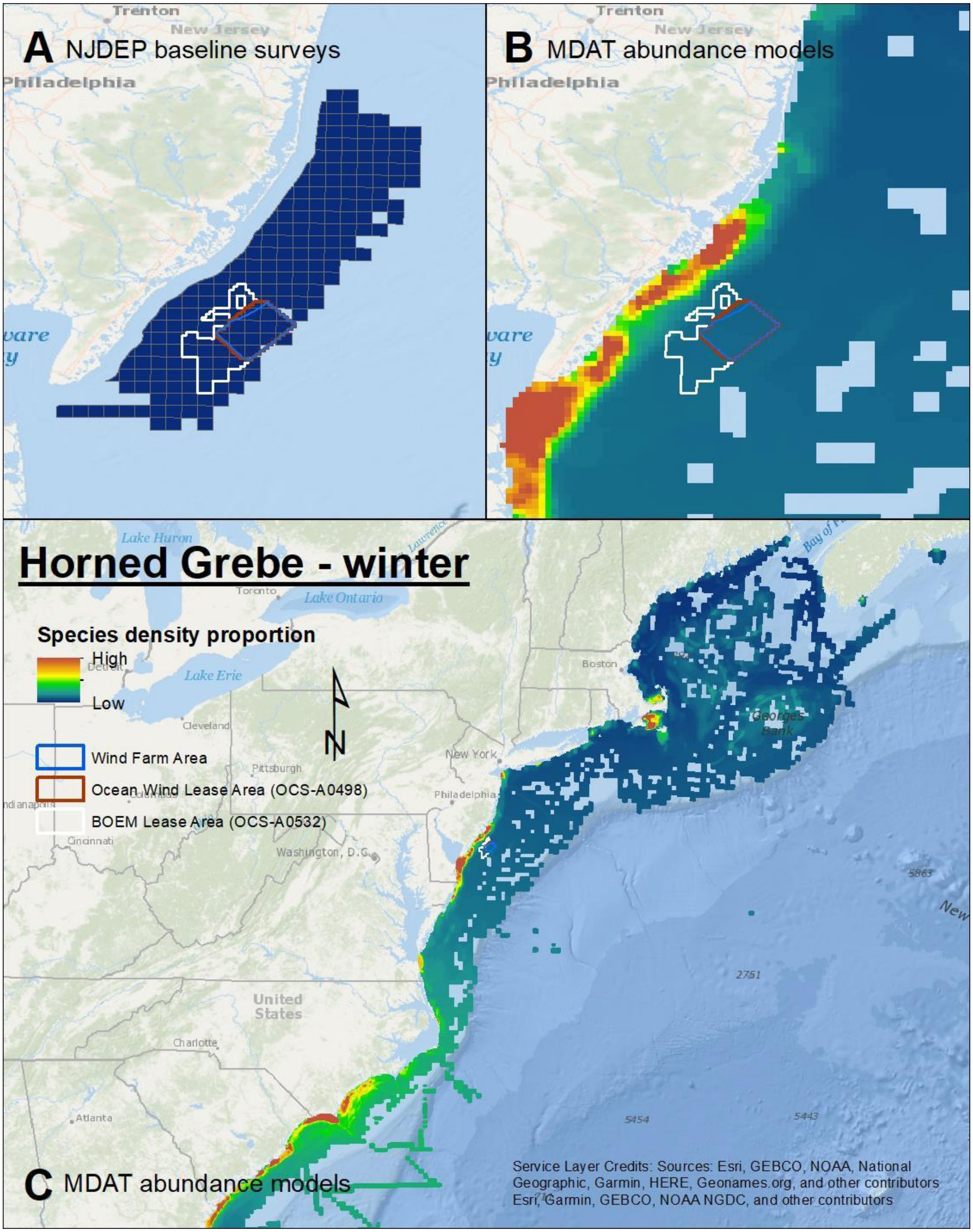
Map 26. Fall Common Loon density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



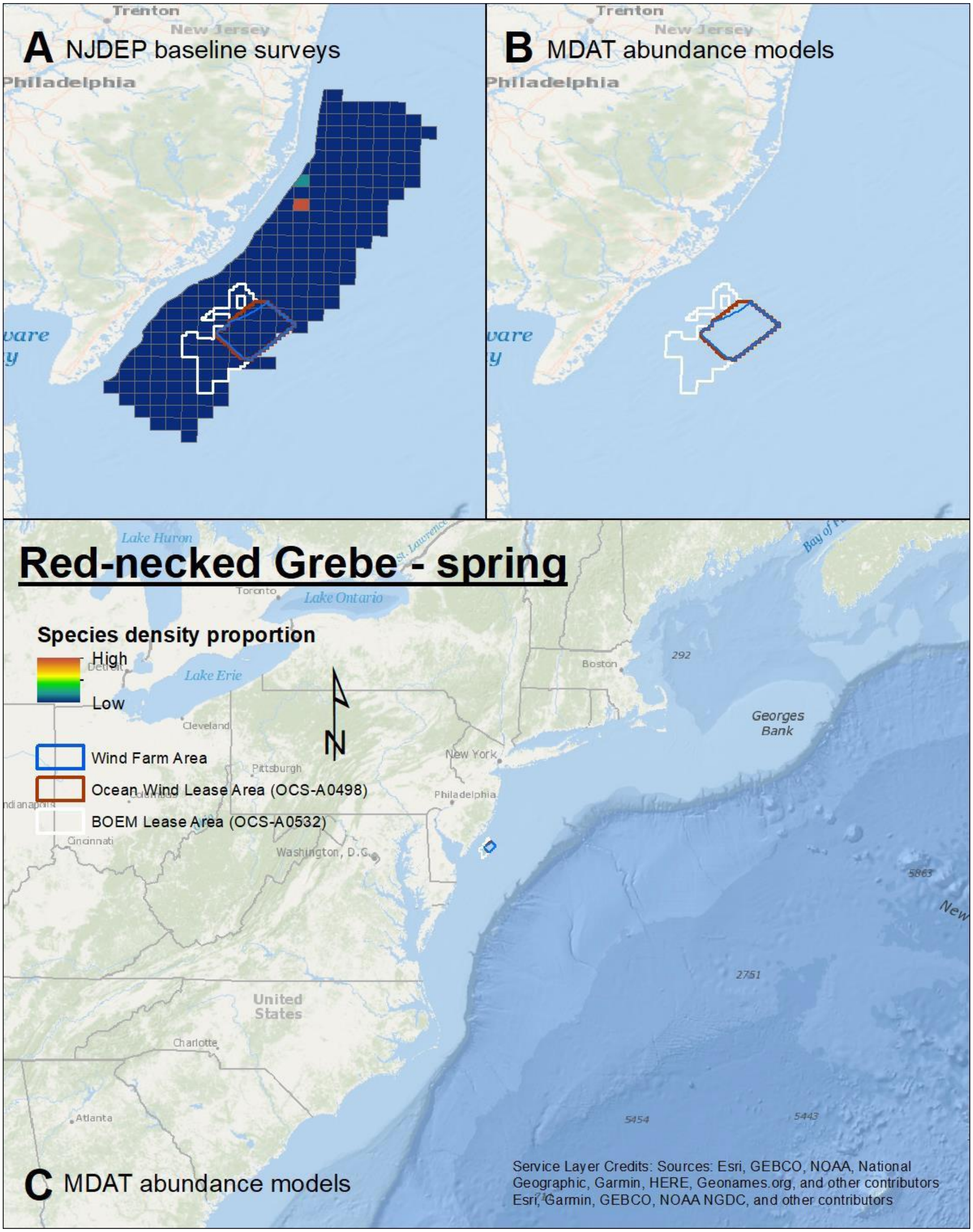
Map 27. Winter Common Loon density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



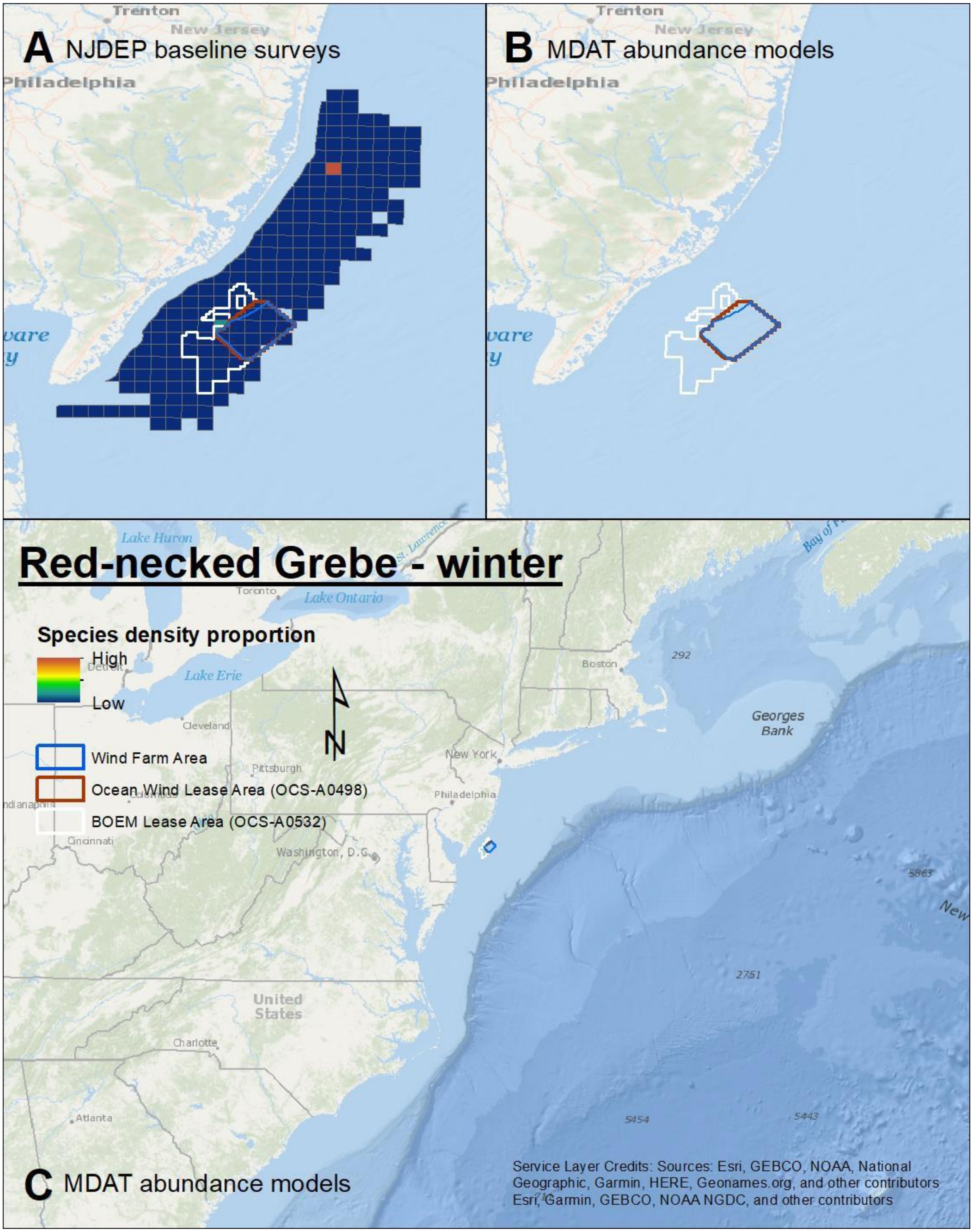
Map 28. Spring Horned Grebe density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



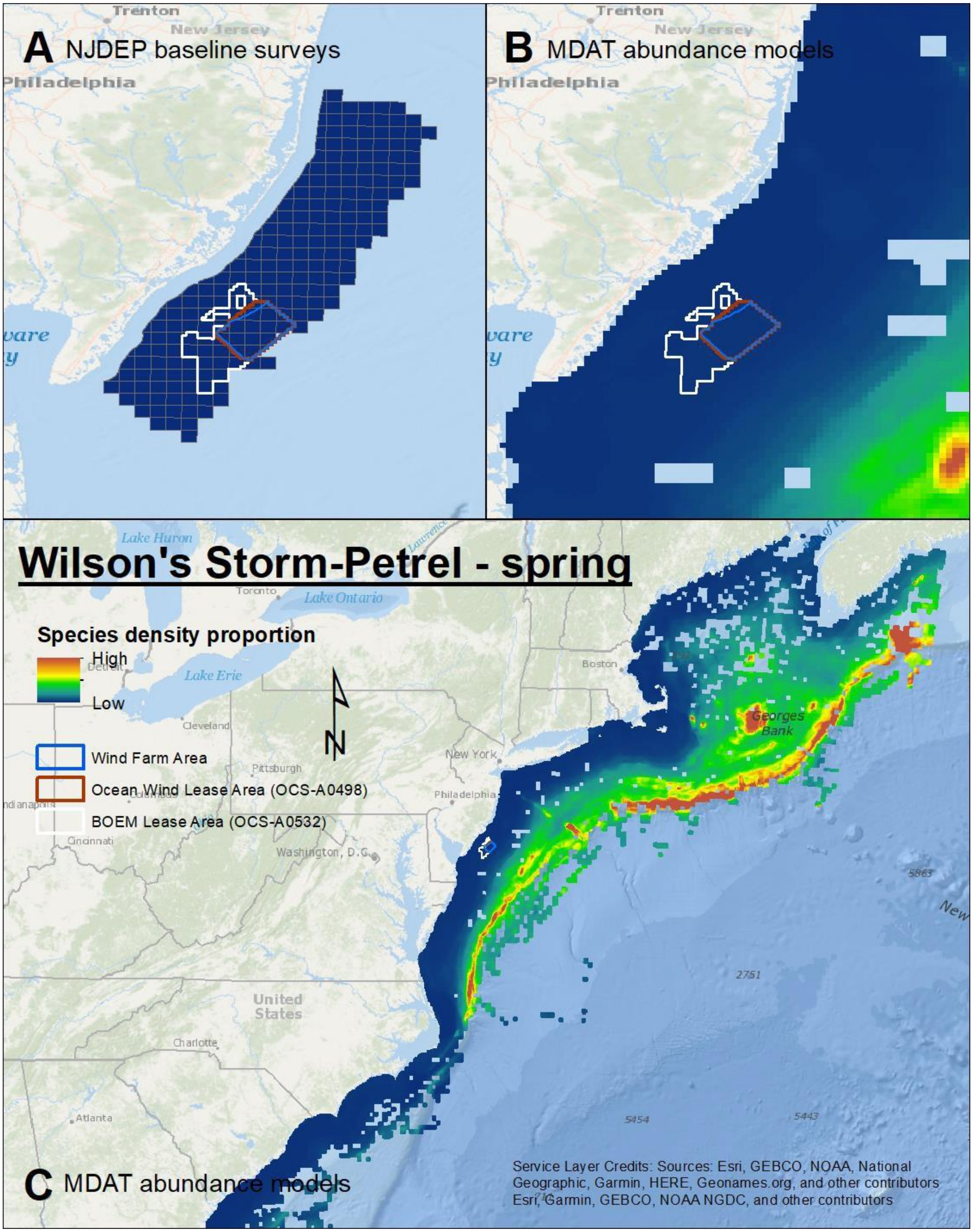
Map 29. Winter Horned Grebe density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



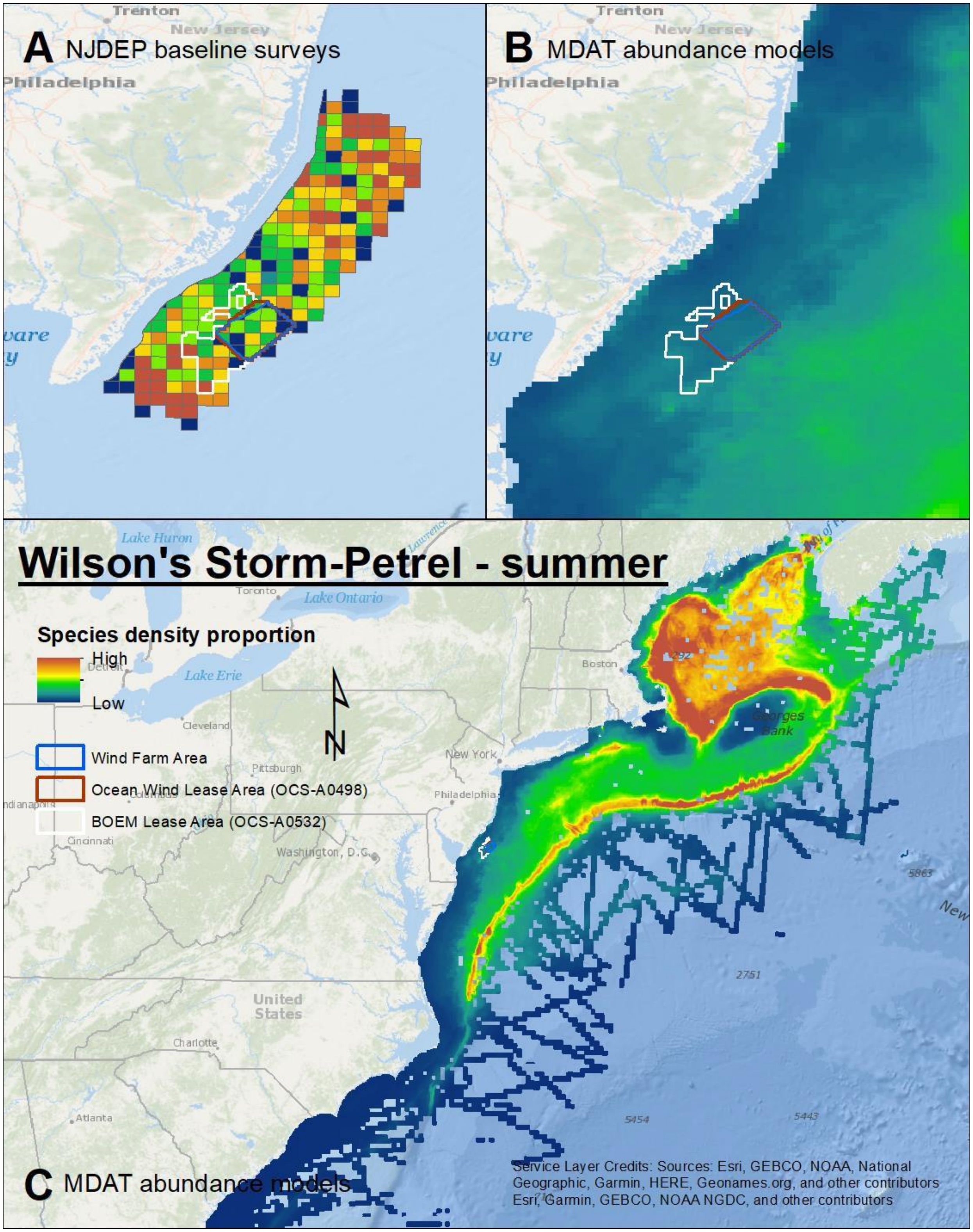
Map 30. Spring Red-necked Grebe density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



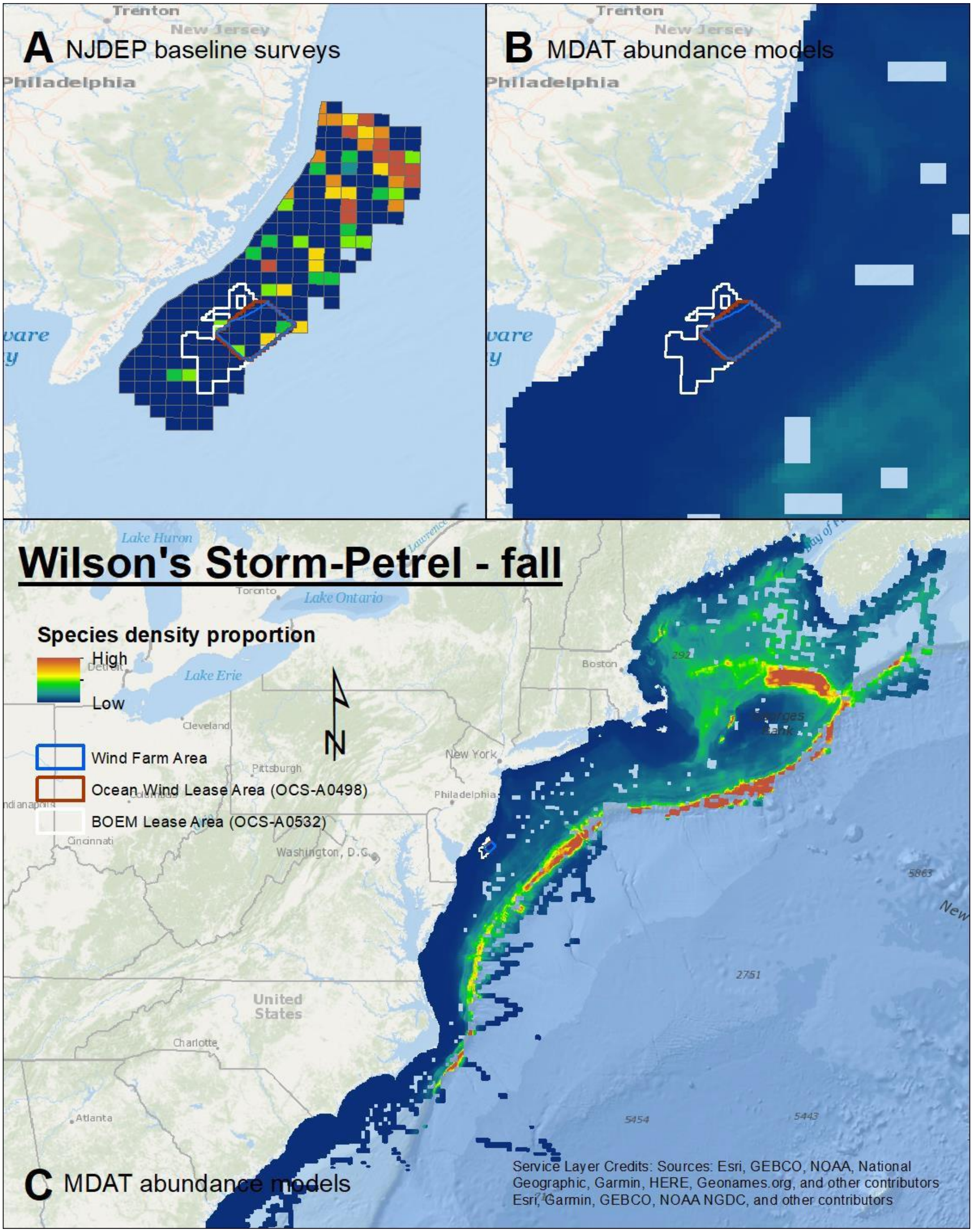
Map 31. Winter Red-necked Grebe density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



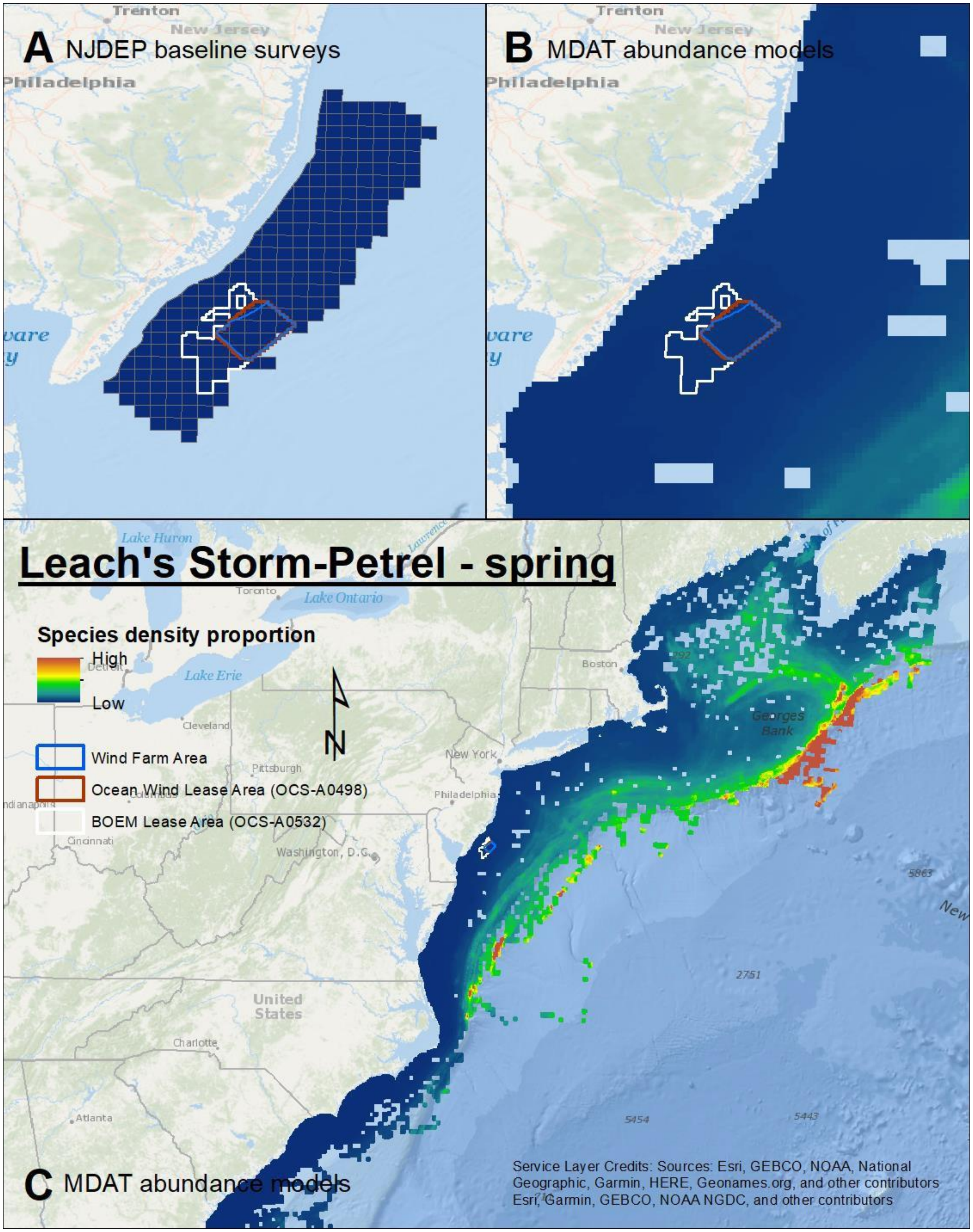
Map 32. Spring Wilson's Storm-Petrel density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



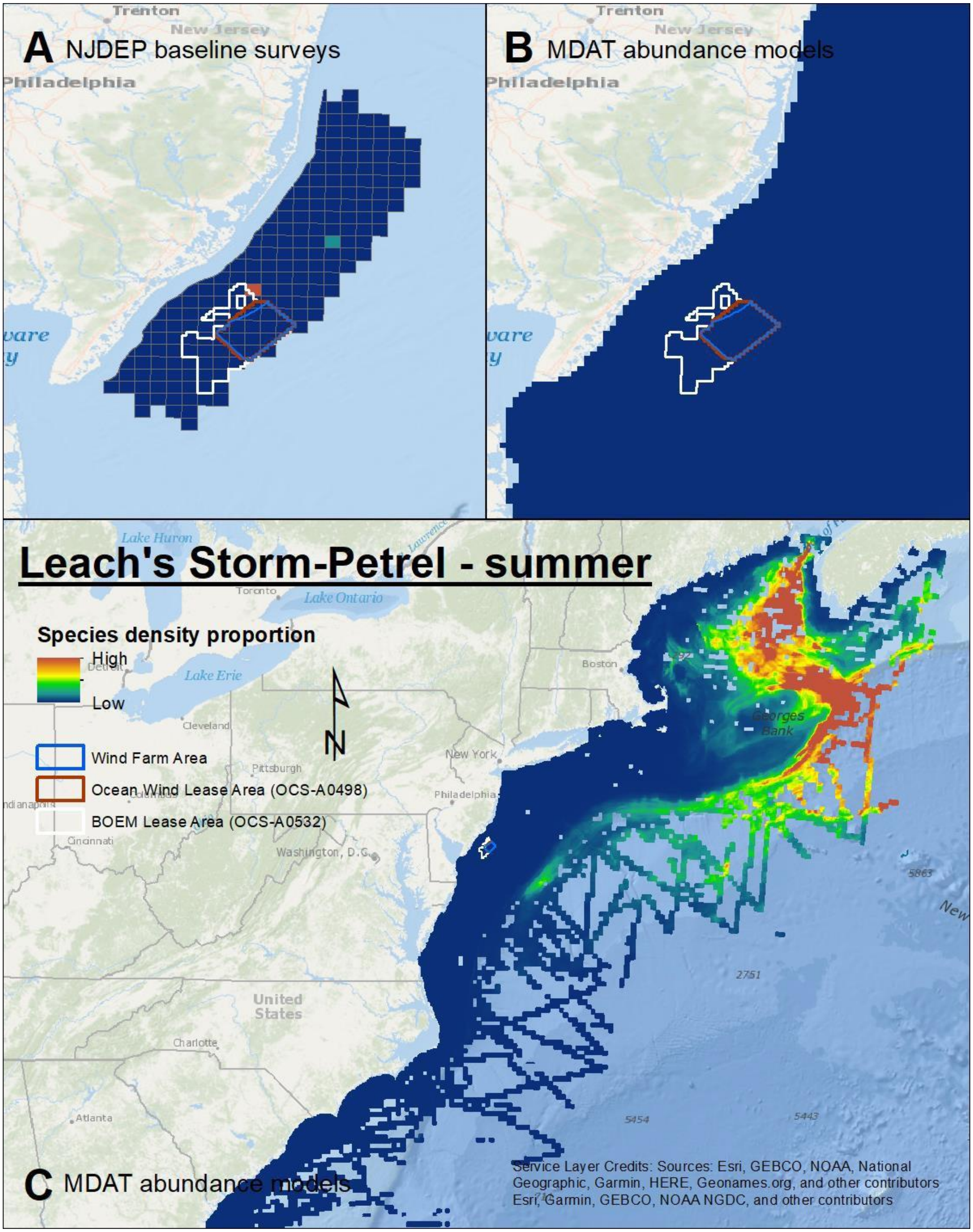
Map 33. Summer Wilson's Storm-Petrel density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



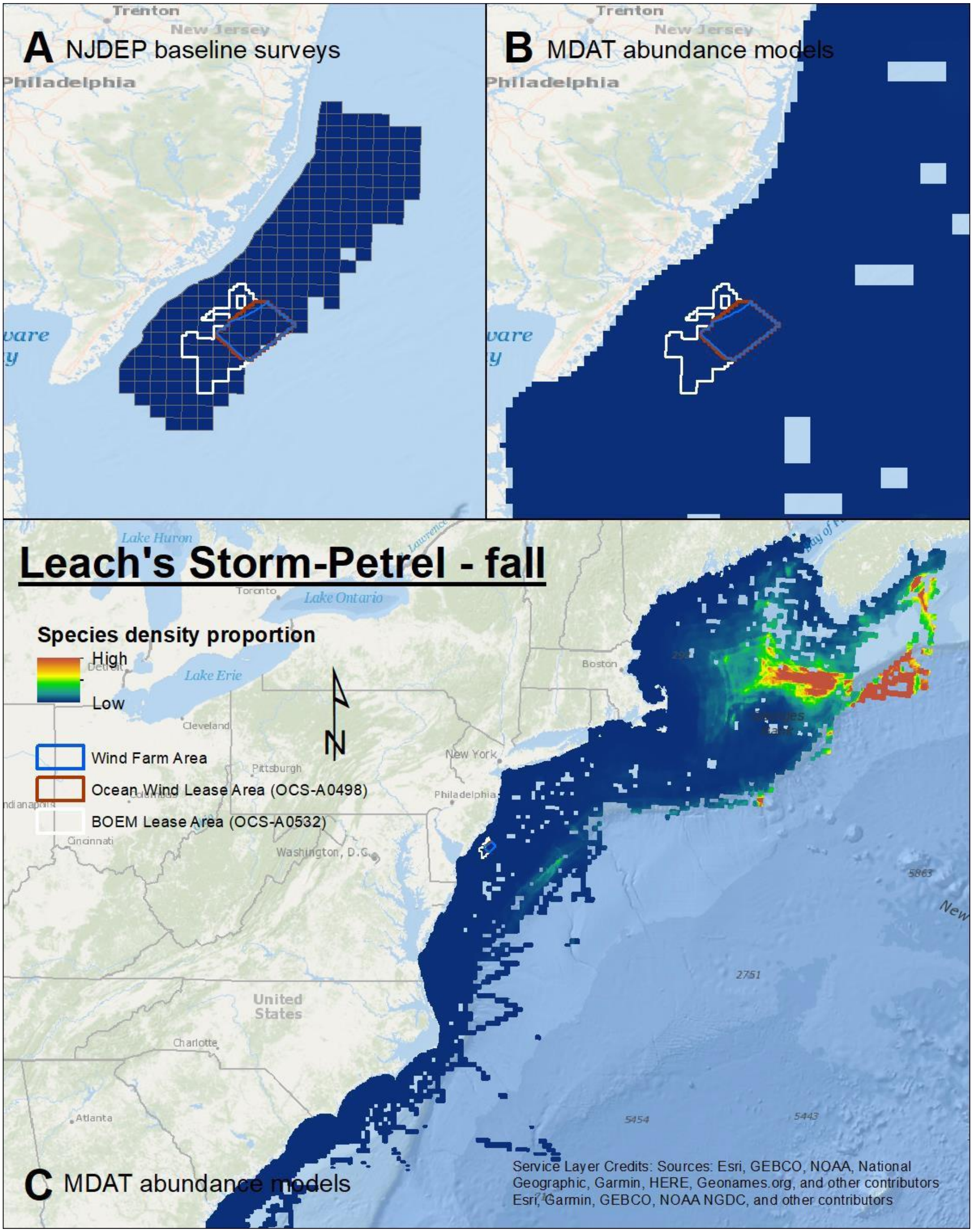
Map 34. Fall Wilson's Storm-Petrel density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



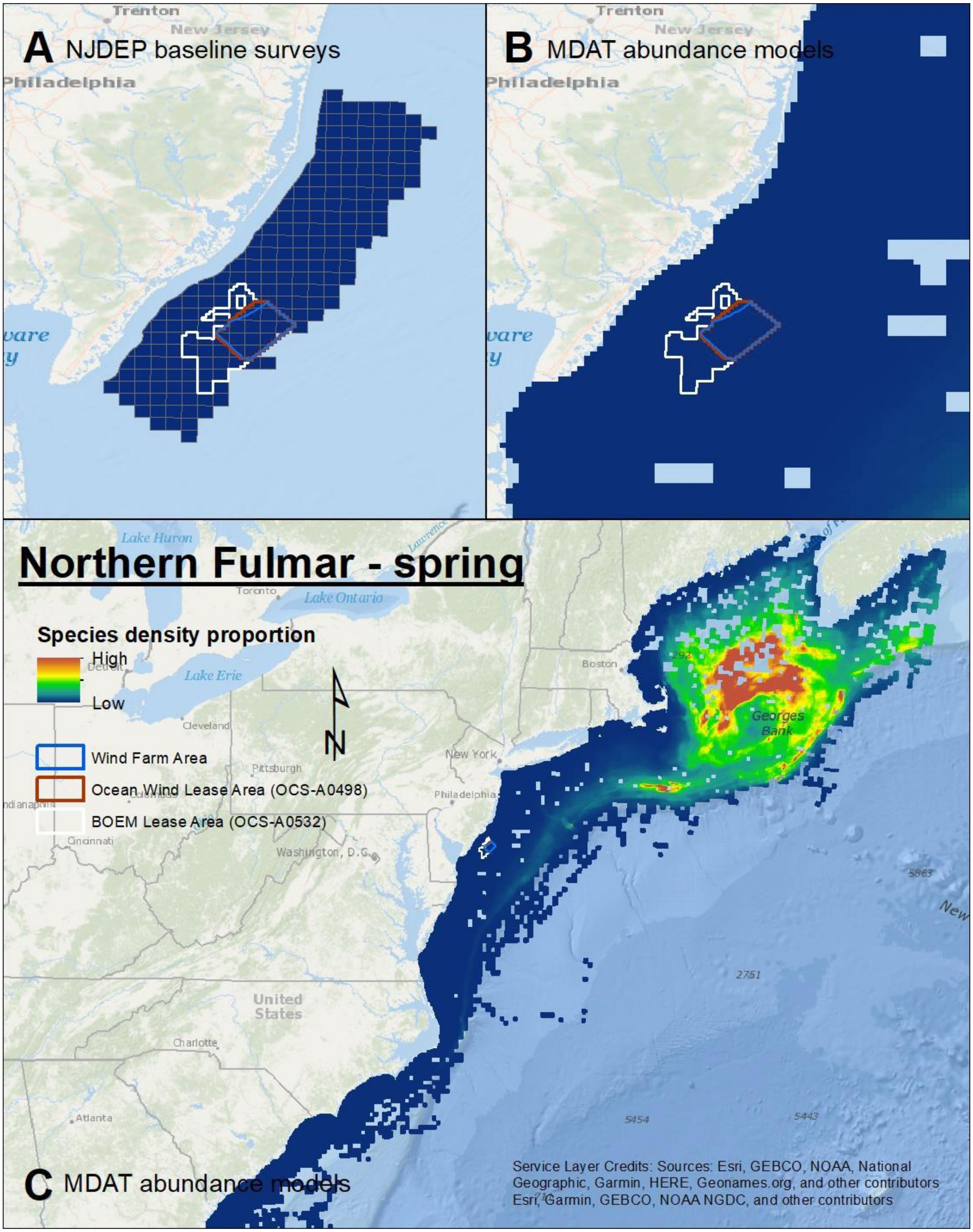
Map 35. Spring Leach's Storm-Petrel density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



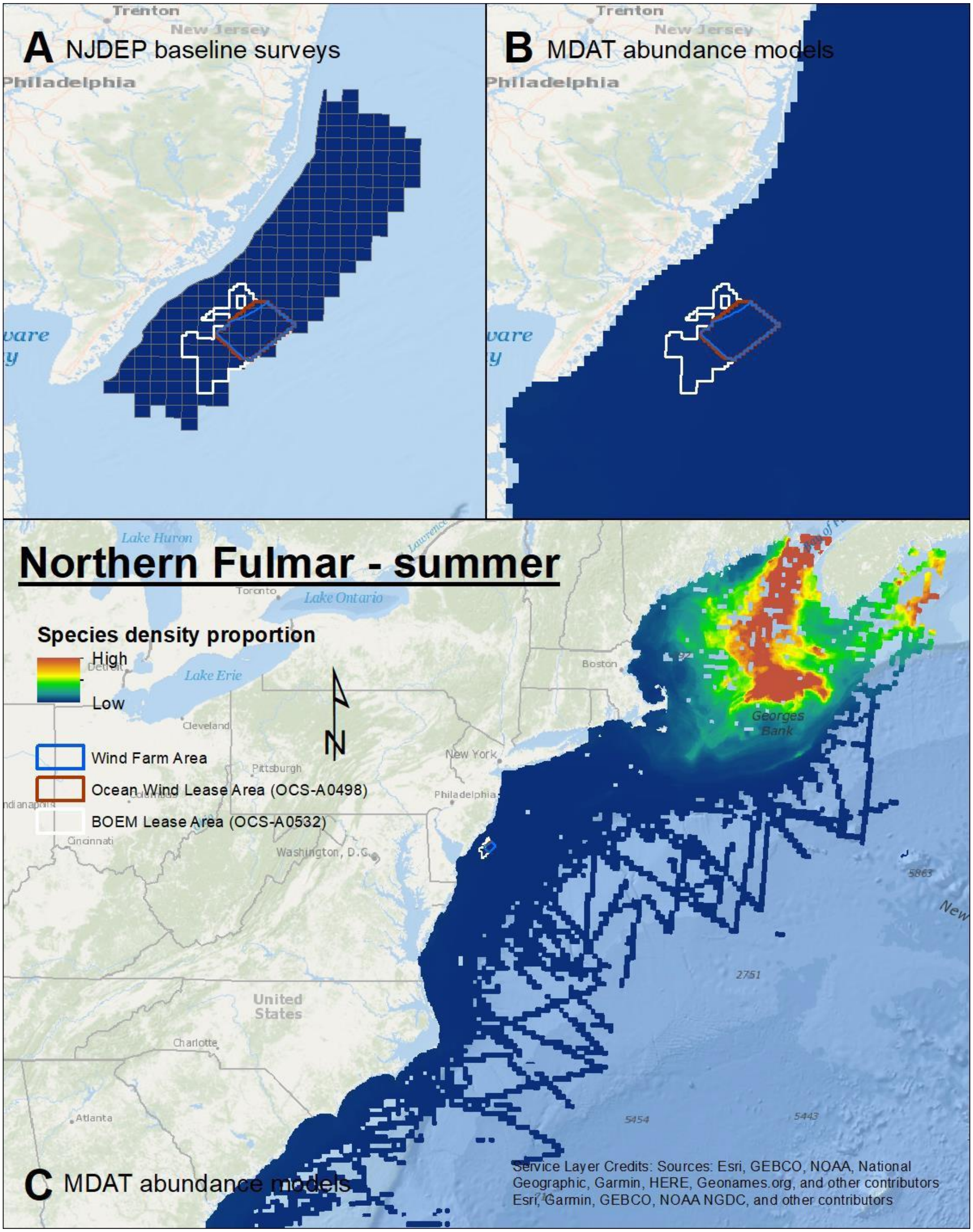
Map 36. Summer Leach's Storm-Petrel density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



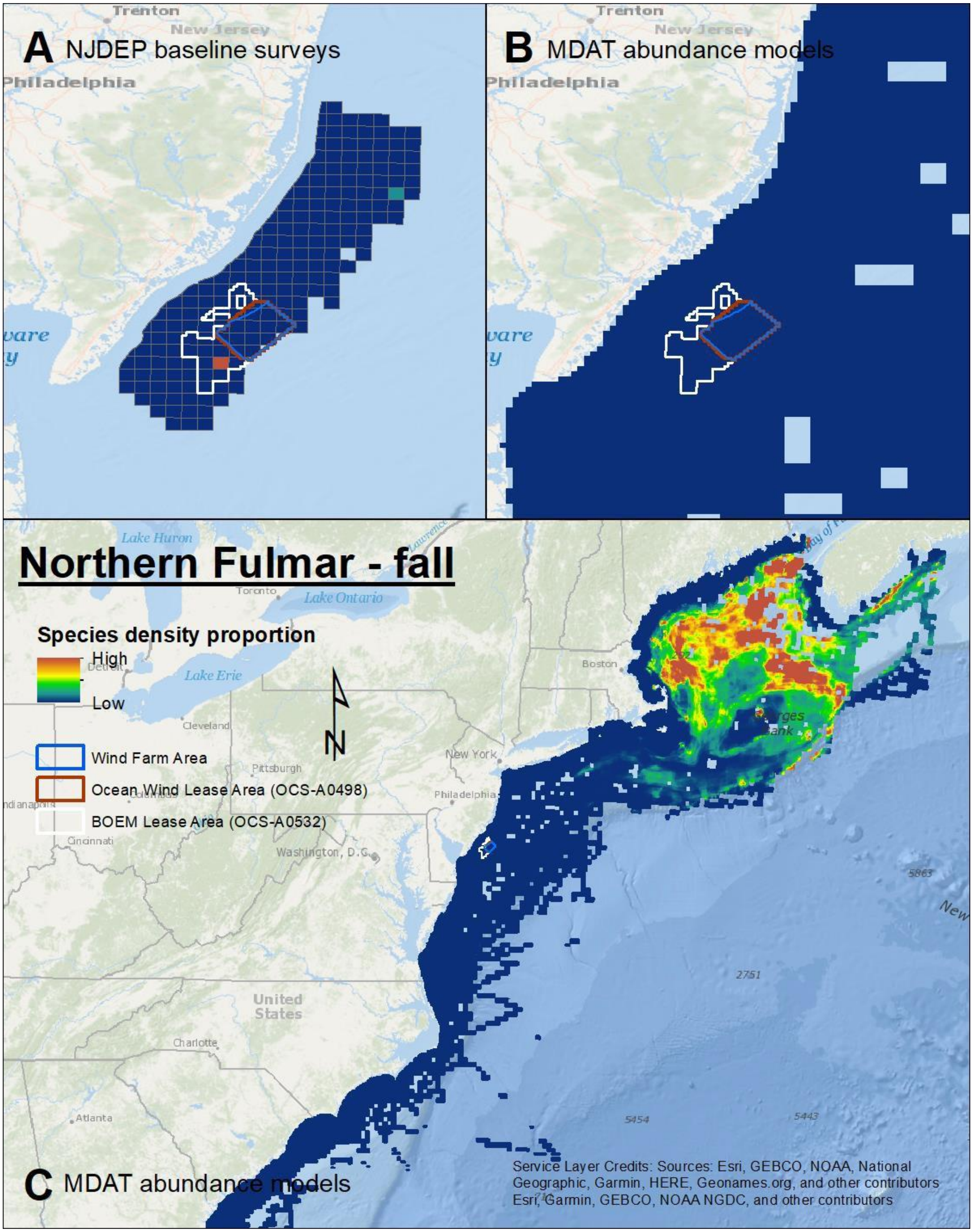
Map 37. Fall Leach's Storm-Petrel density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



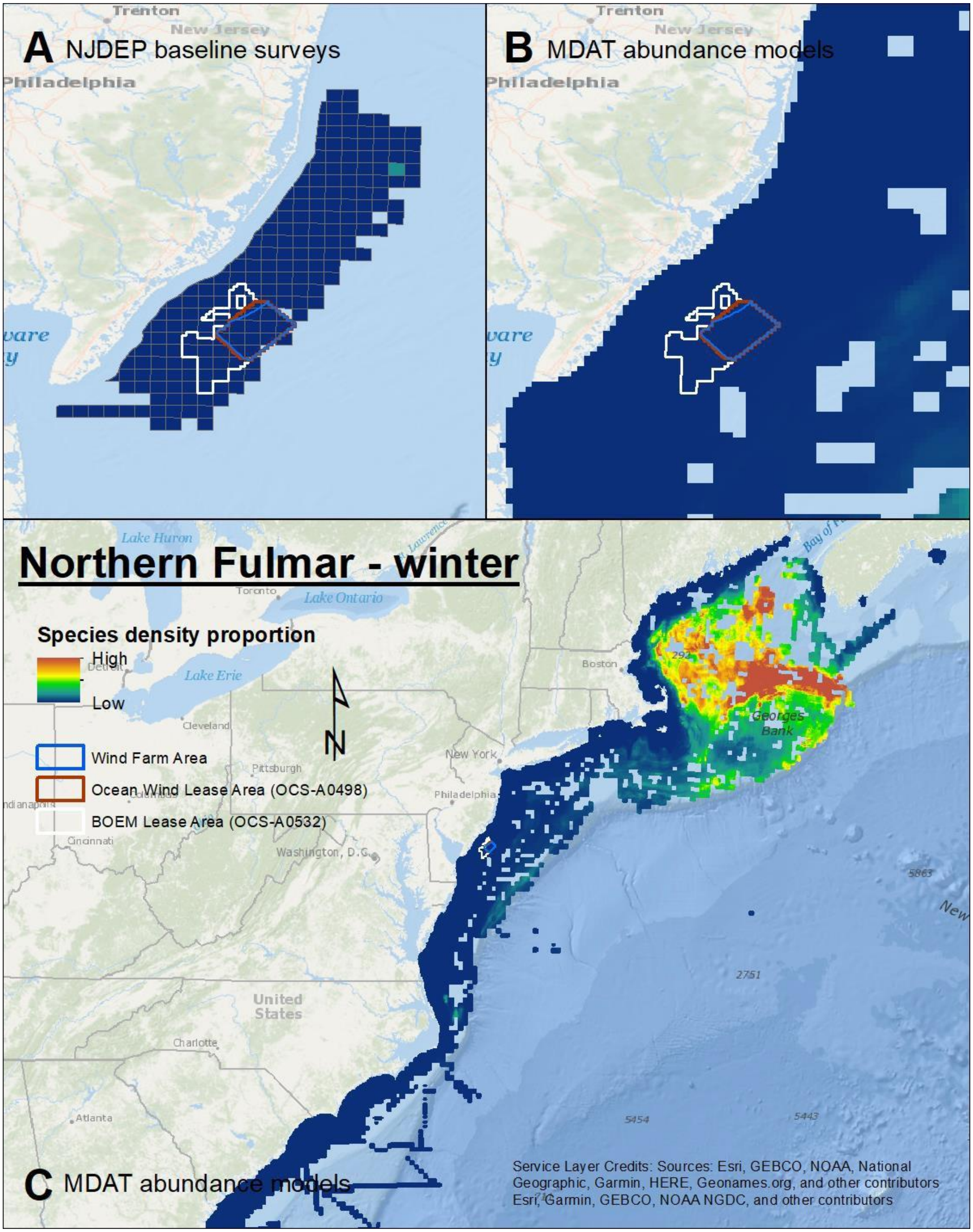
Map 38. Spring Northern Fulmar density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



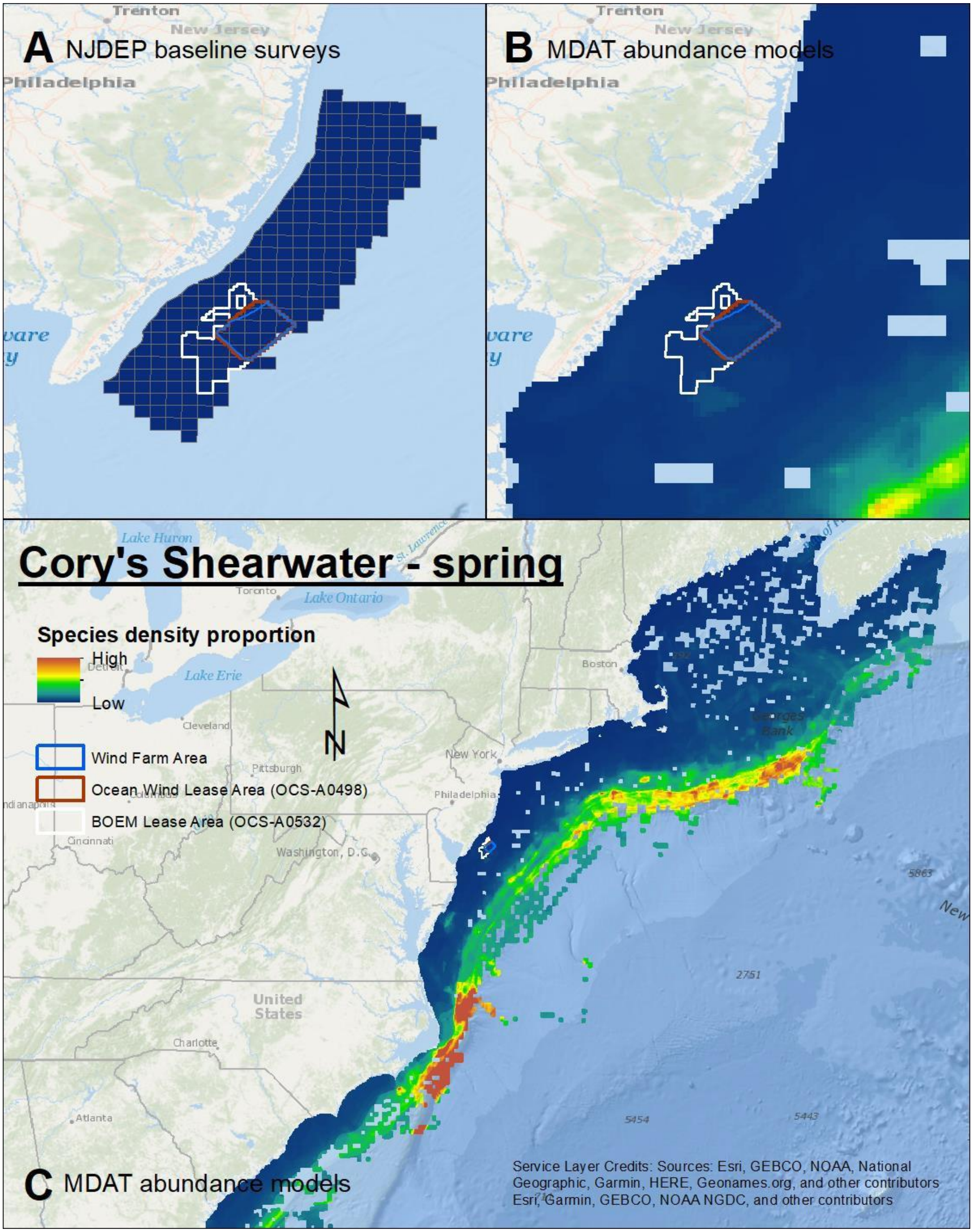
Map 39. Summer Northern Fulmar density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



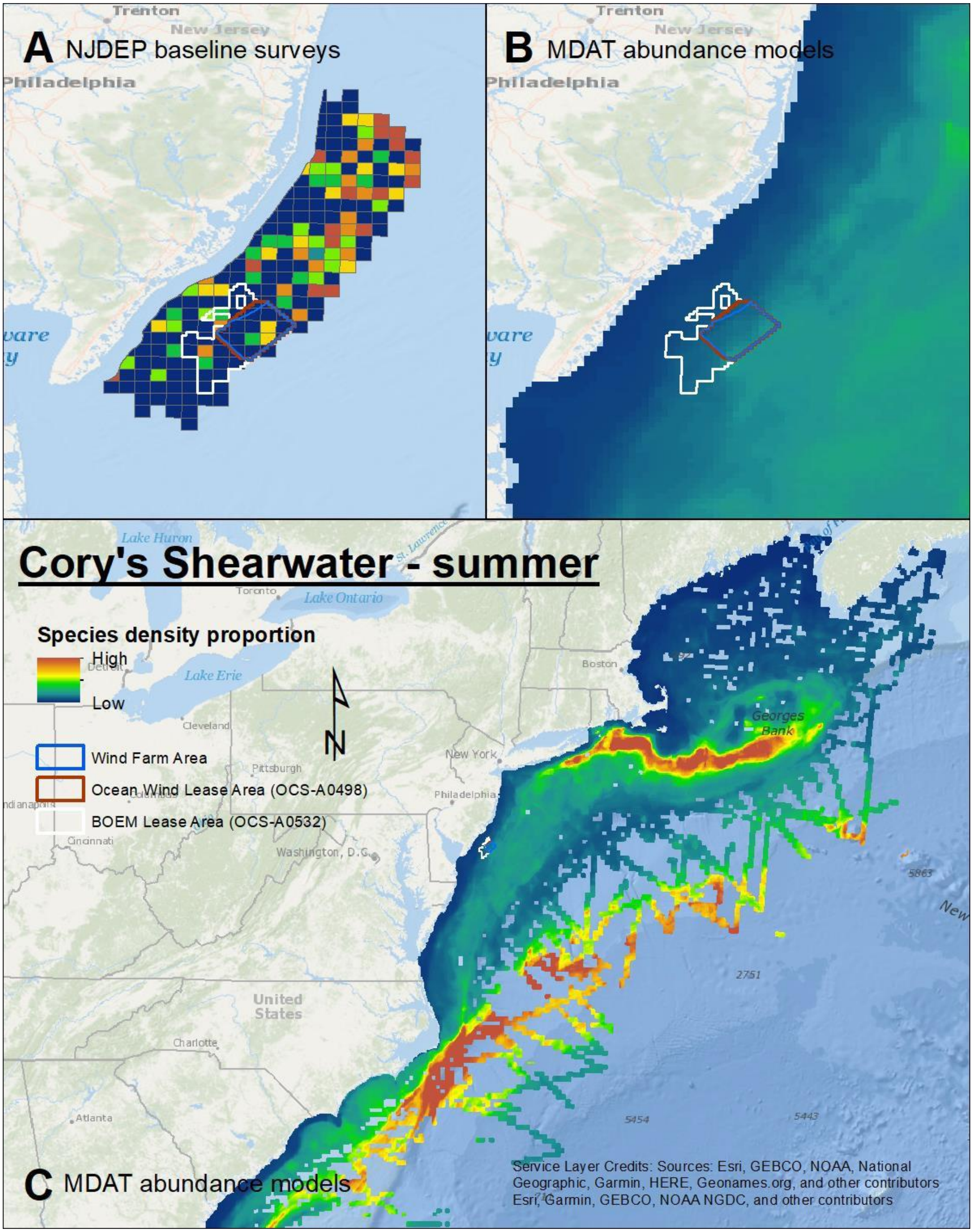
Map 40. Fall Northern Fulmar density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



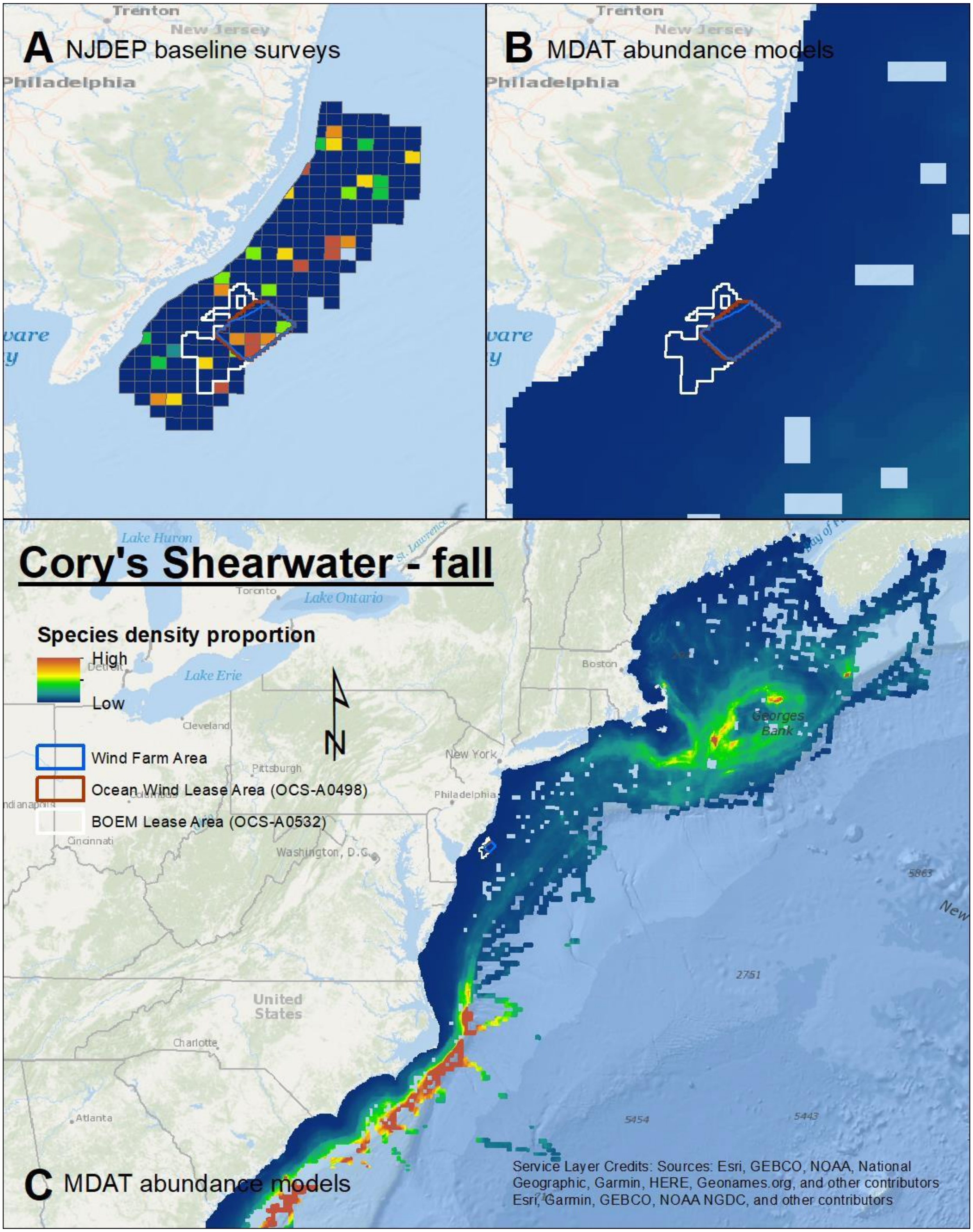
Map 41. Winter Northern Fulmar density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



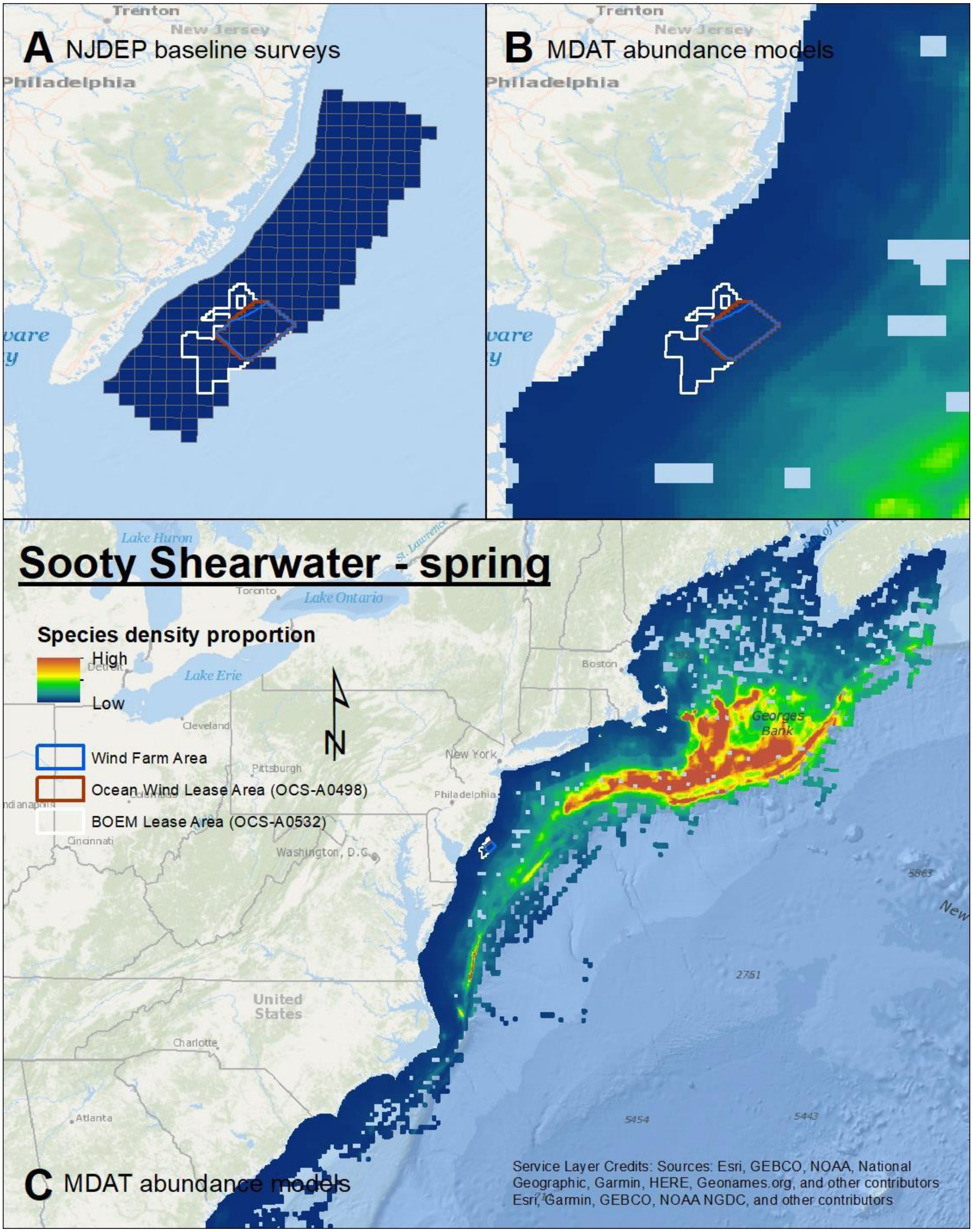
Map 42. Spring Cory's Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



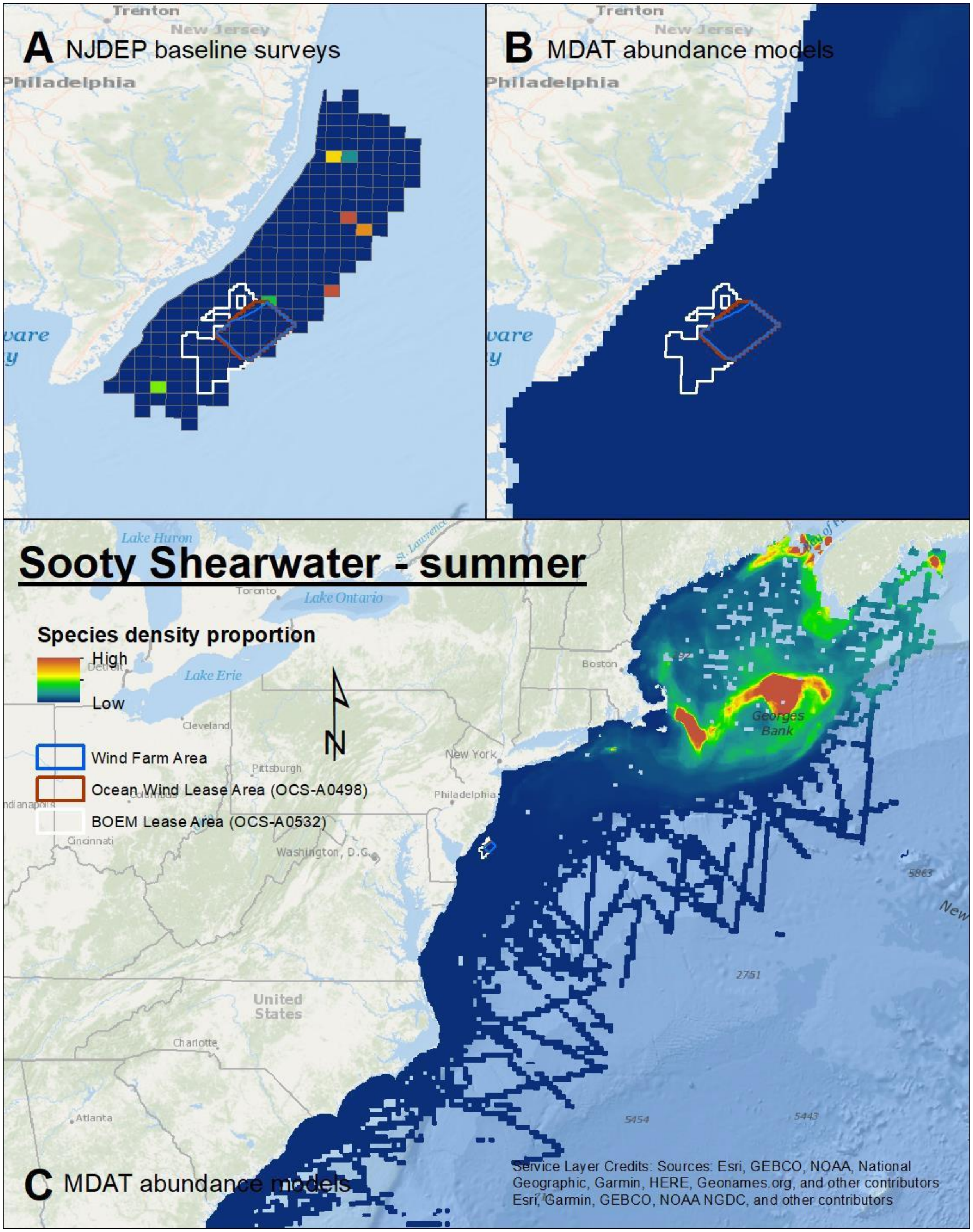
Map 43. Summer Cory's Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



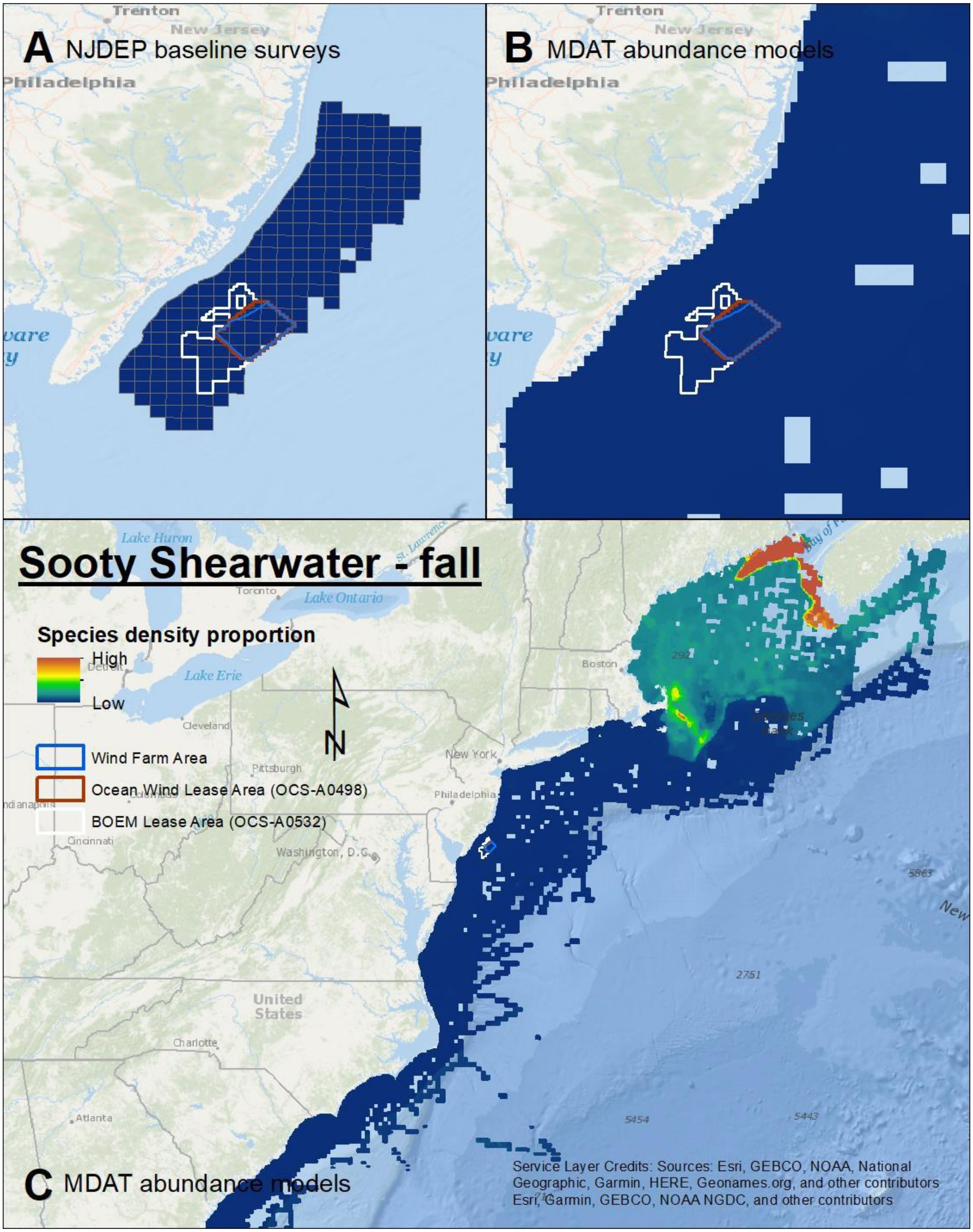
Map 44. Fall Cory's Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



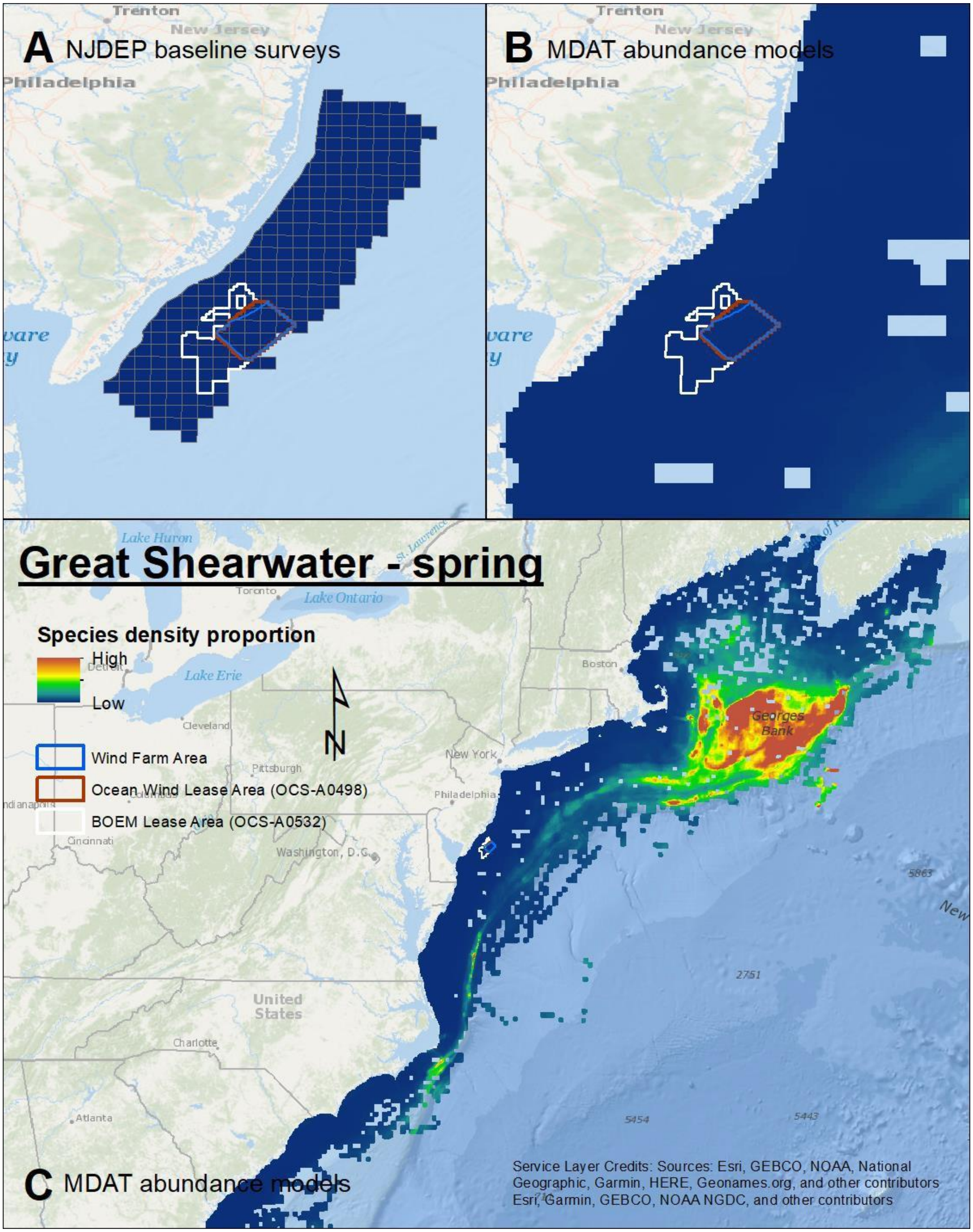
Map 45. Spring Sooty Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



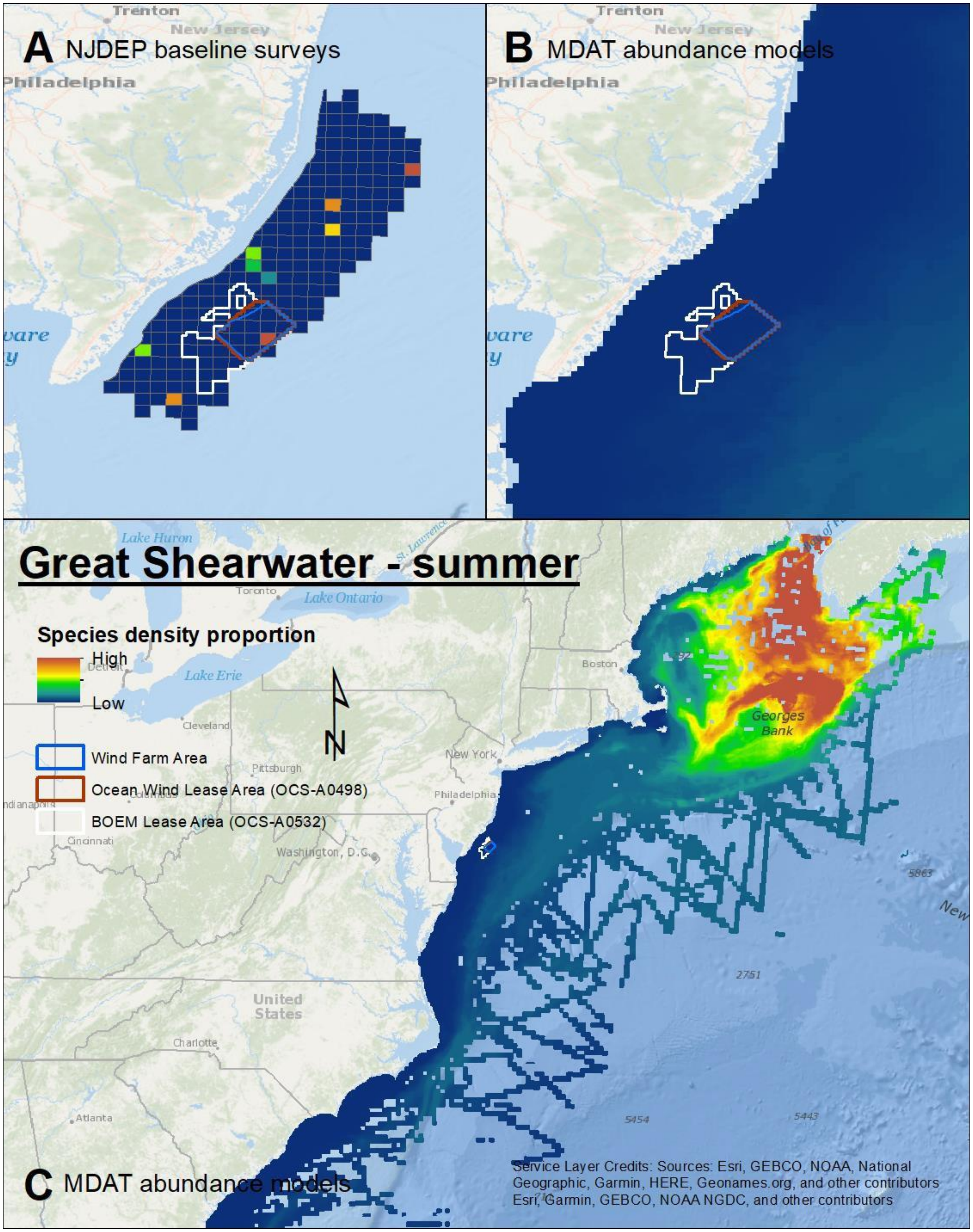
Map 46. Summer Sooty Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



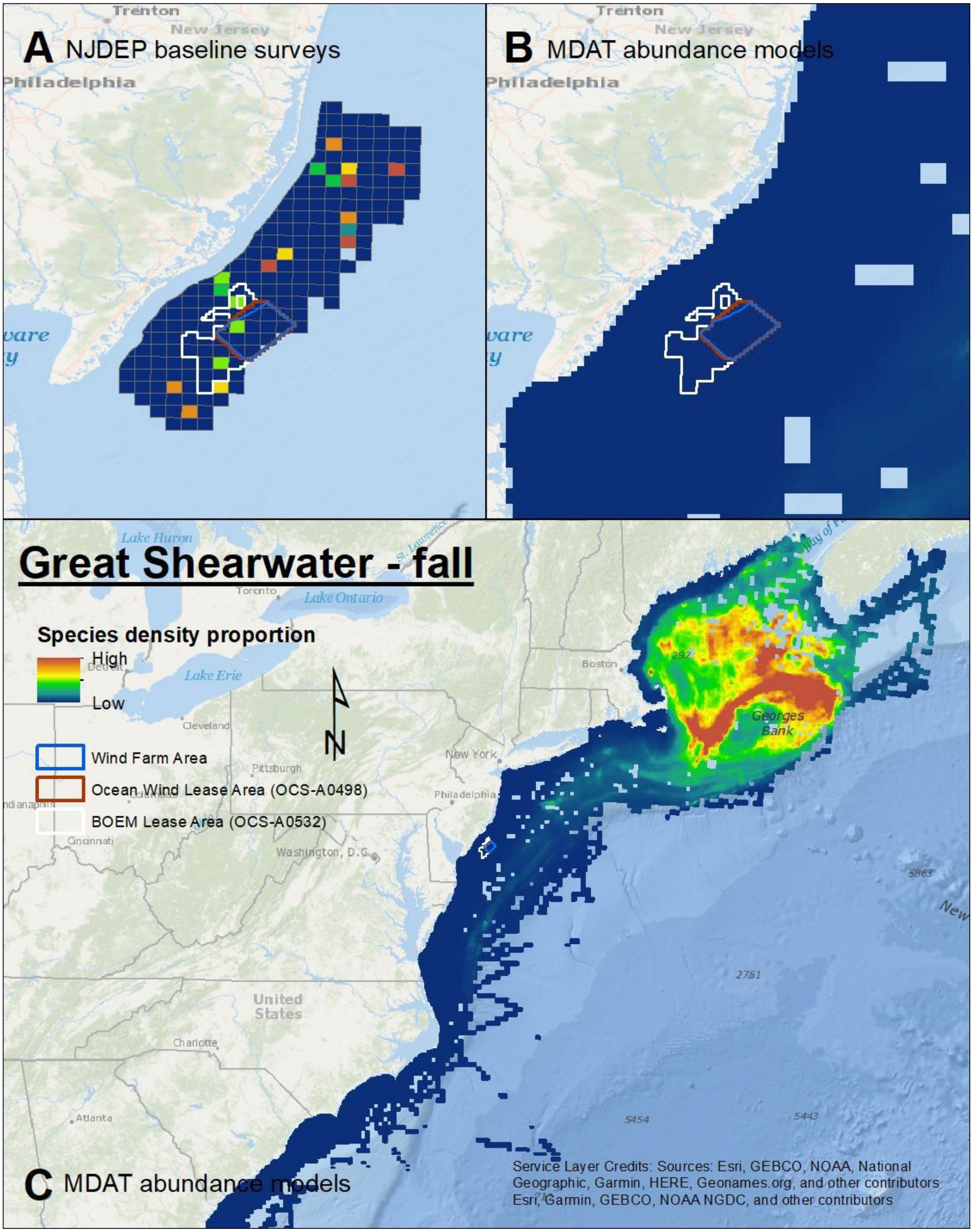
Map 47. Fall Sooty Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



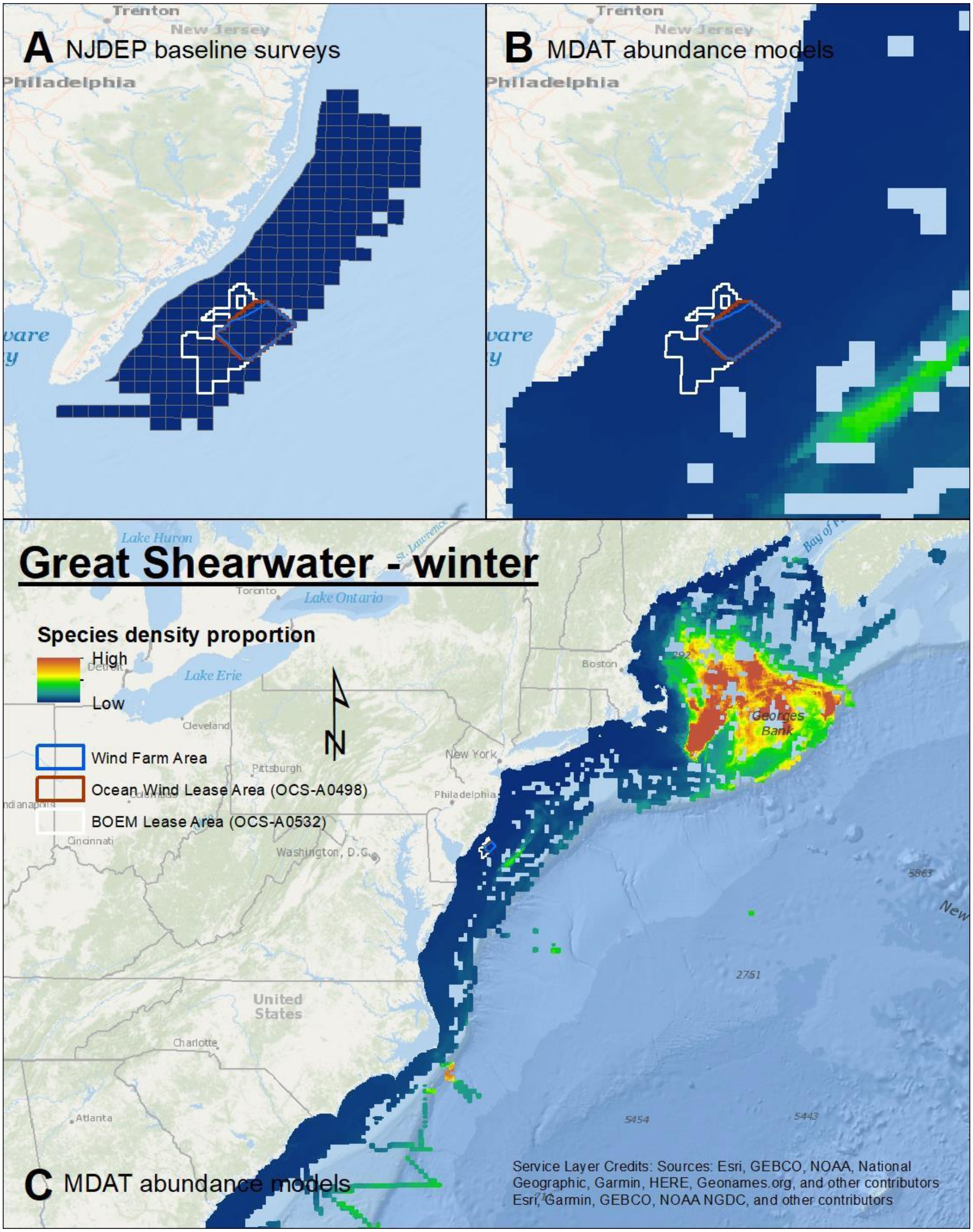
Map 48. Spring Great Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



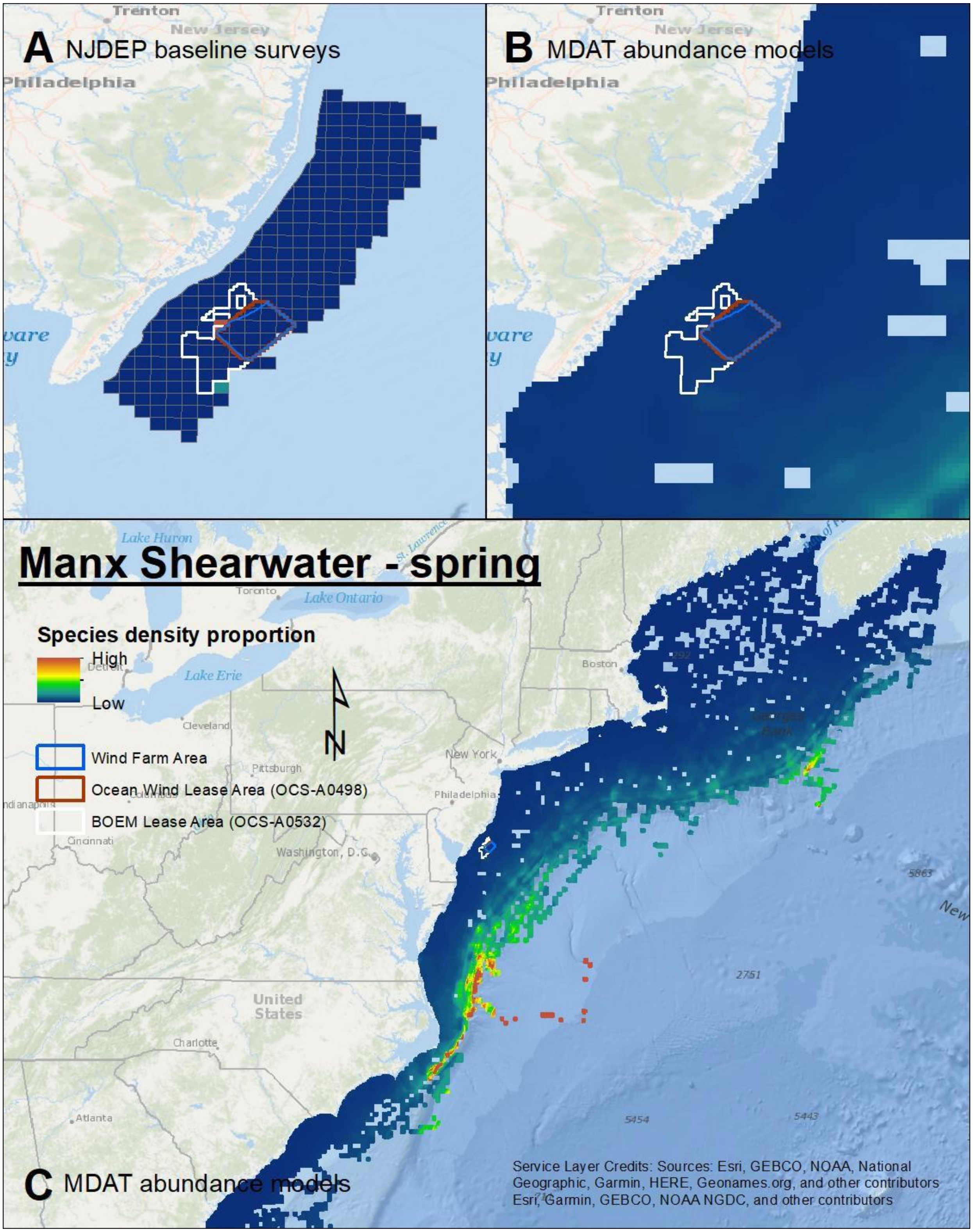
Map 49. Summer Great Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



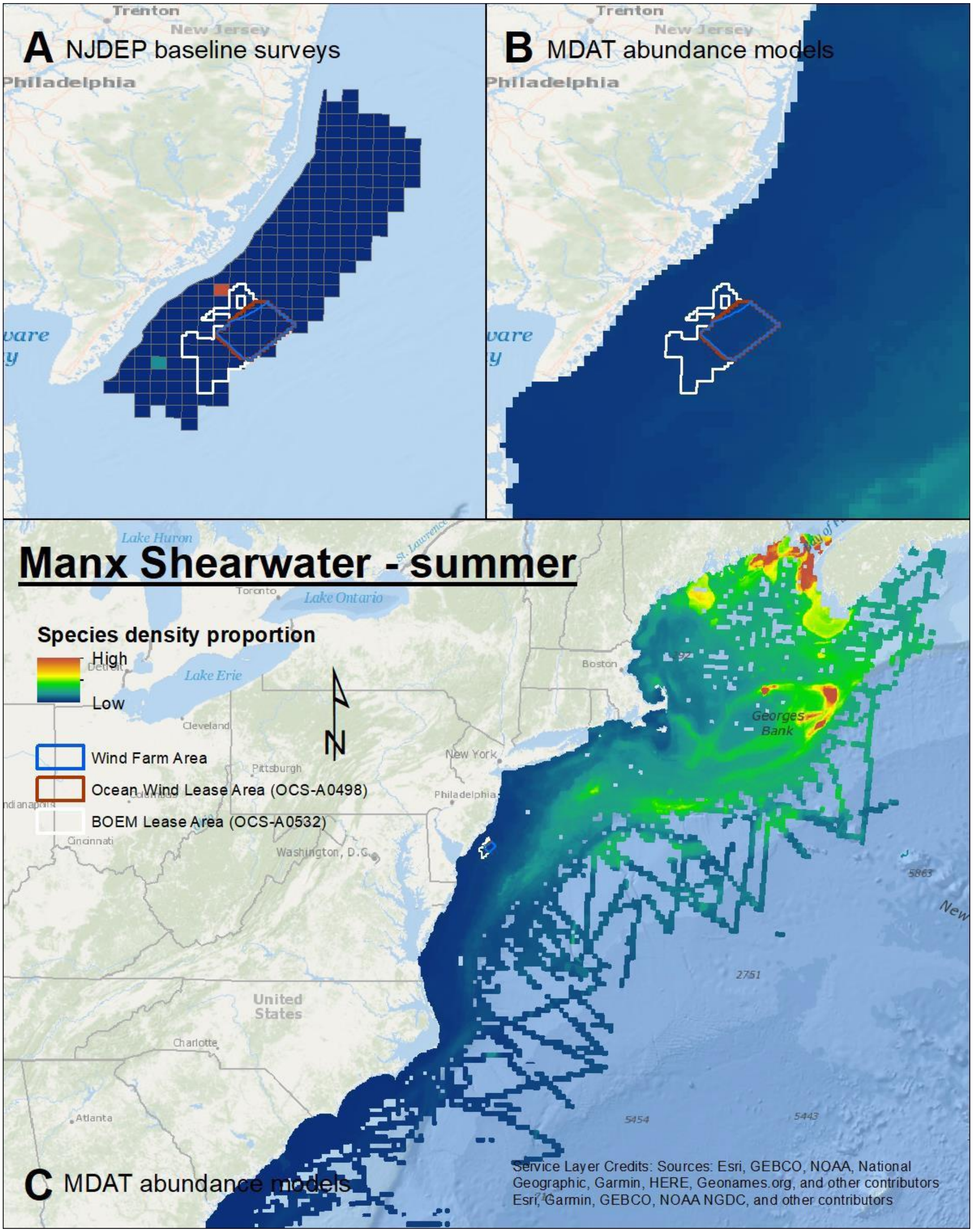
Map 50. Fall Great Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



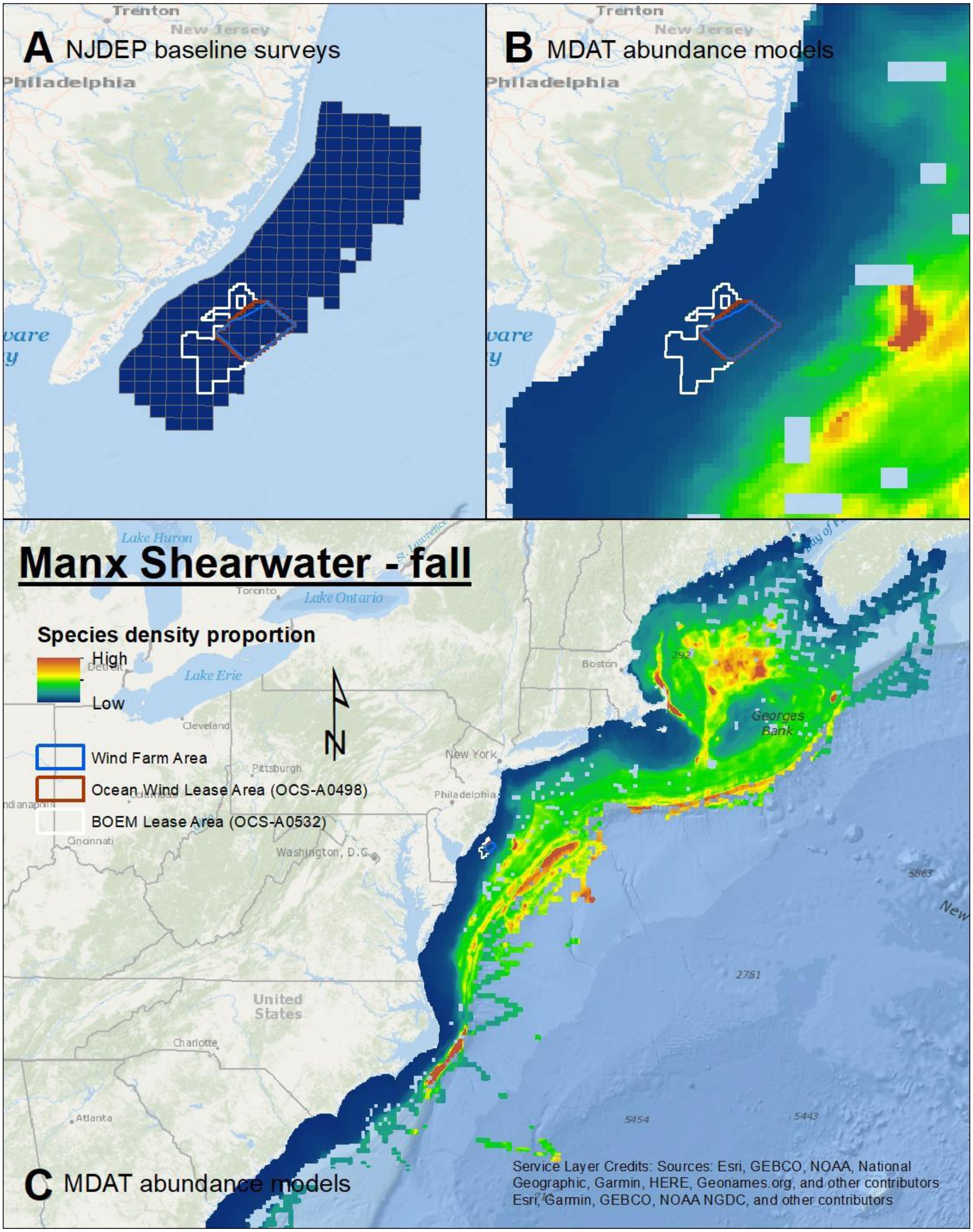
Map 51. Winter Great Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



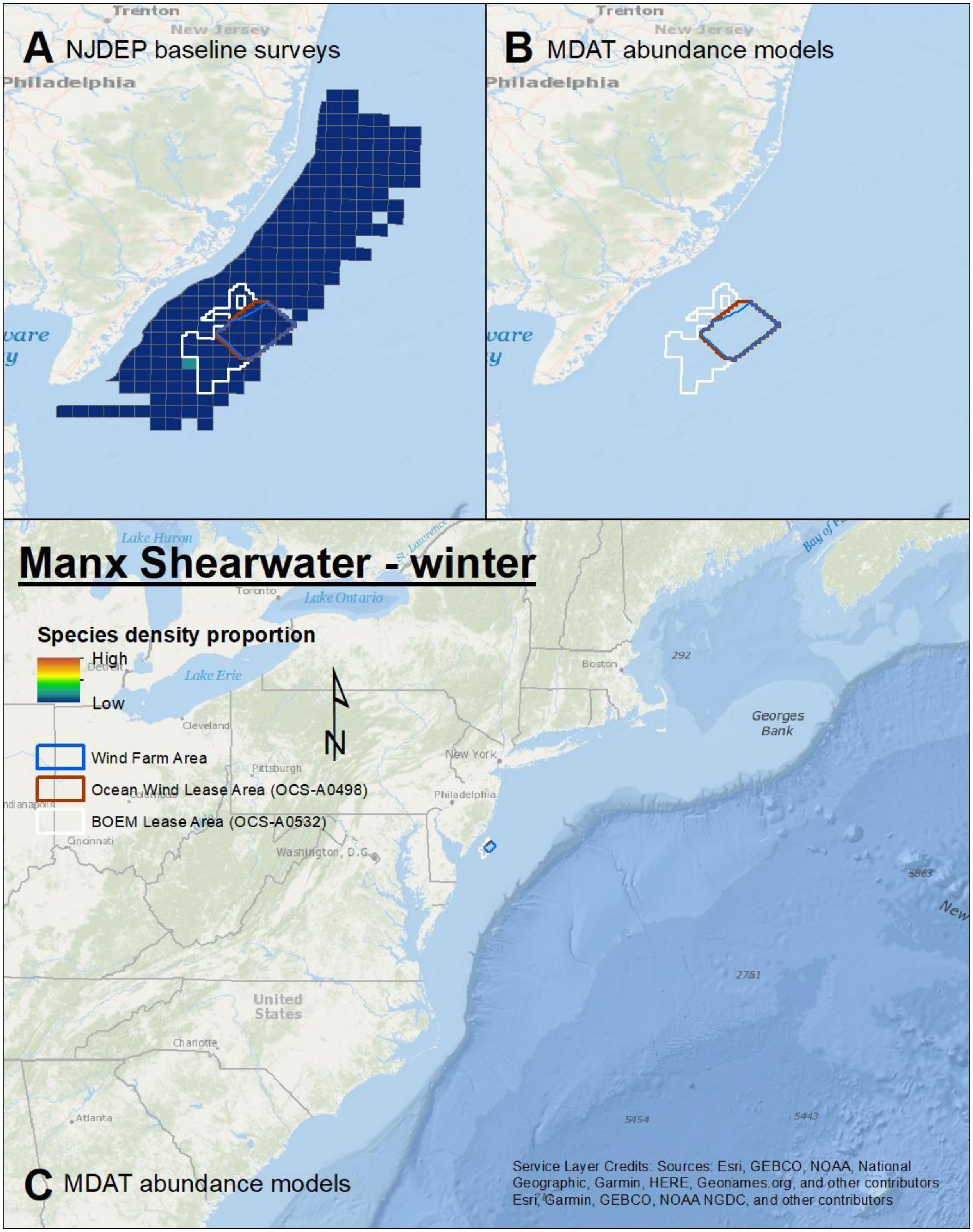
Map 52. Spring Manx Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



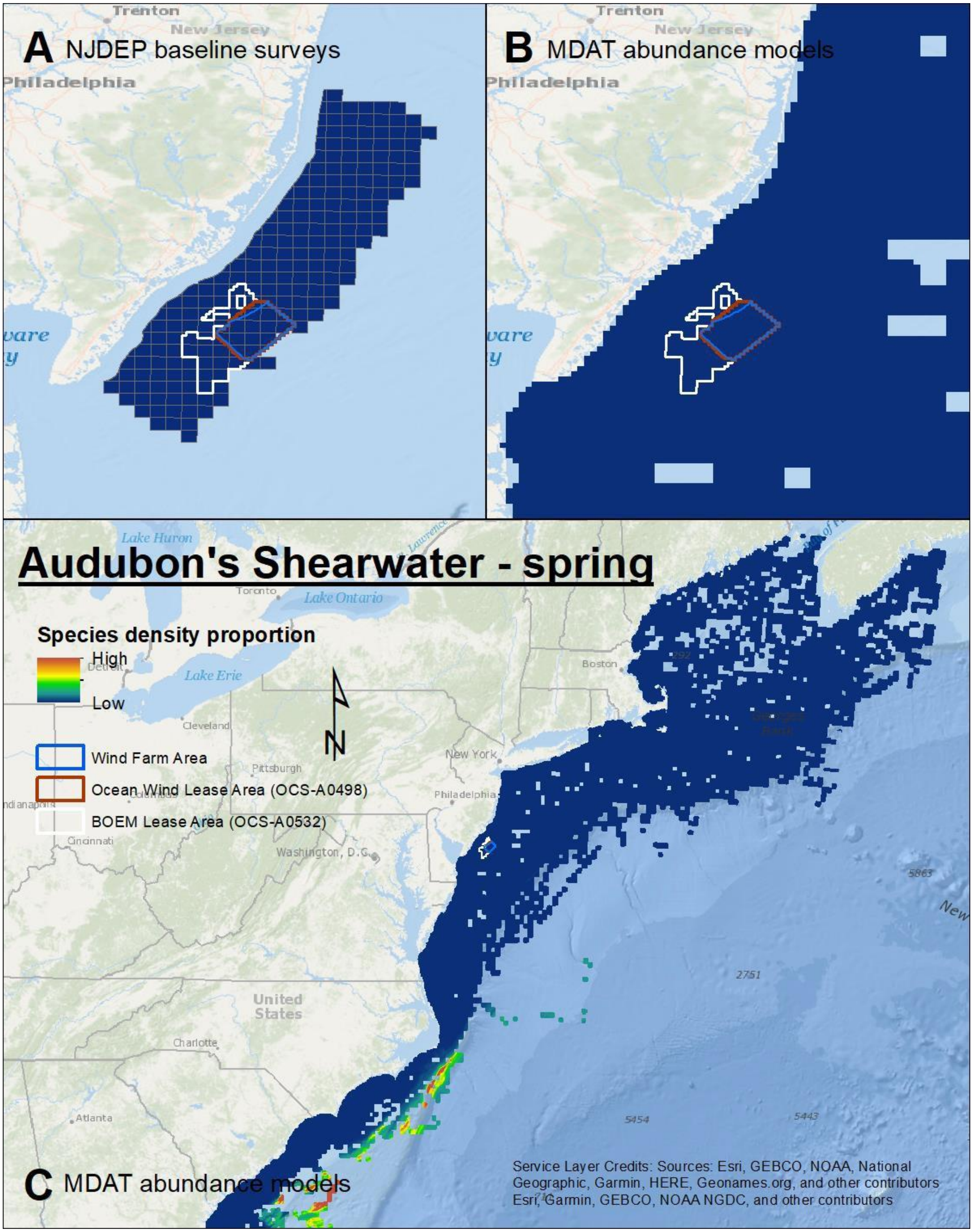
Map 53. Summer Manx Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



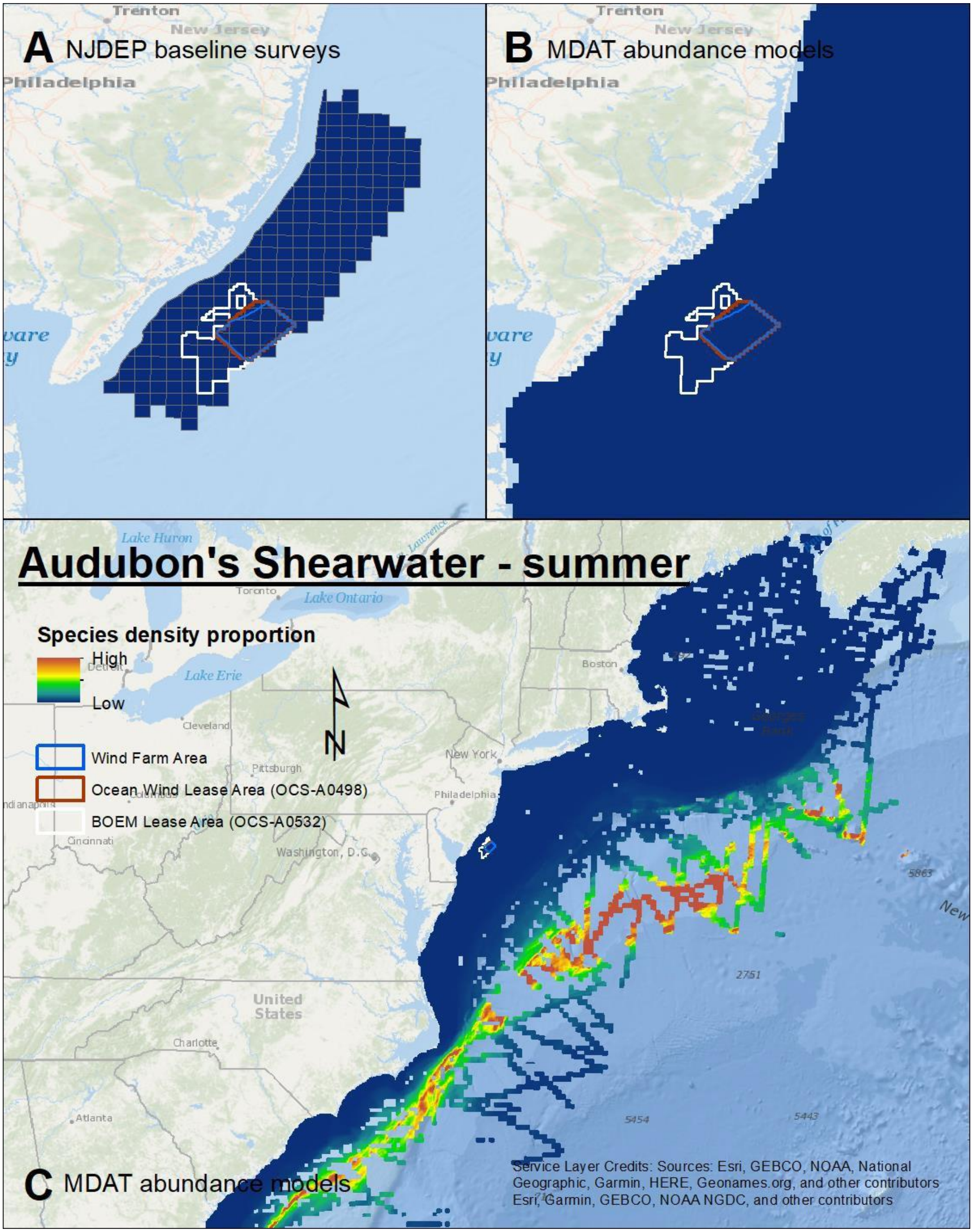
Map 54. Fall Manx Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



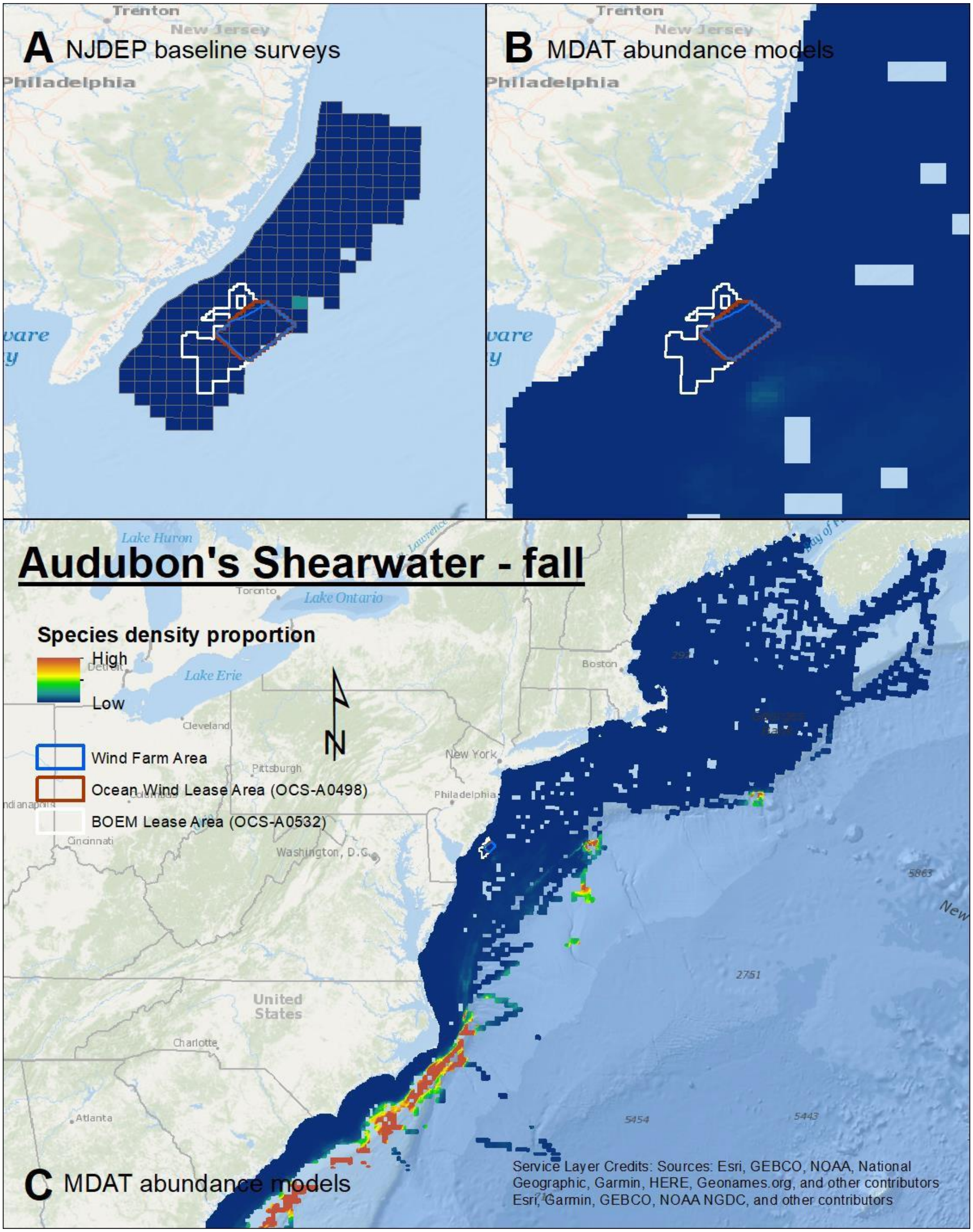
Map 55. Winter Manx Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



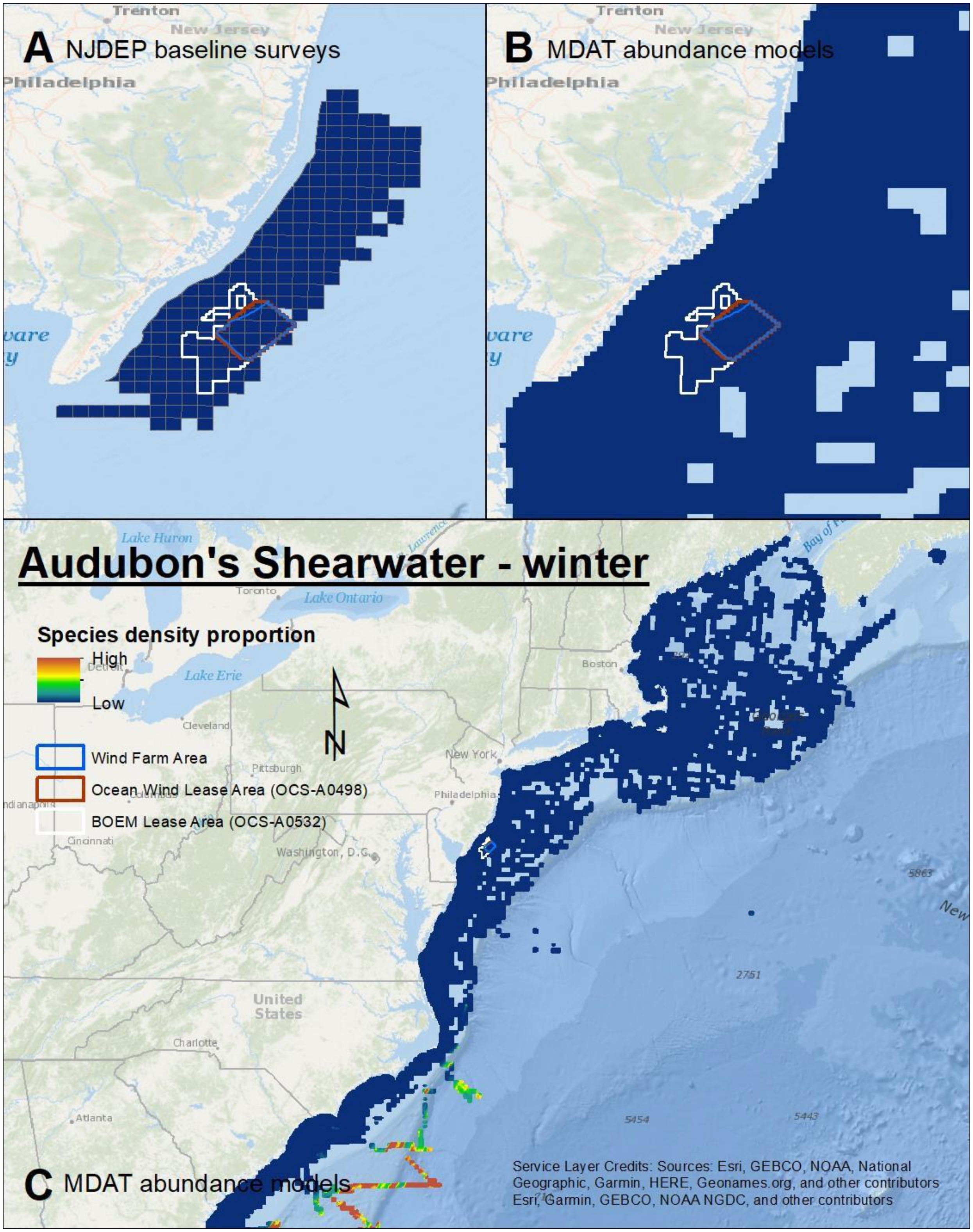
Map 56. Spring Audubon's Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



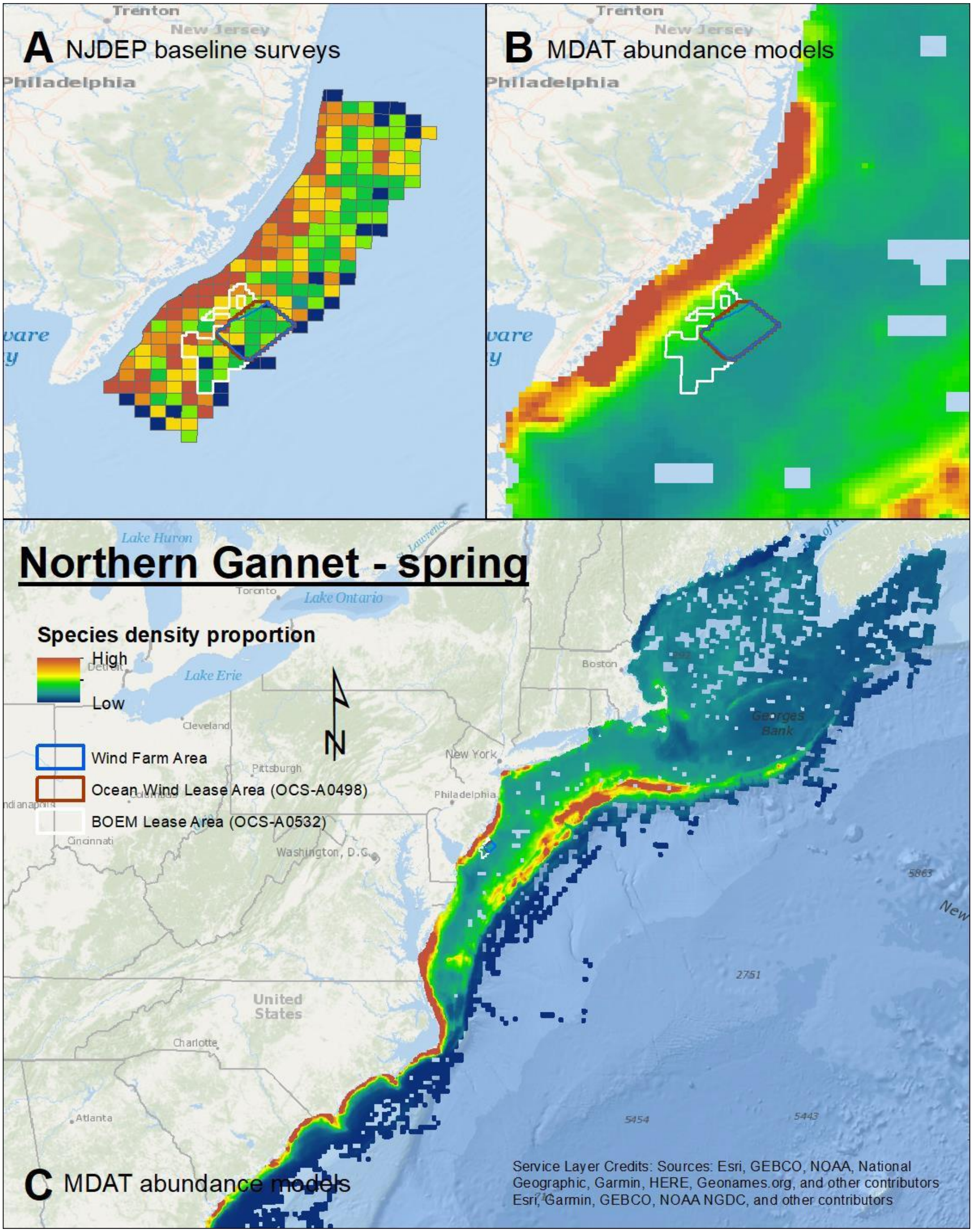
Map 57. Summer Audubon's Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



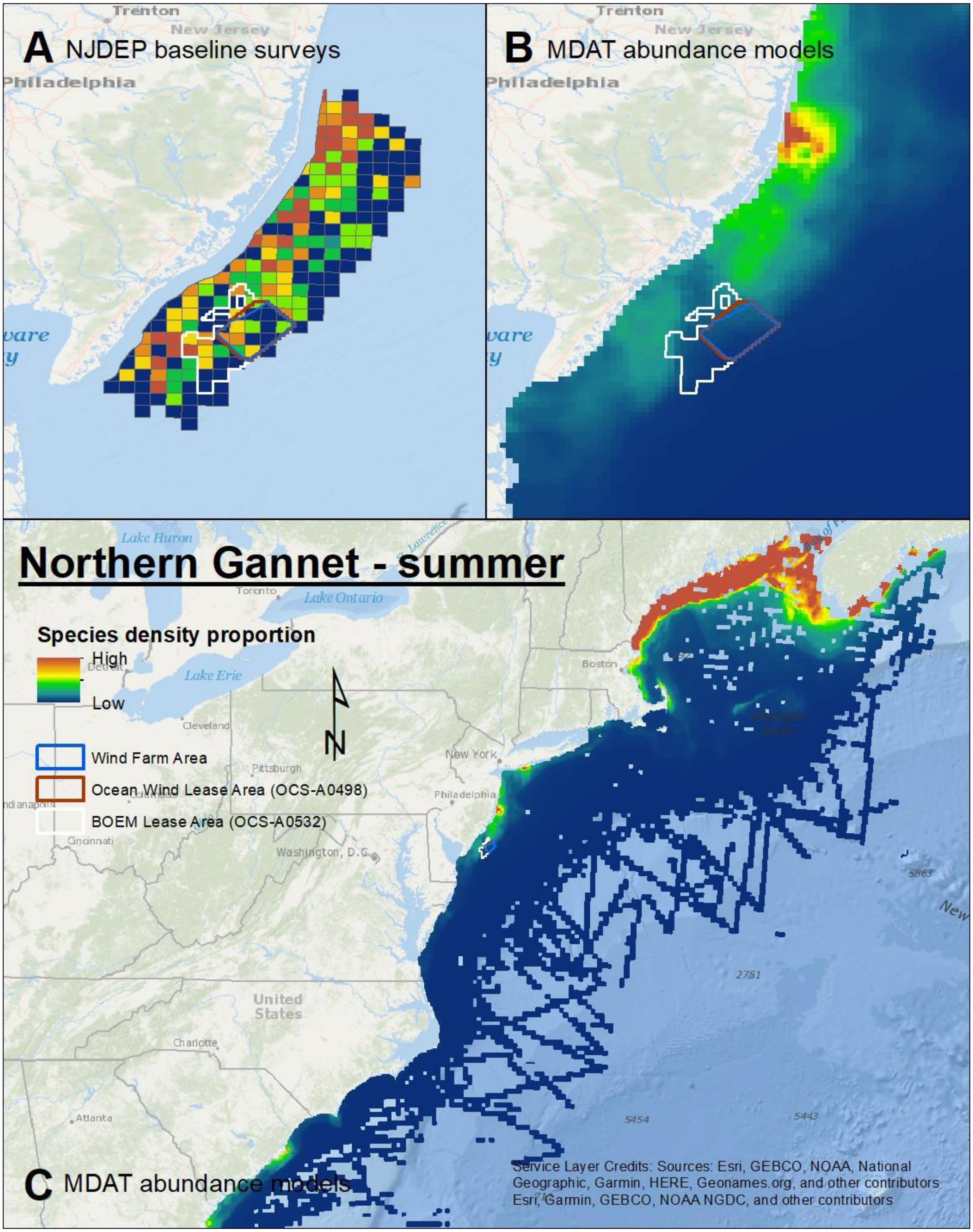
Map 58. Fall Audubon's Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



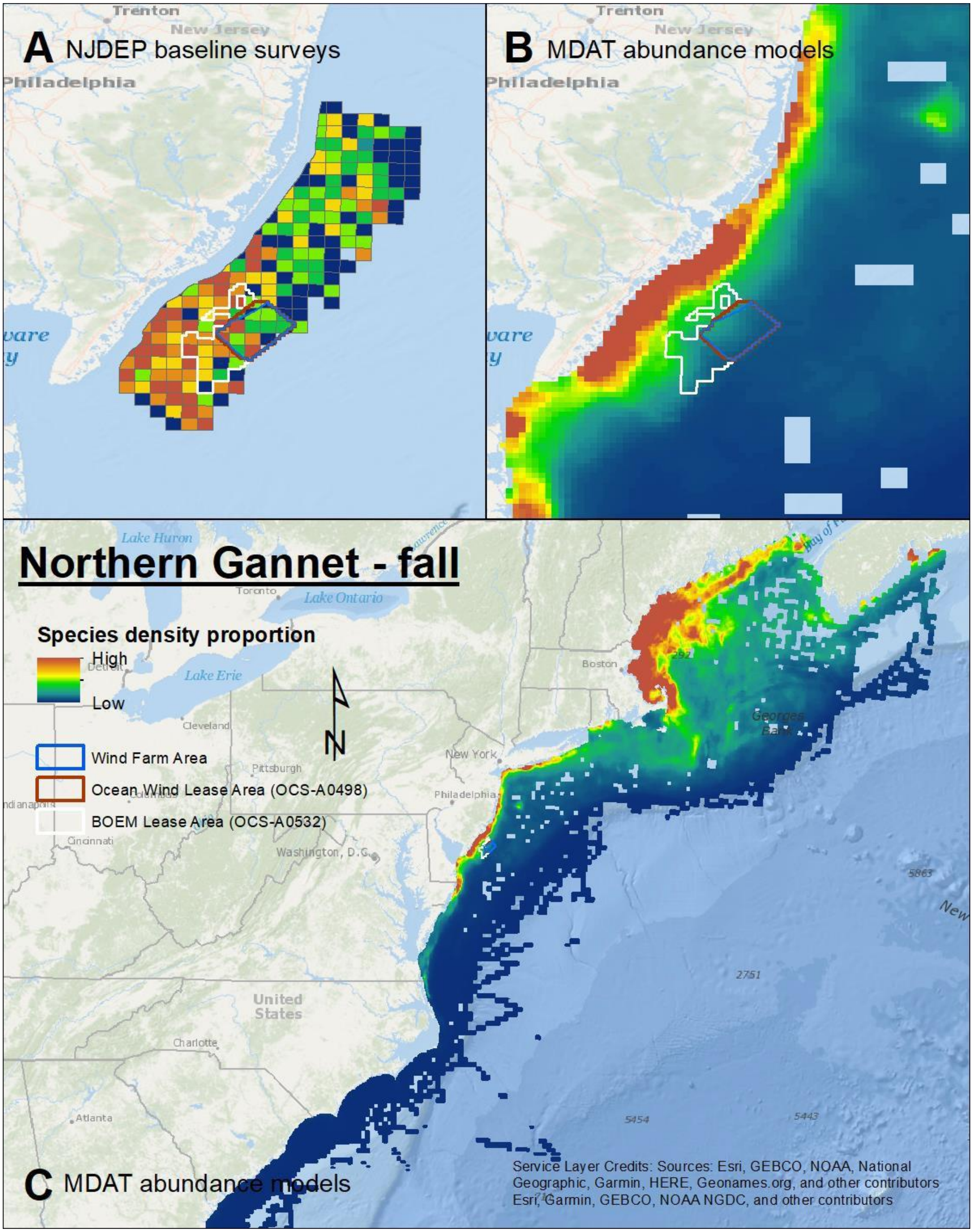
Map 59. Winter Audubon's Shearwater density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



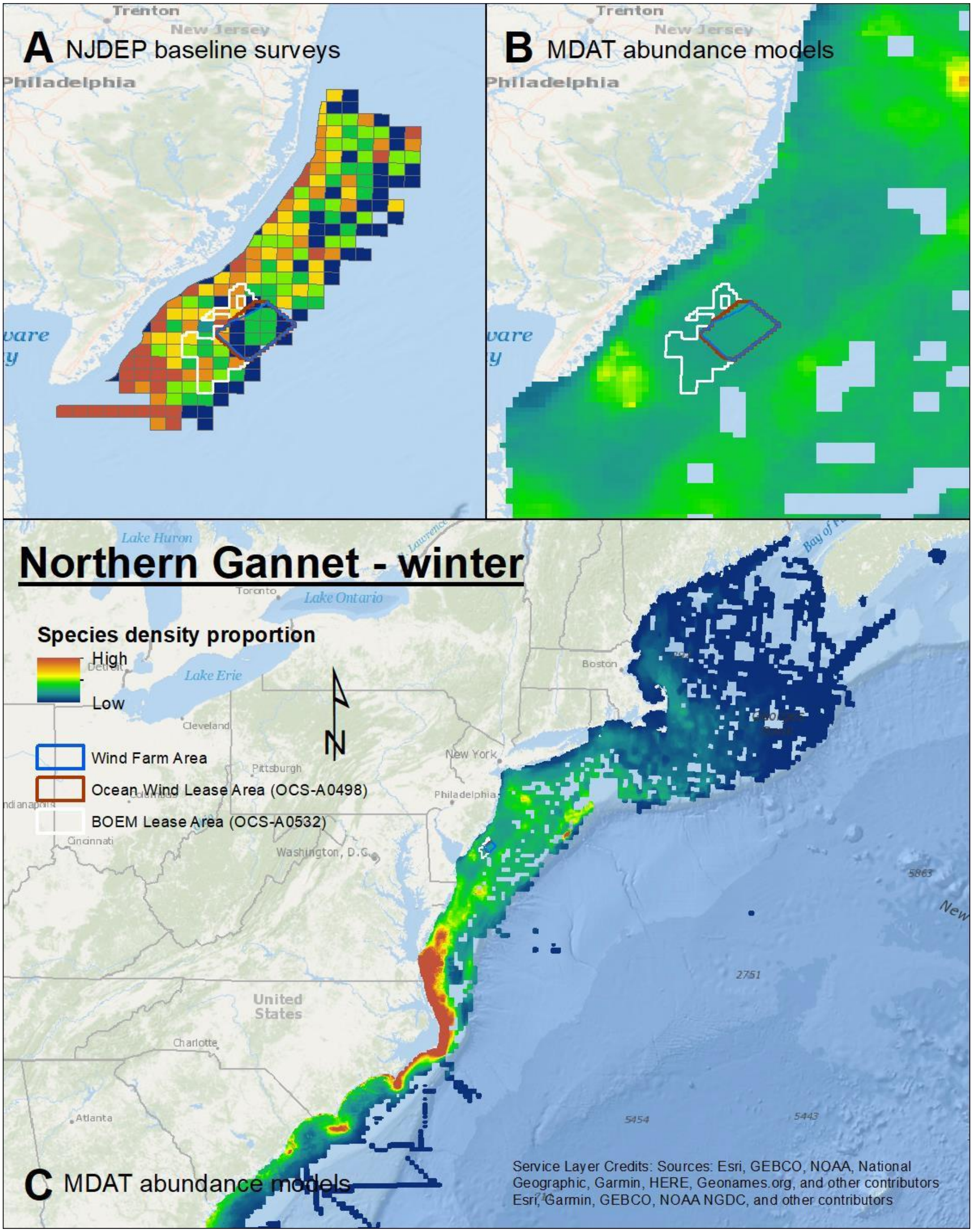
Map 60. Spring Northern Gannet density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



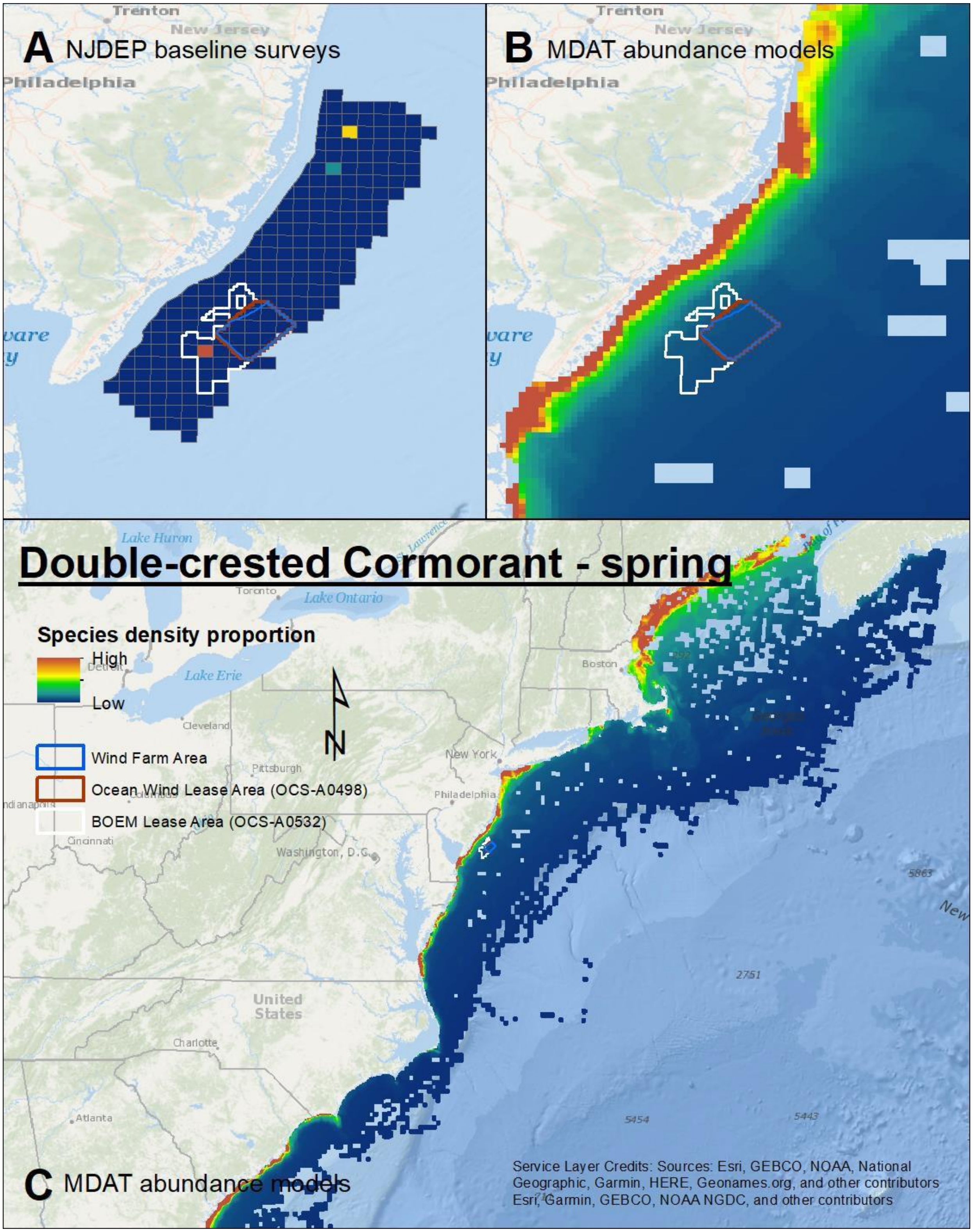
Map 61. Summer Northern Gannet density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



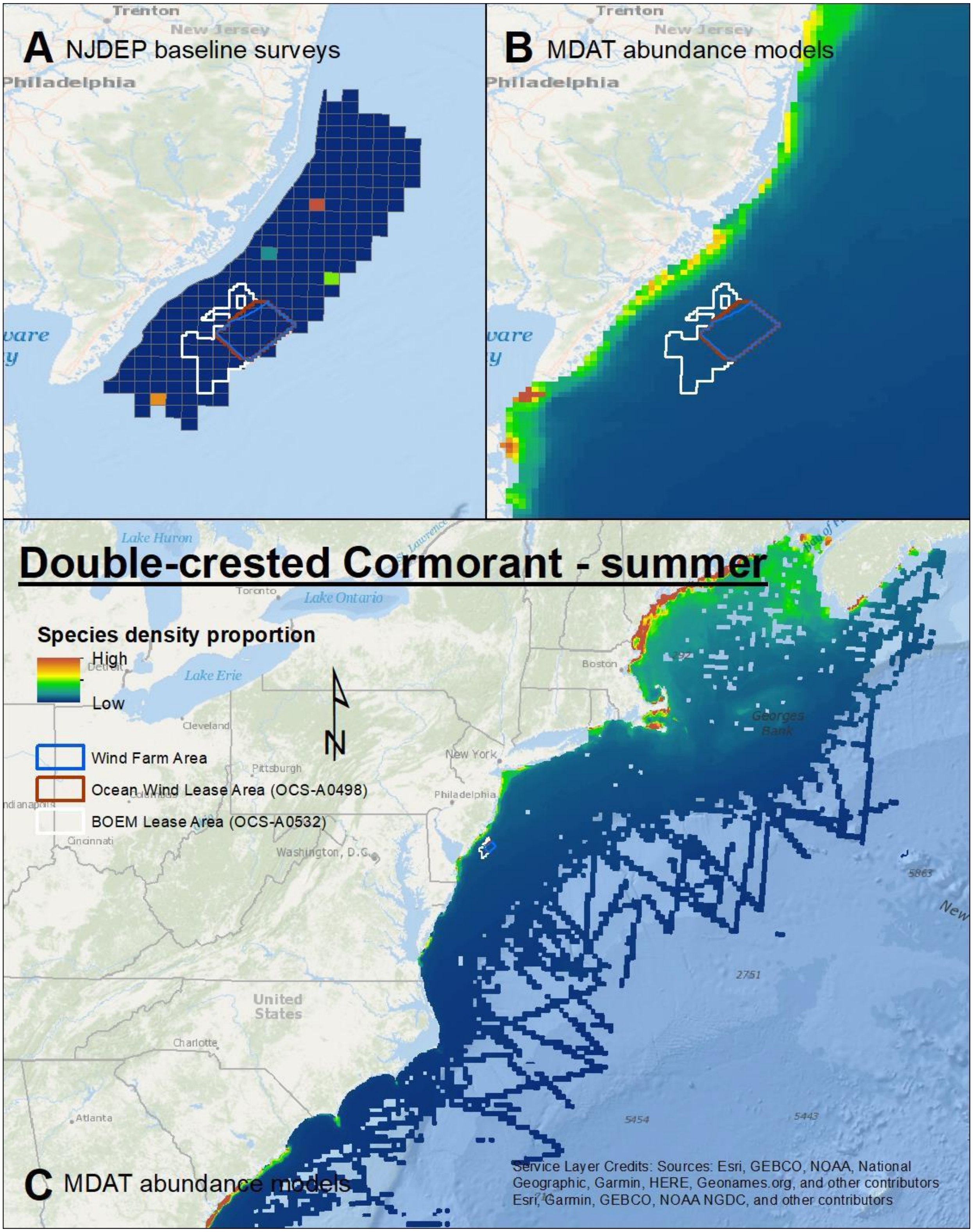
Map 62. Fall Northern Gannet density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



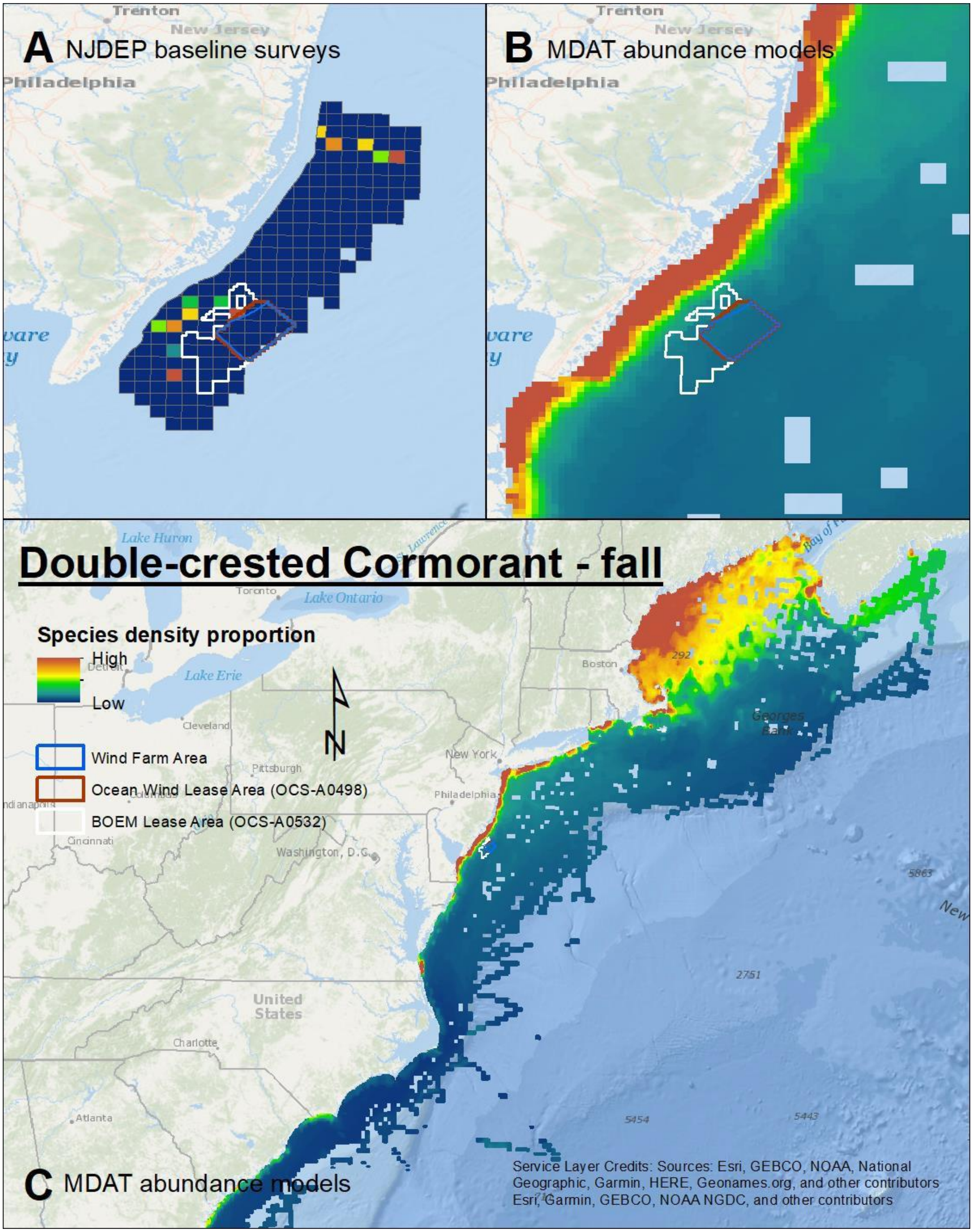
Map 63. Winter Northern Gannet density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



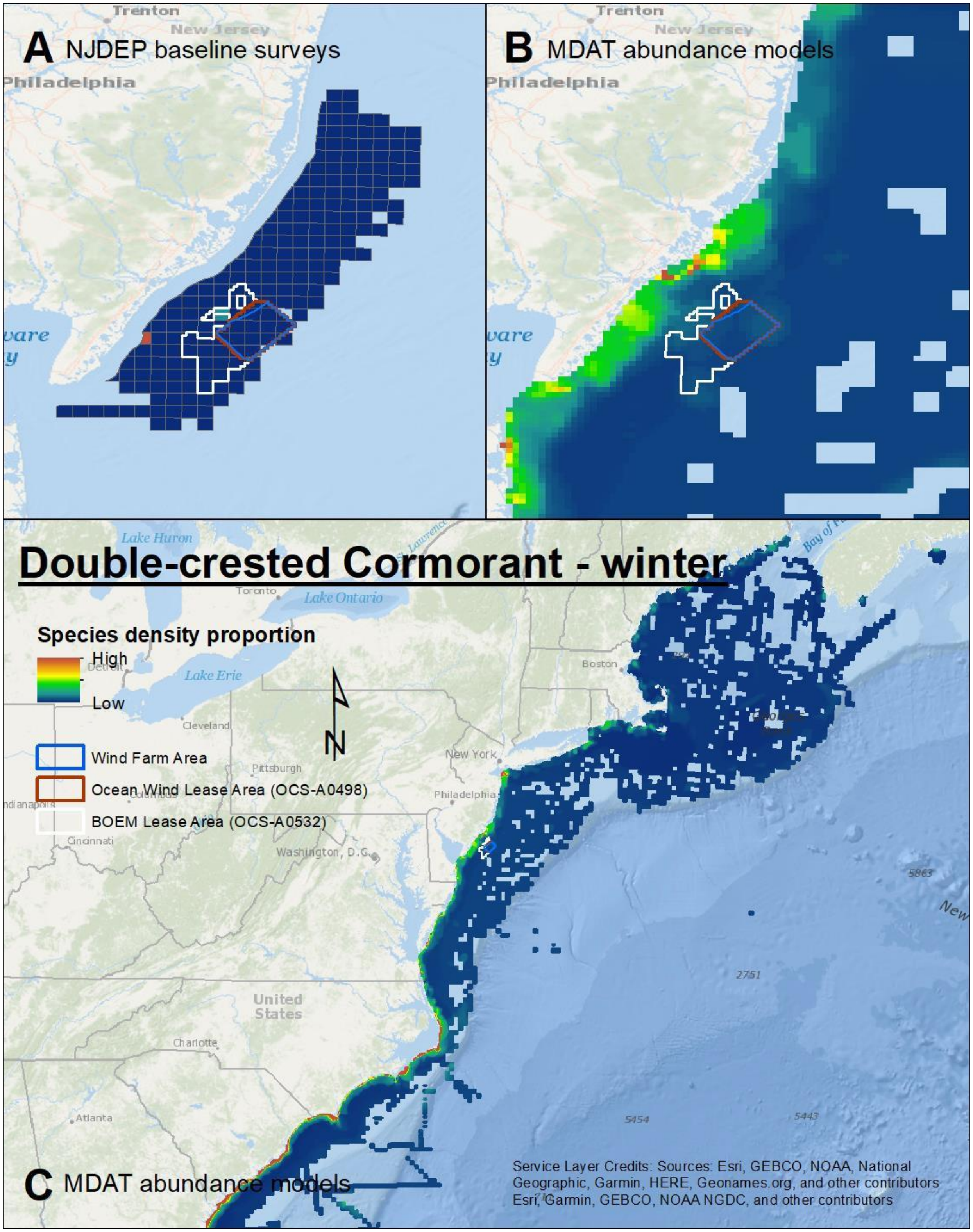
Map 64. Spring Double-crested Cormorant density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



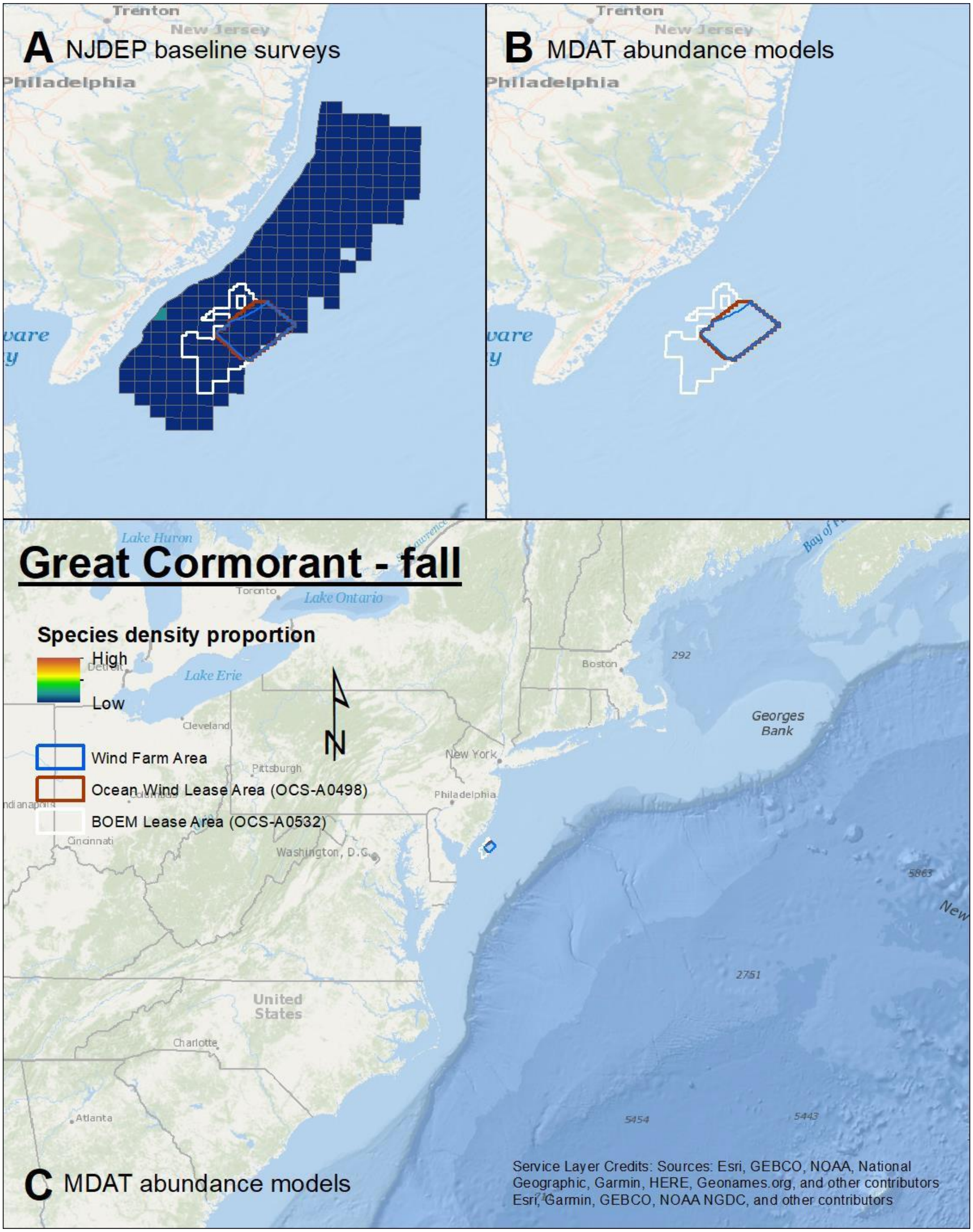
Map 65. Summer Double-crested Cormorant density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



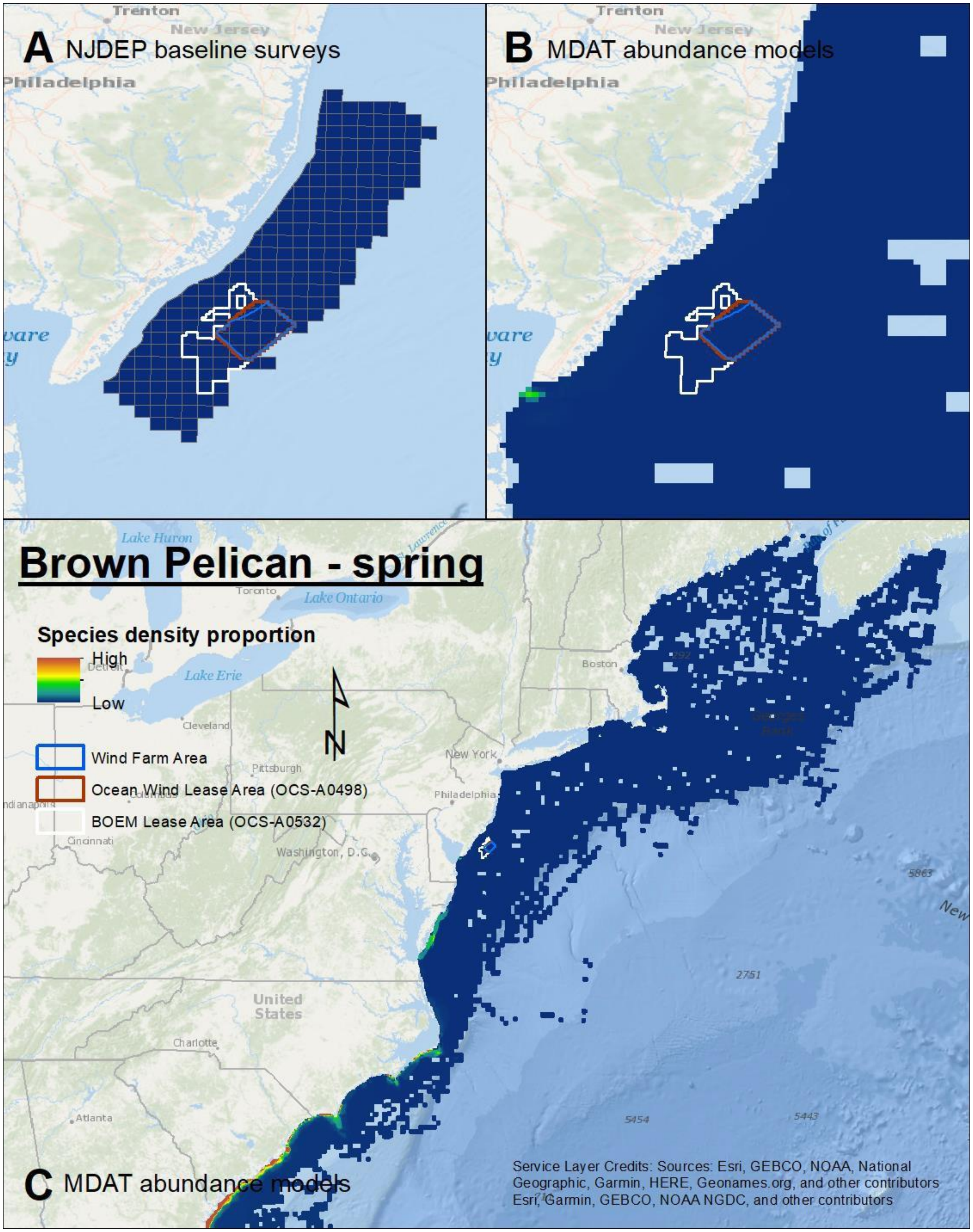
Map 66. Fall Double-crested Cormorant density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



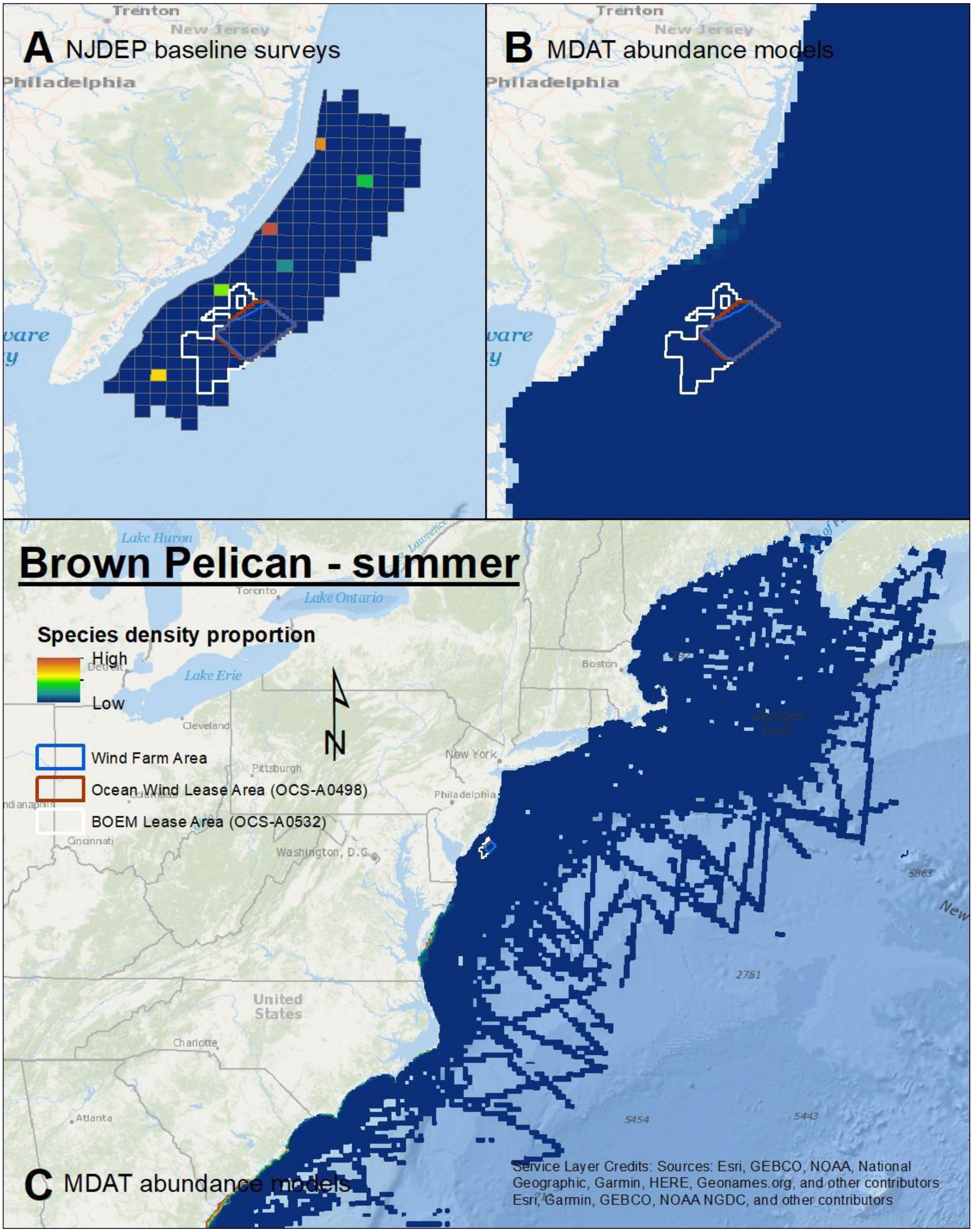
Map 67. Winter Double-crested Cormorant density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



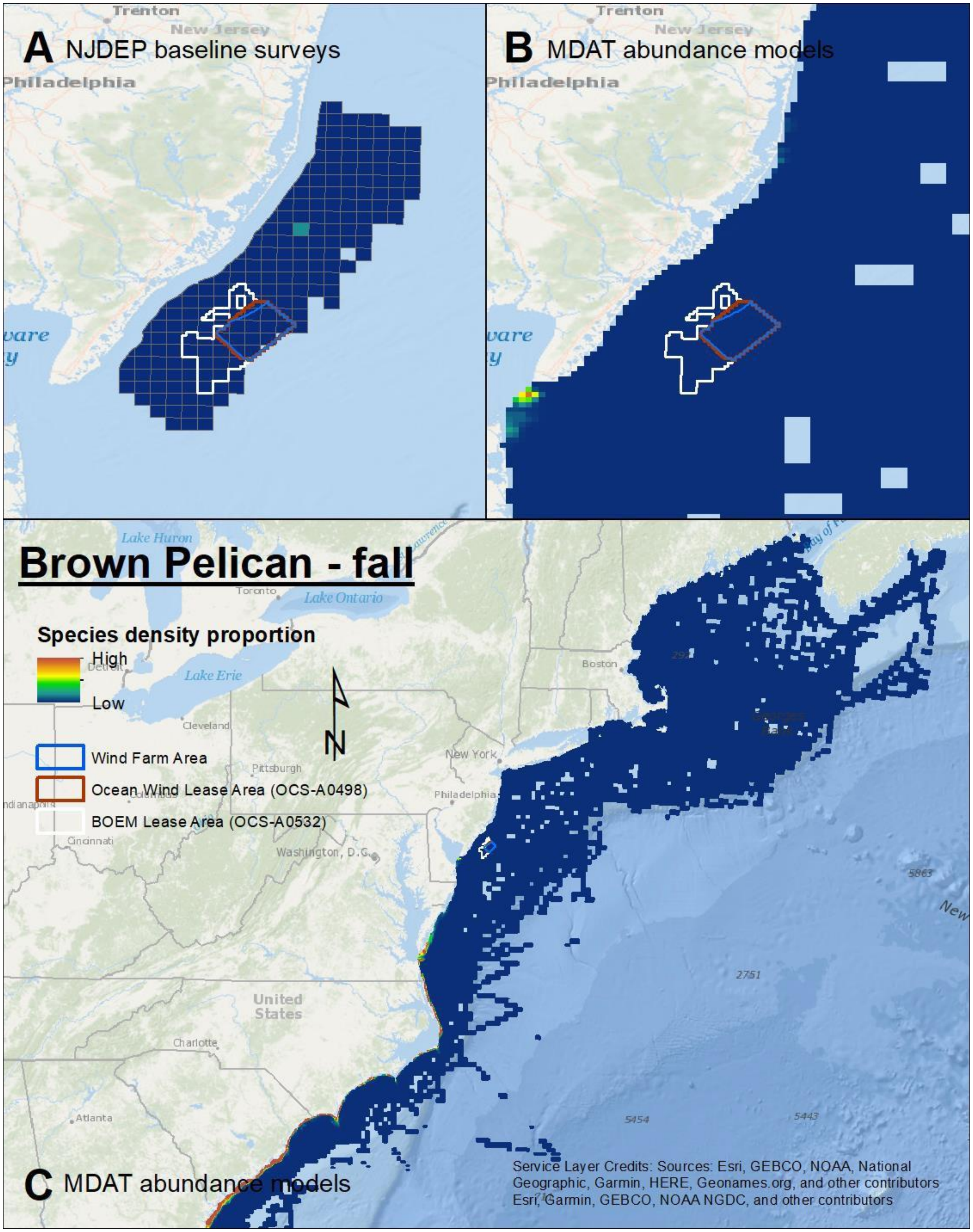
Map 68. Fall Great Cormorant density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



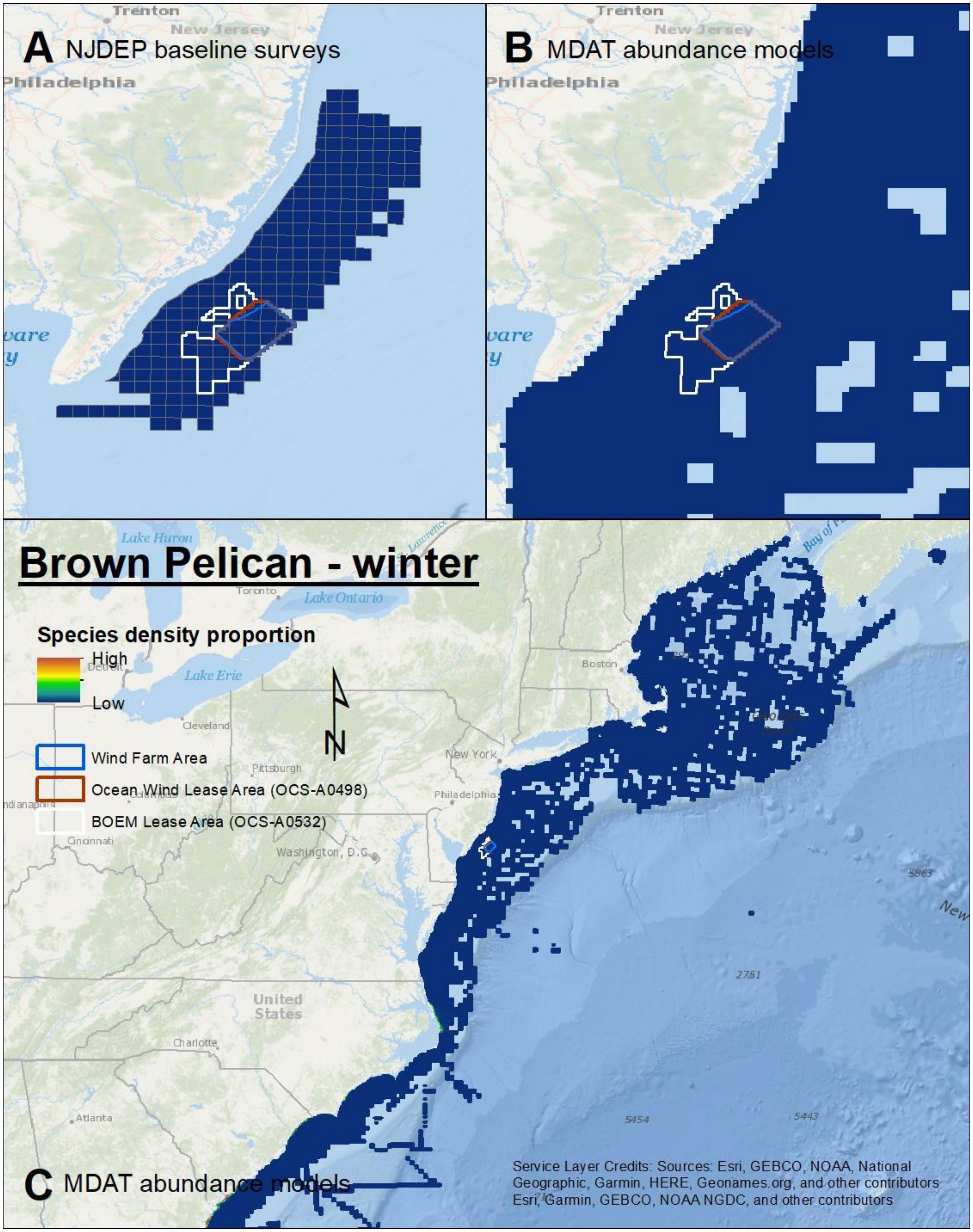
Map 69. Spring Brown Pelican density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



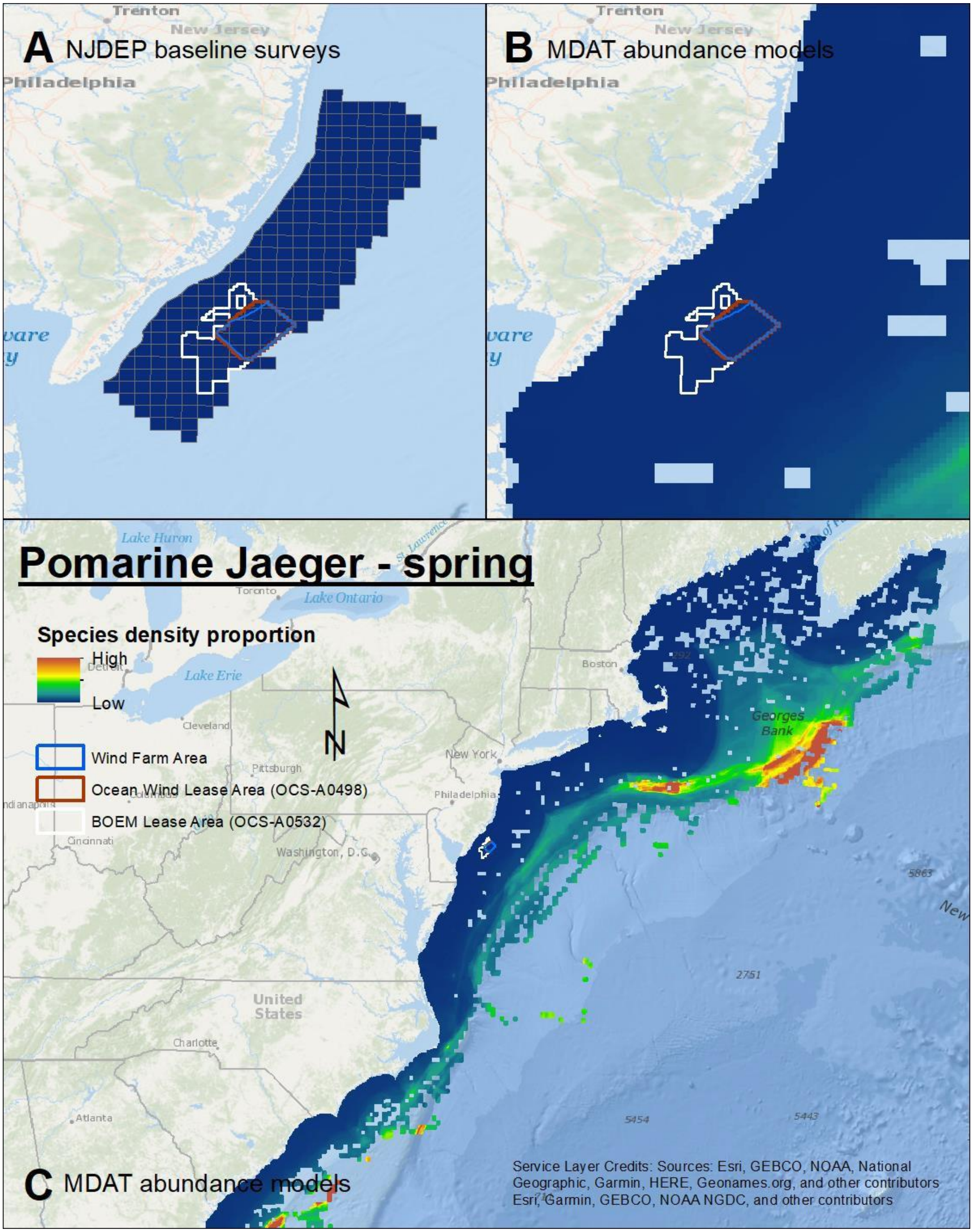
Map 70. Summer Brown Pelican density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



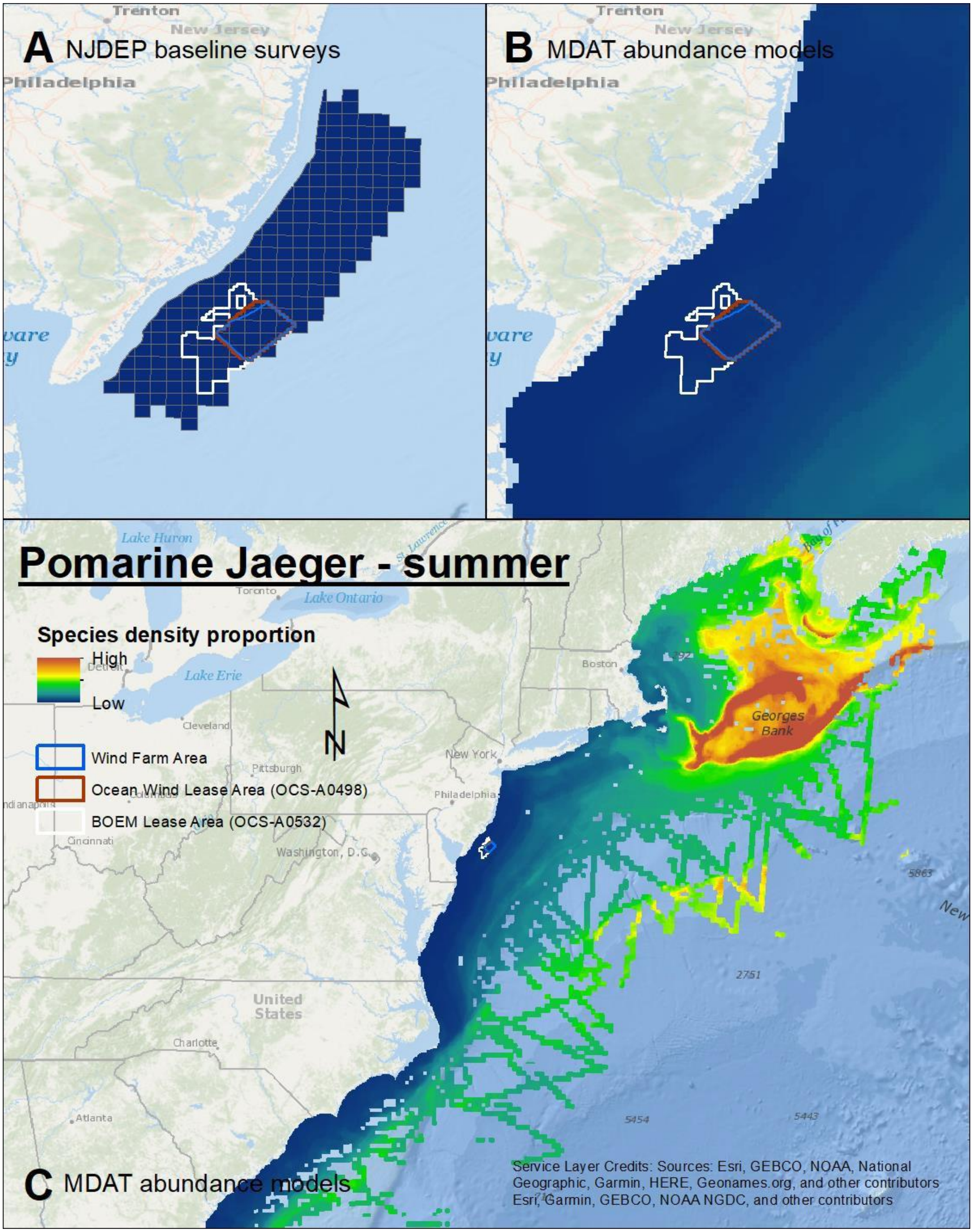
Map 71. Fall Brown Pelican density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



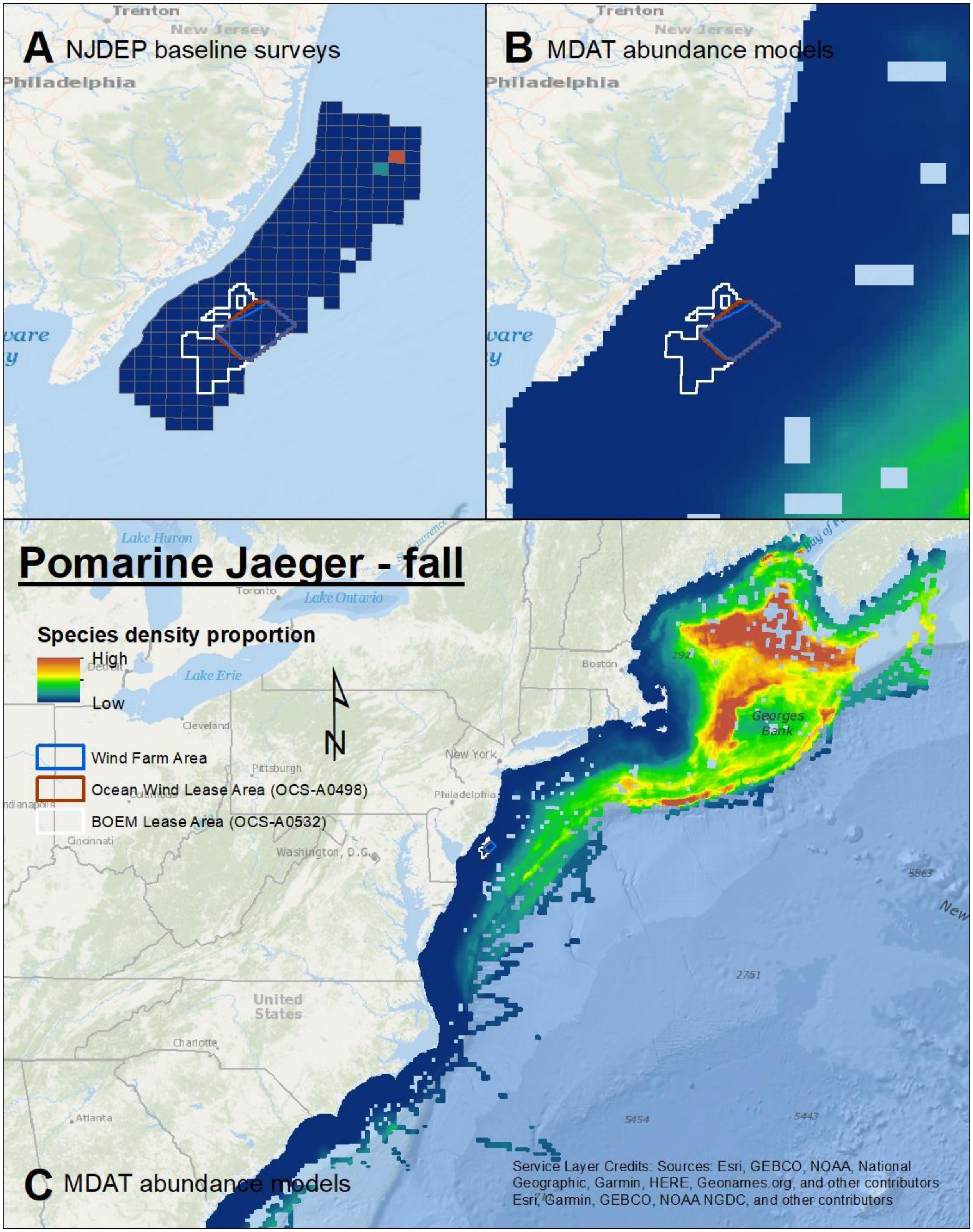
Map 72. Winter Brown Pelican density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



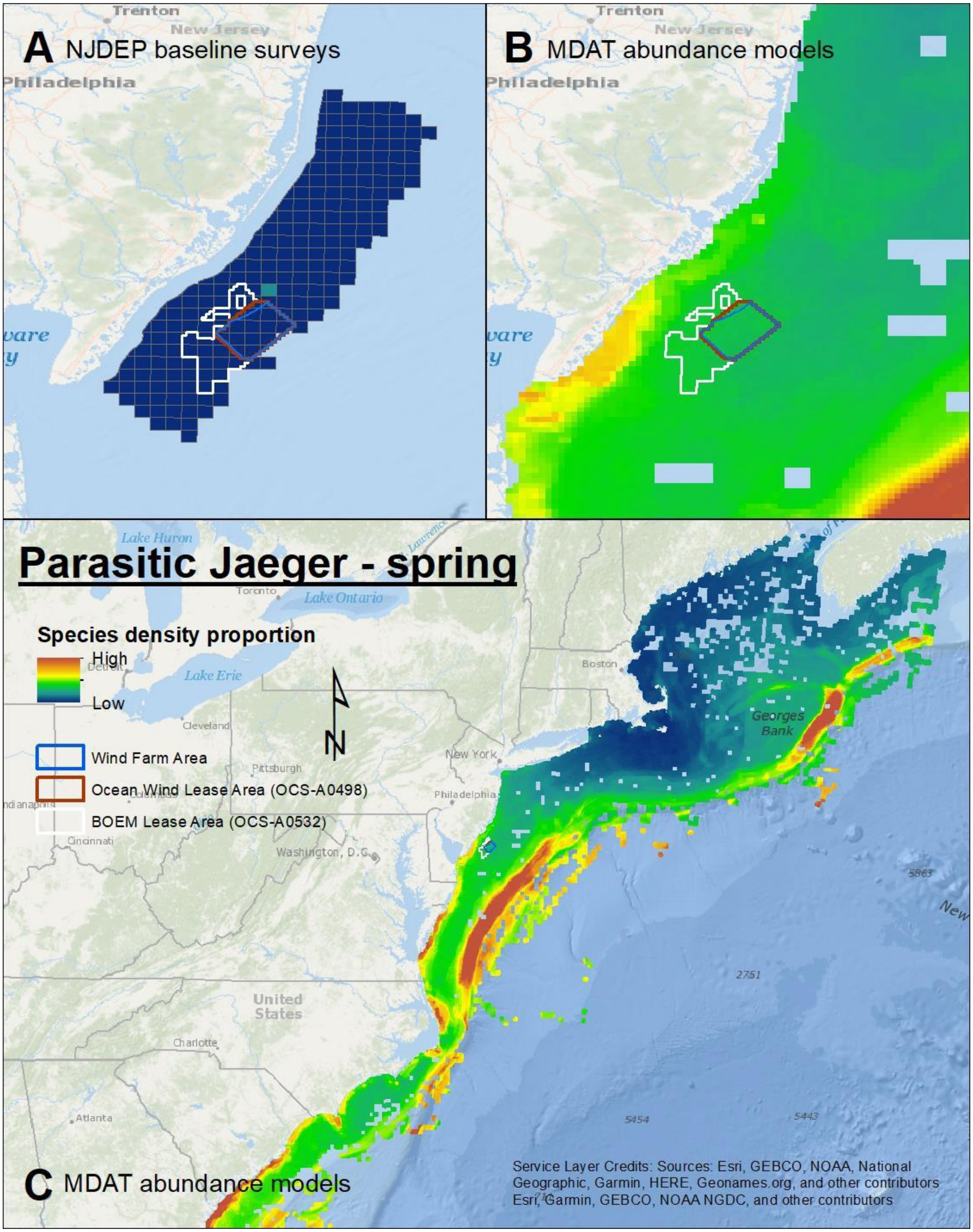
Map 73. Spring Pomarine Jaeger density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



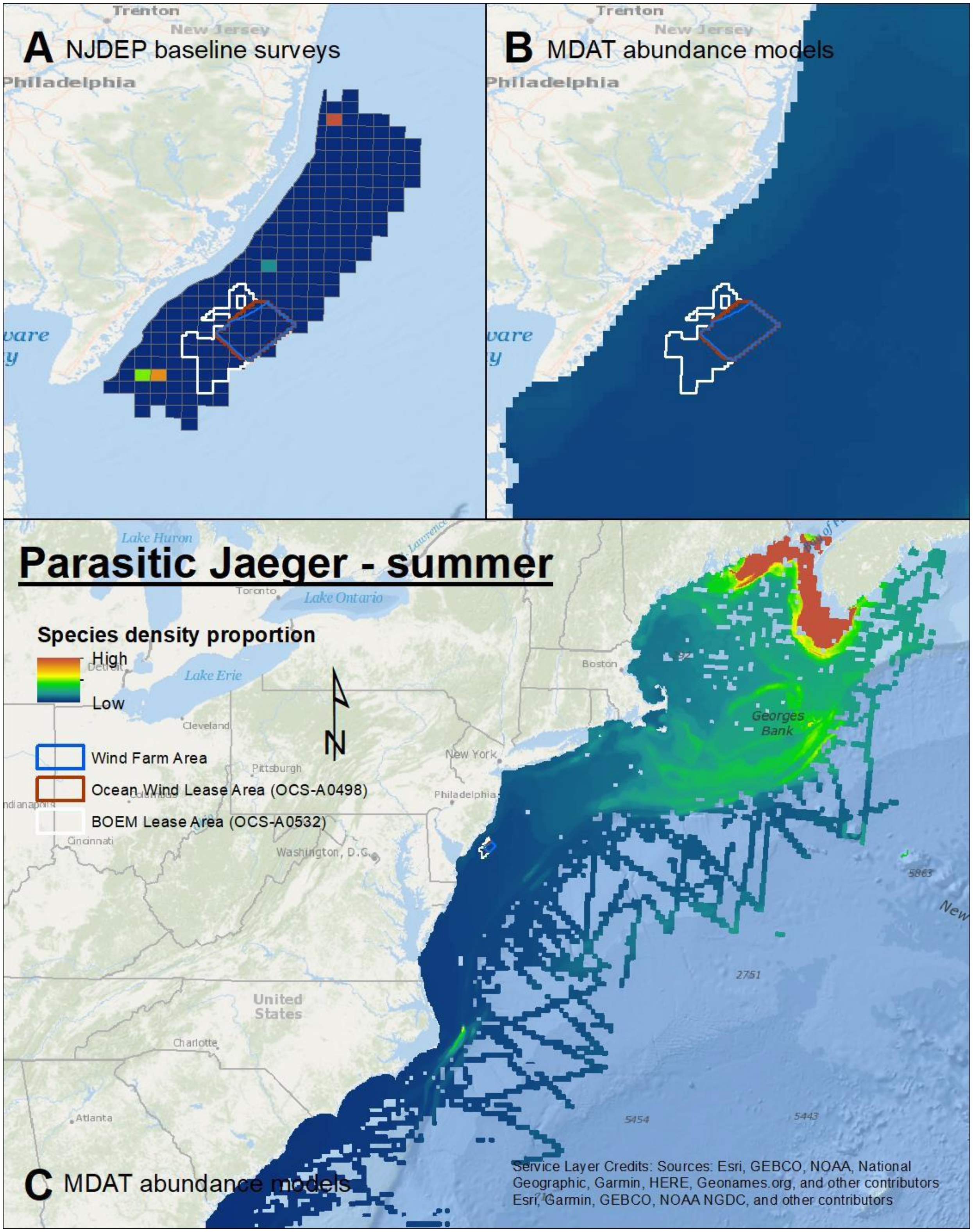
Map 74. Summer Pomarine Jaeger density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



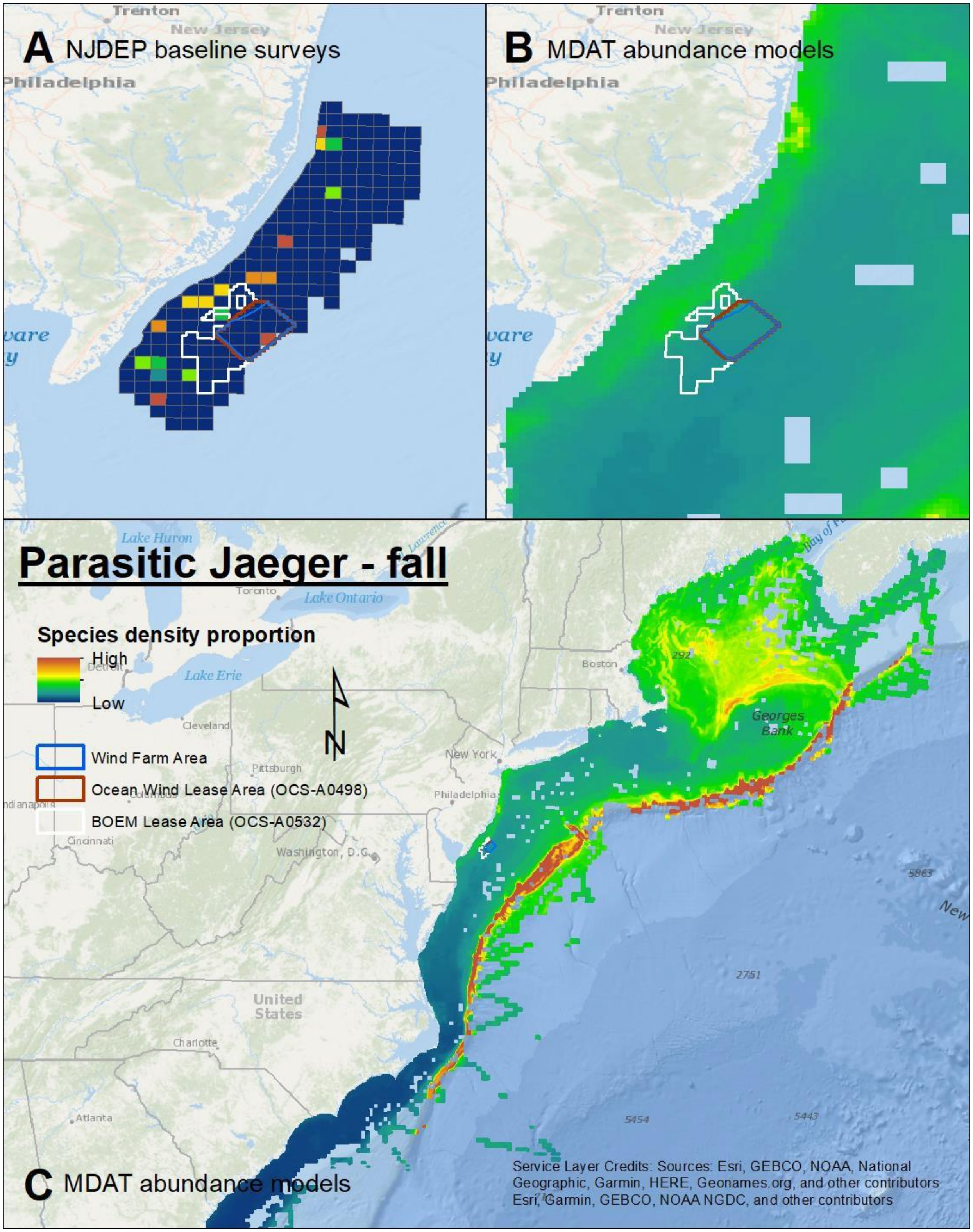
Map 75. Fall Pomarine Jaeger density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



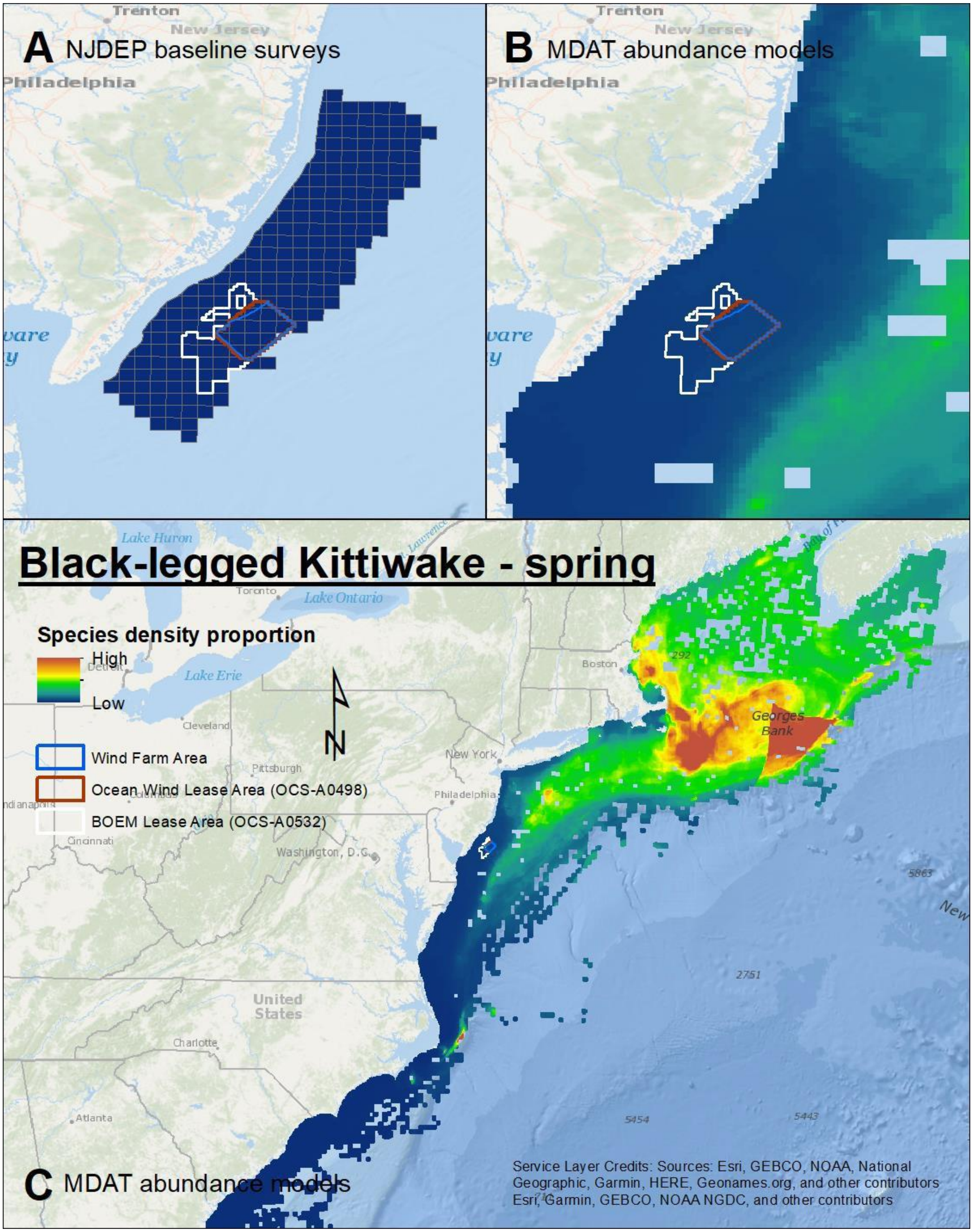
Map 76. Spring Parasitic Jaeger density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



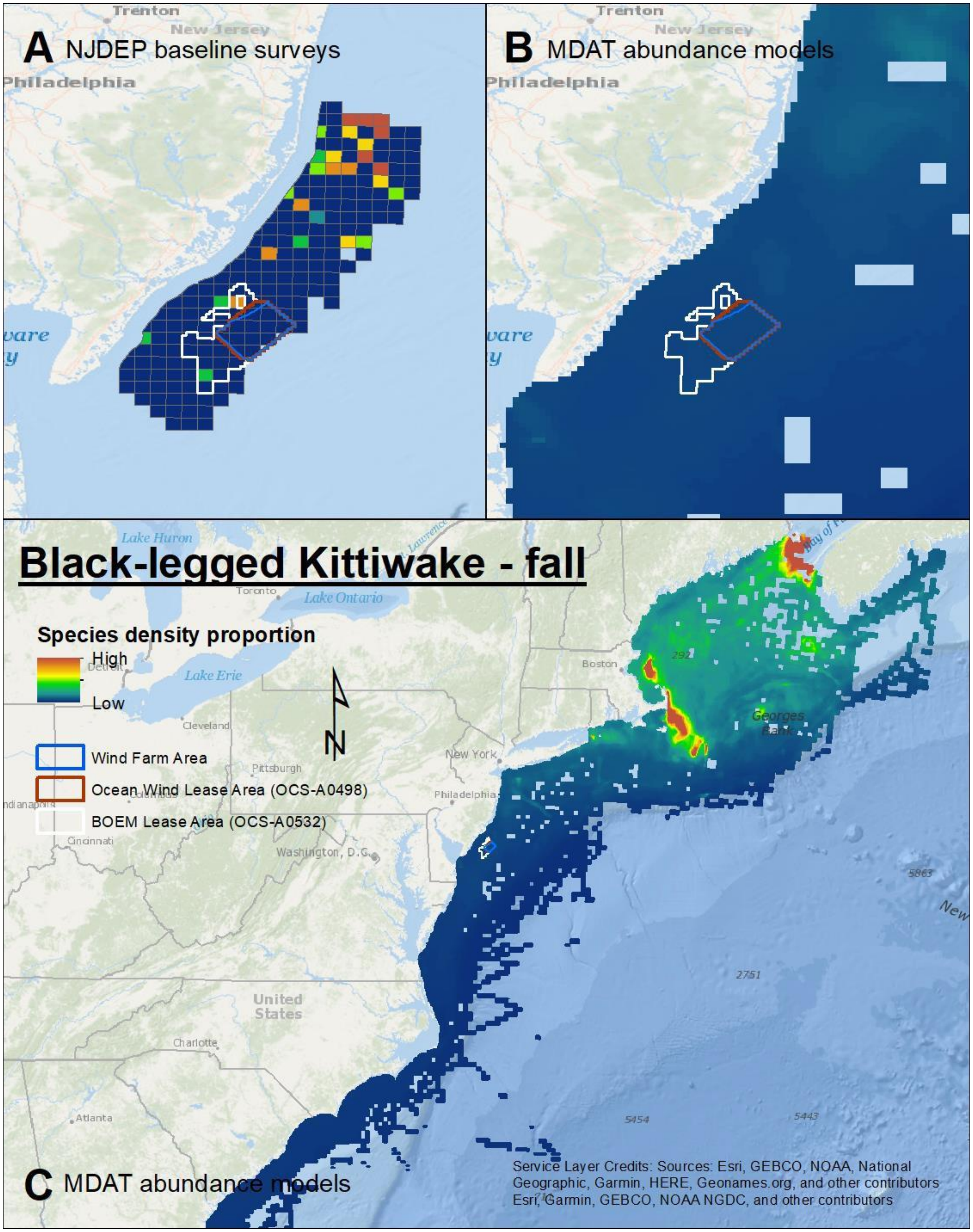
Map 77. Summer Parasitic Jaeger density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



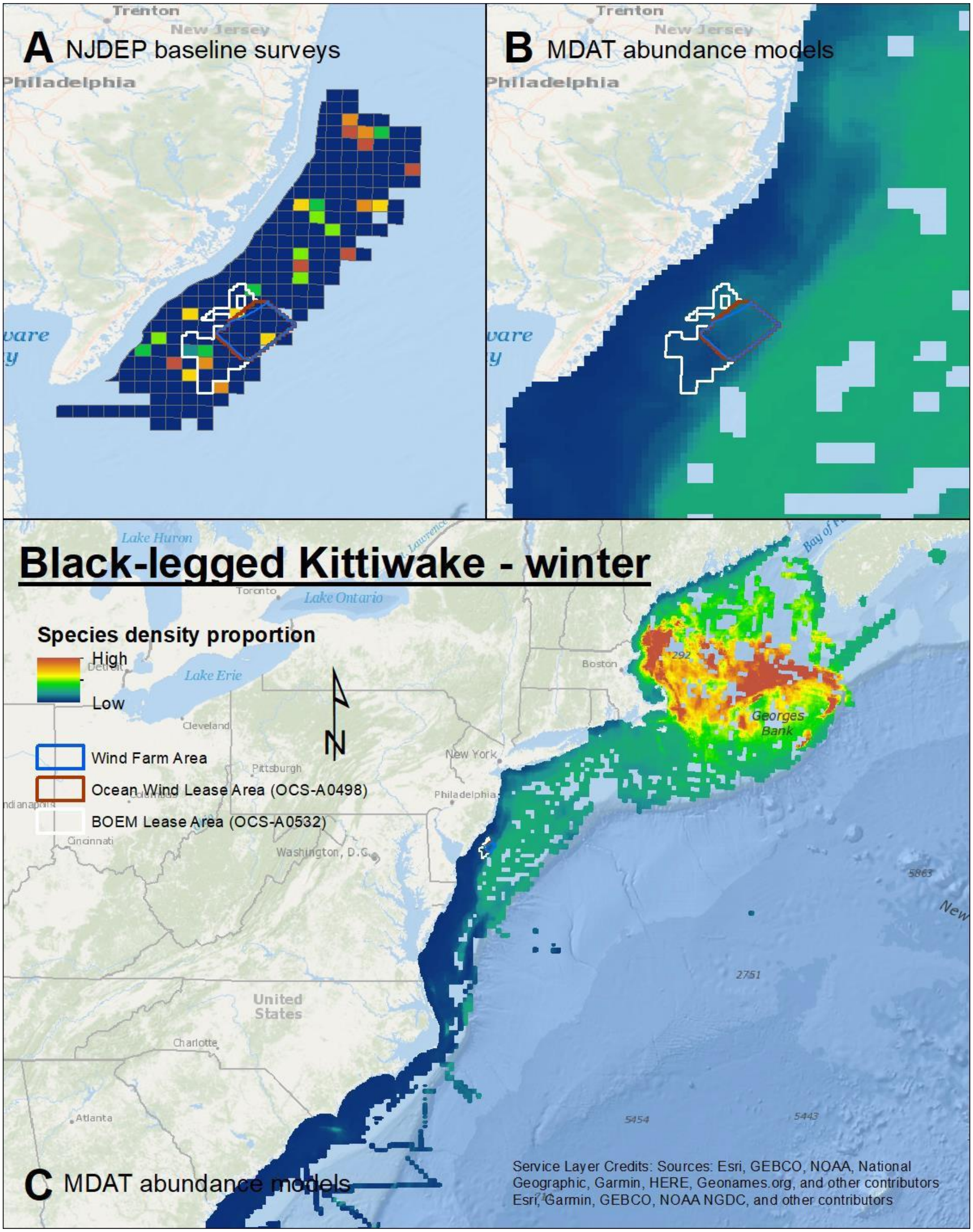
Map 78. Fall Parasitic Jaeger density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



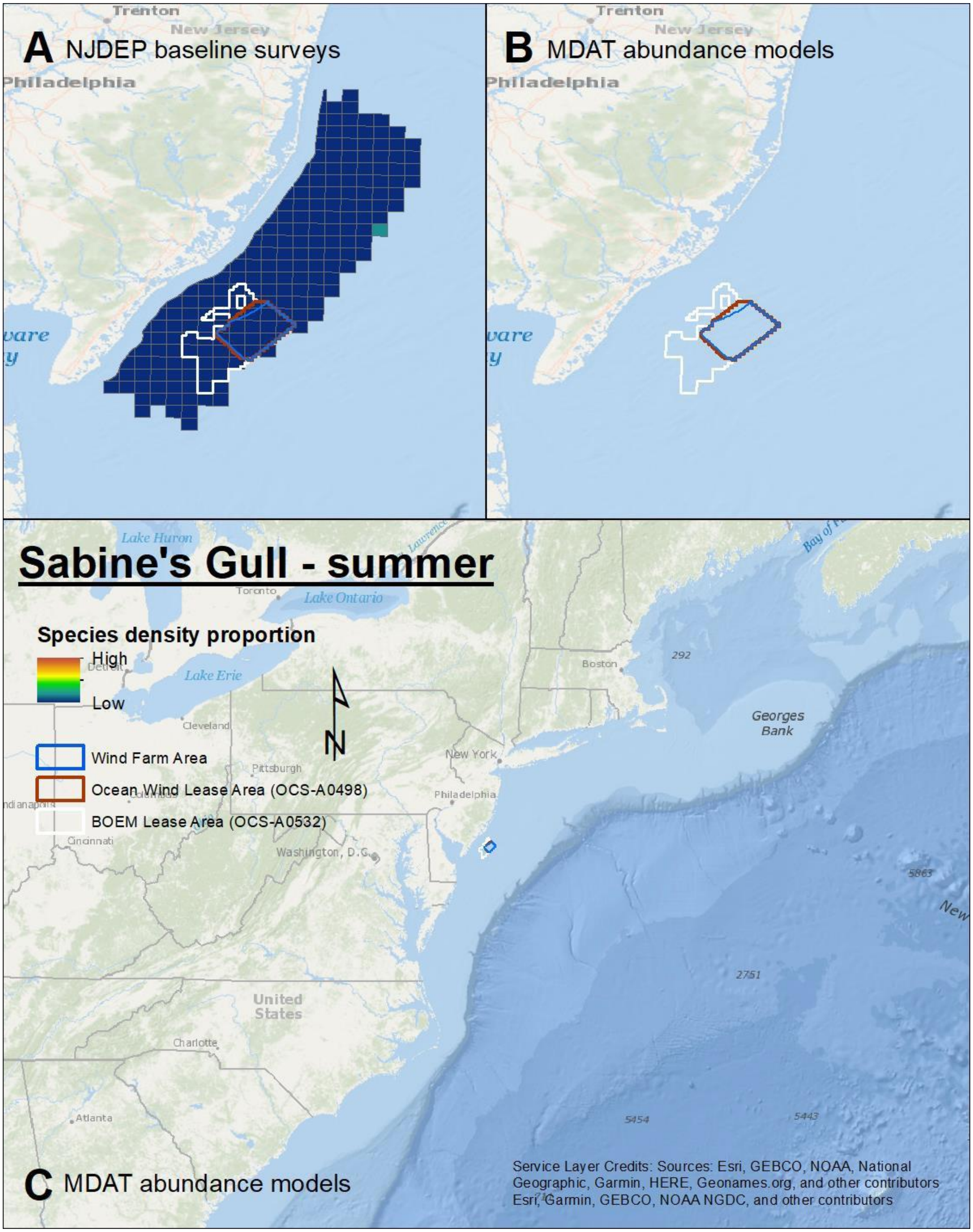
Map 79. Spring Black-legged Kittiwake density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



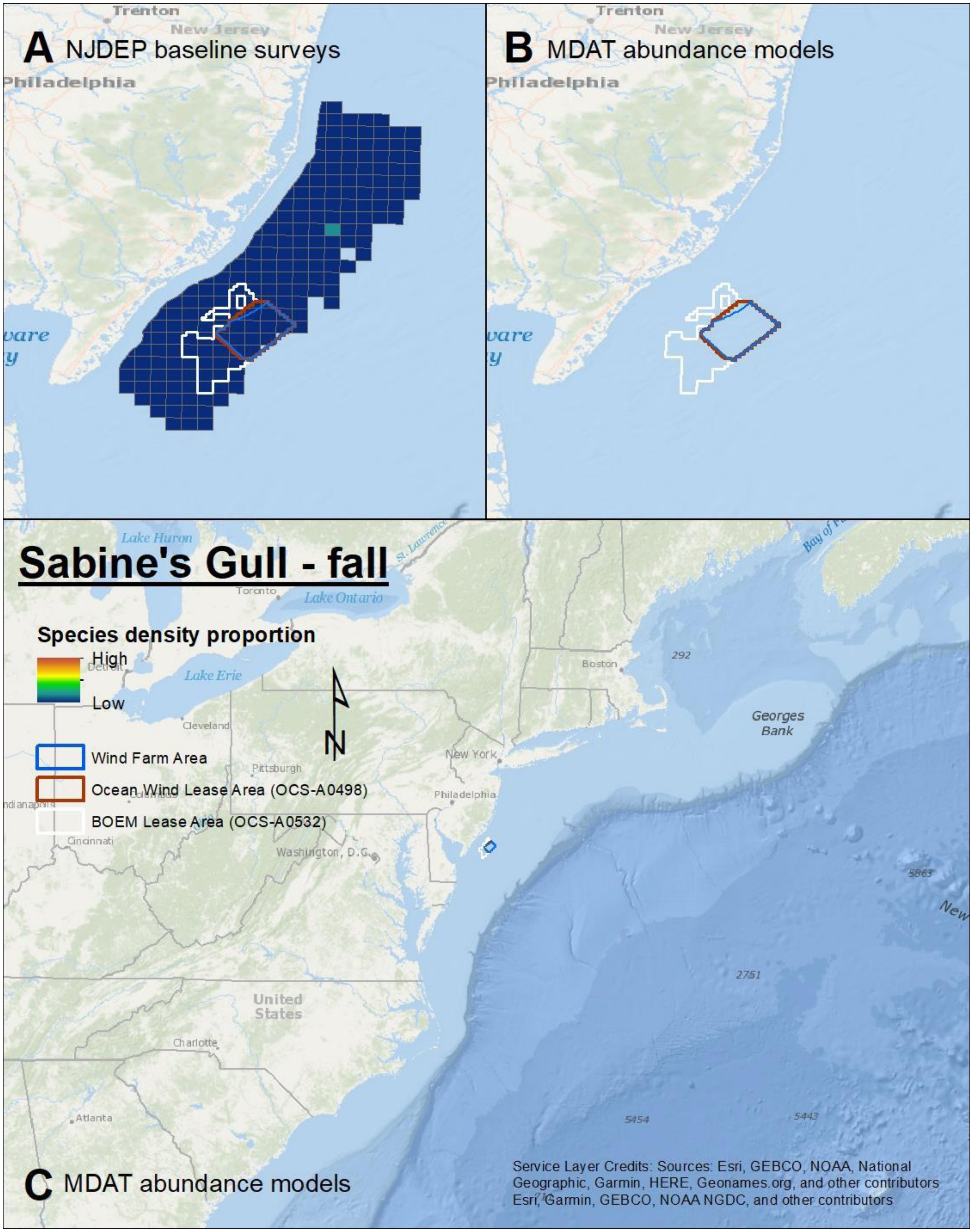
Map 80. Fall Black-legged Kittiwake density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



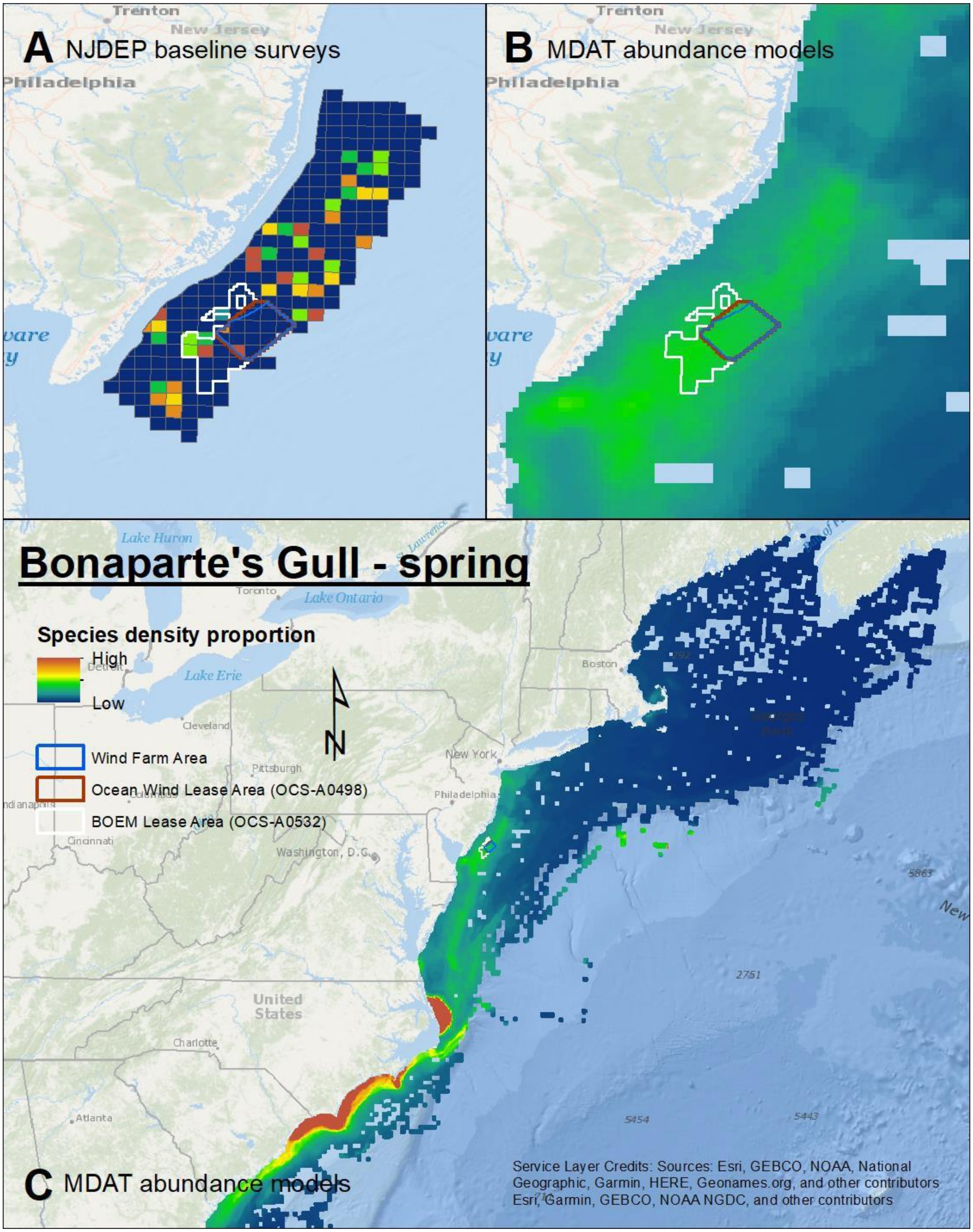
Map 81. Winter Black-legged Kittiwake density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



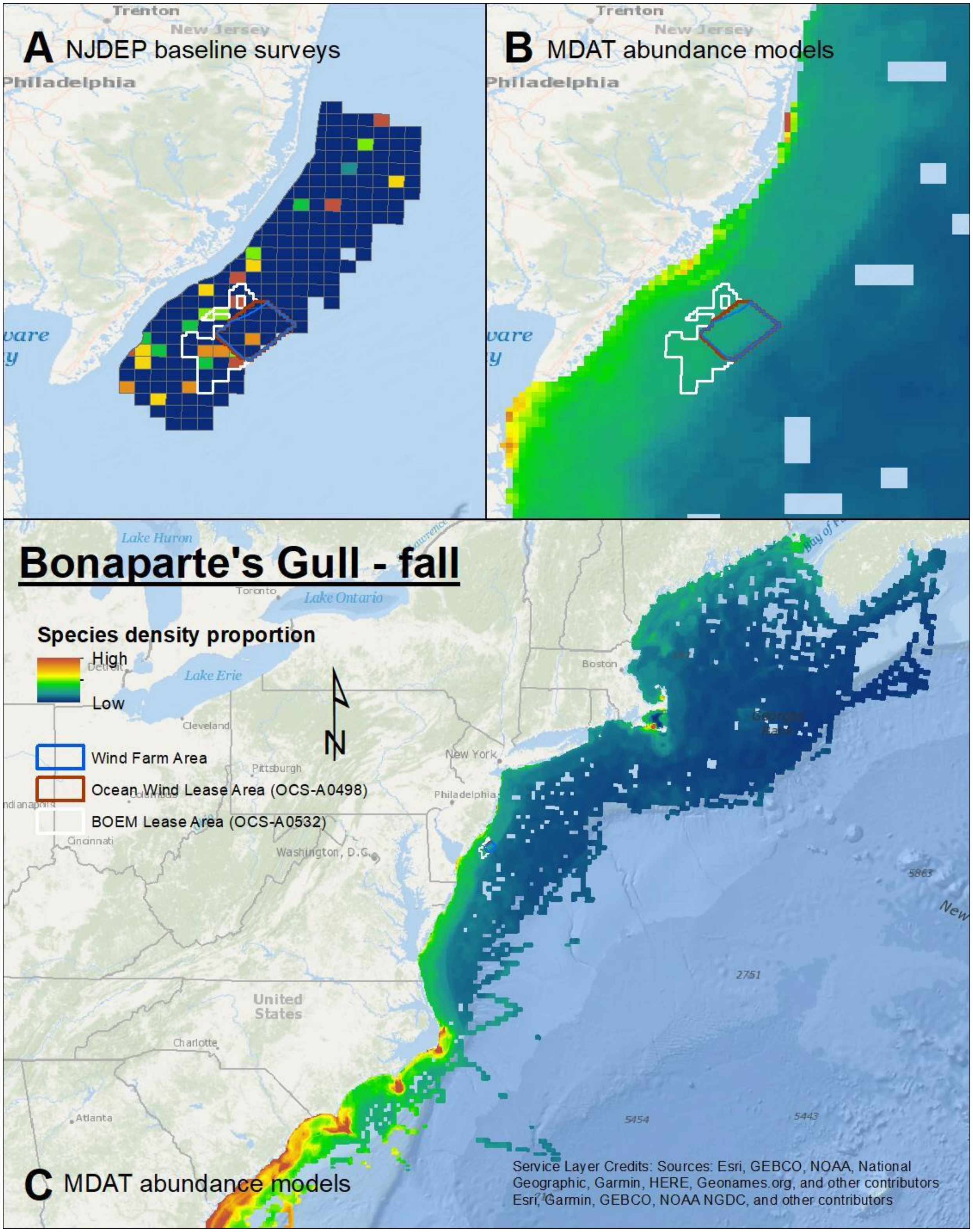
Map 82. Summer Sabine's Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



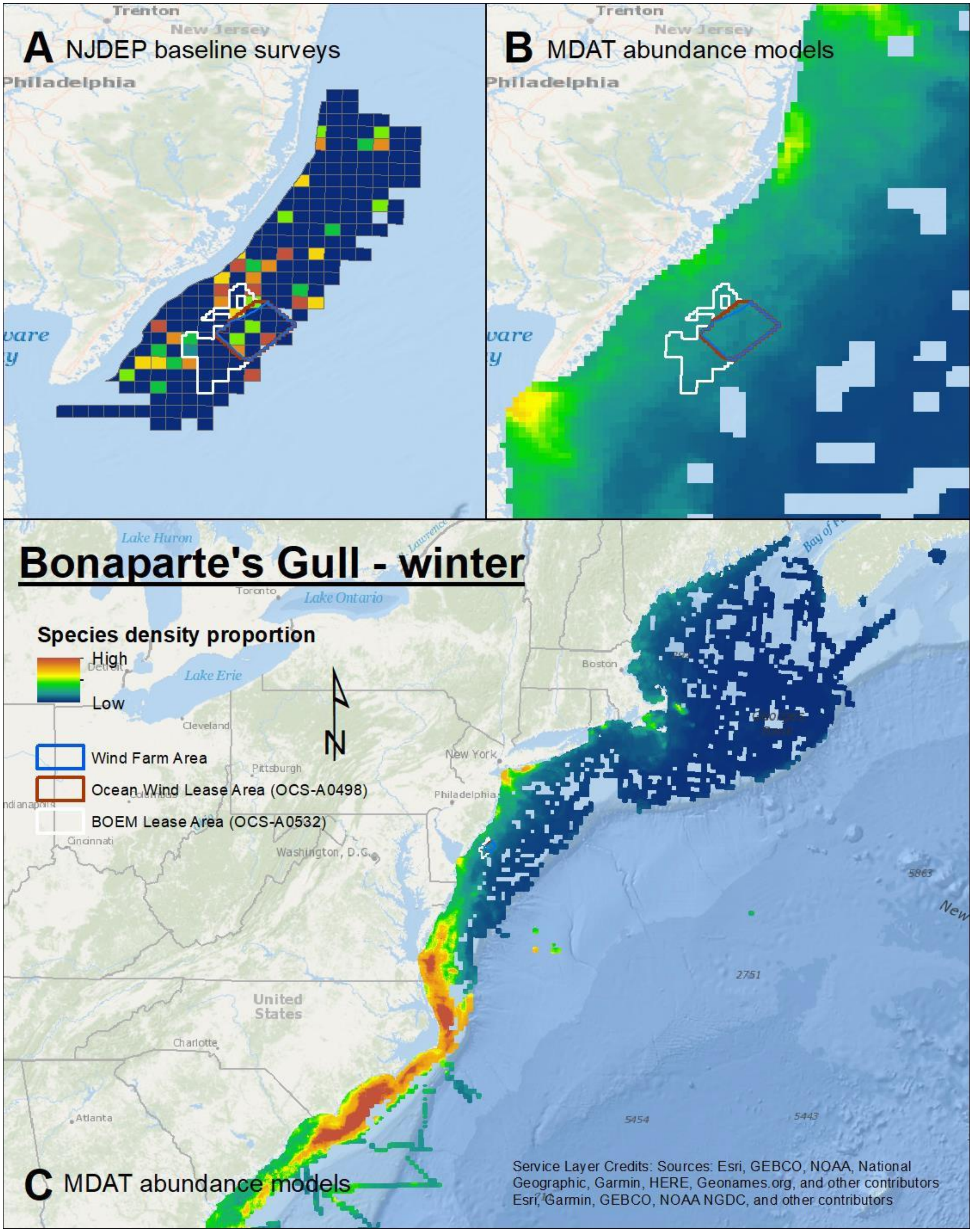
Map 83. Fall Sabine's Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



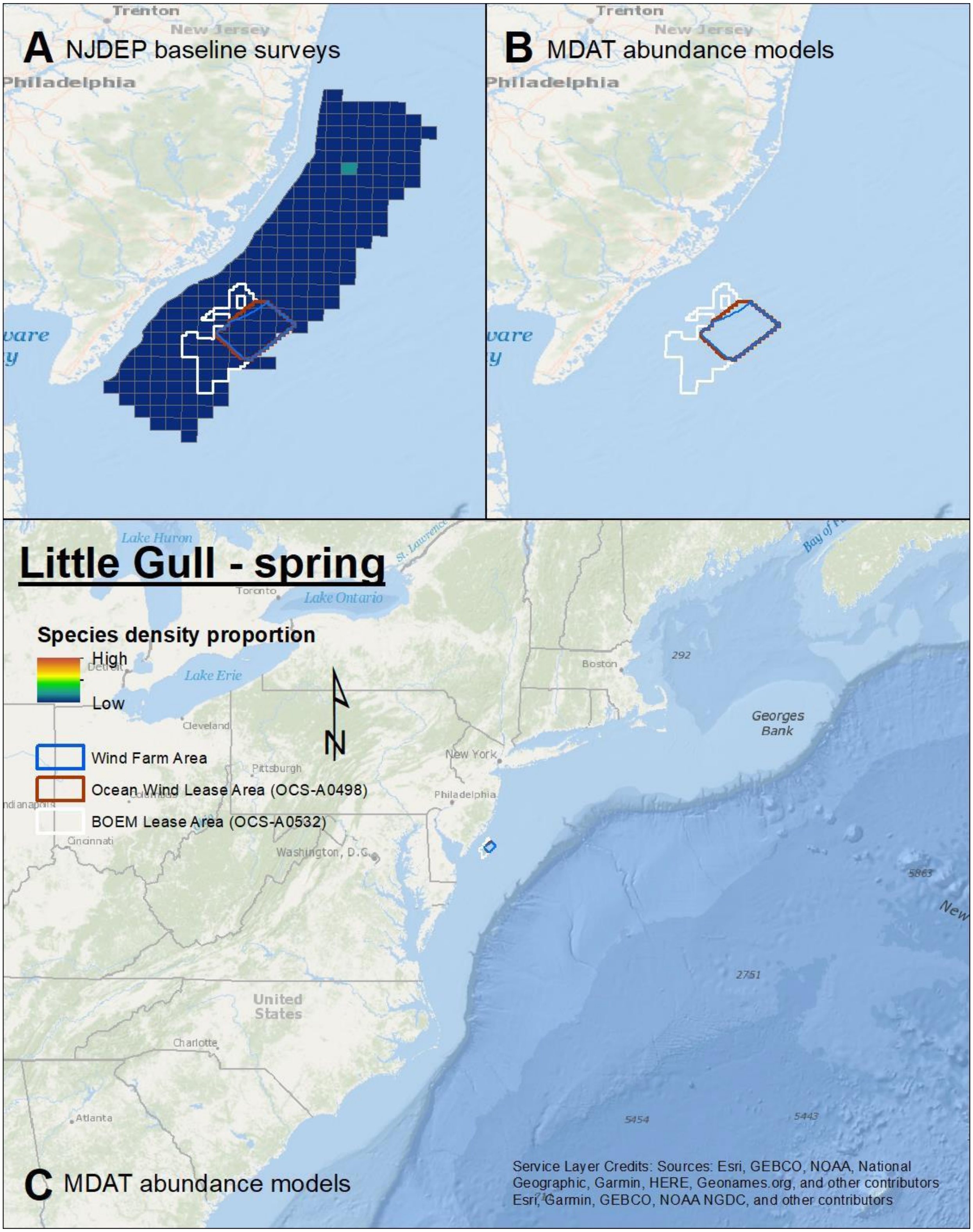
Map 84. Spring Bonaparte's Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



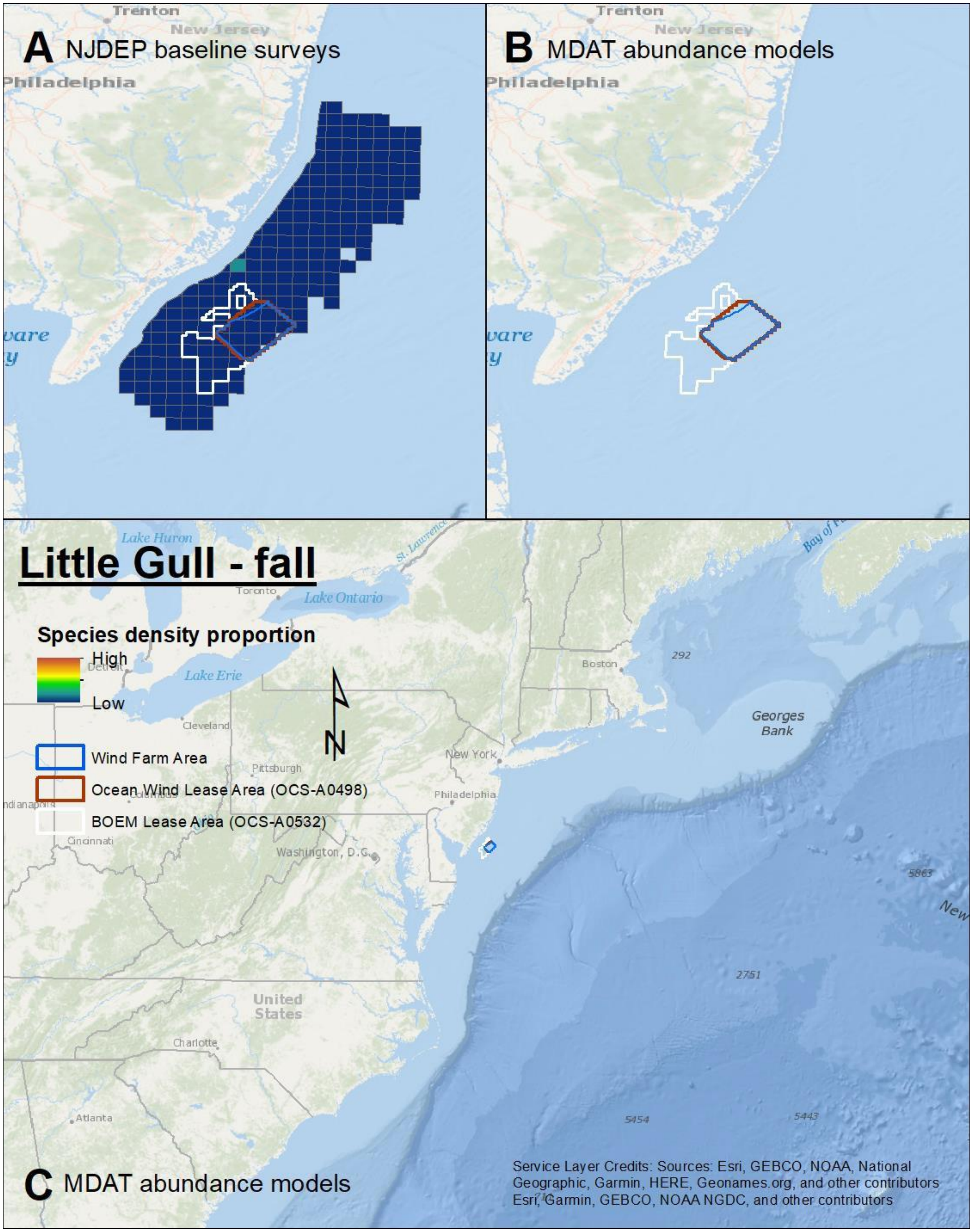
Map 85. Fall Bonaparte's Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



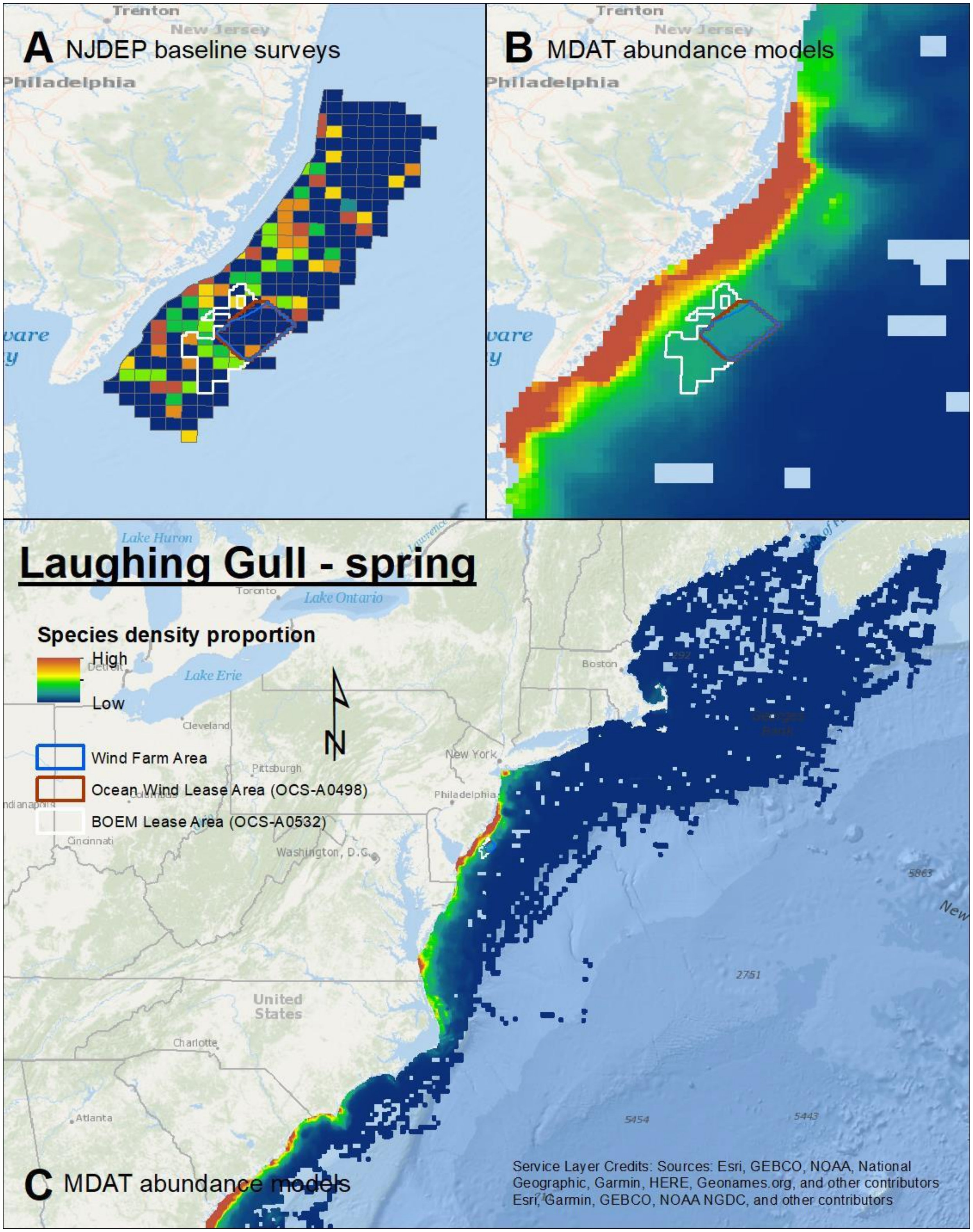
Map 86. Winter Bonaparte's Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



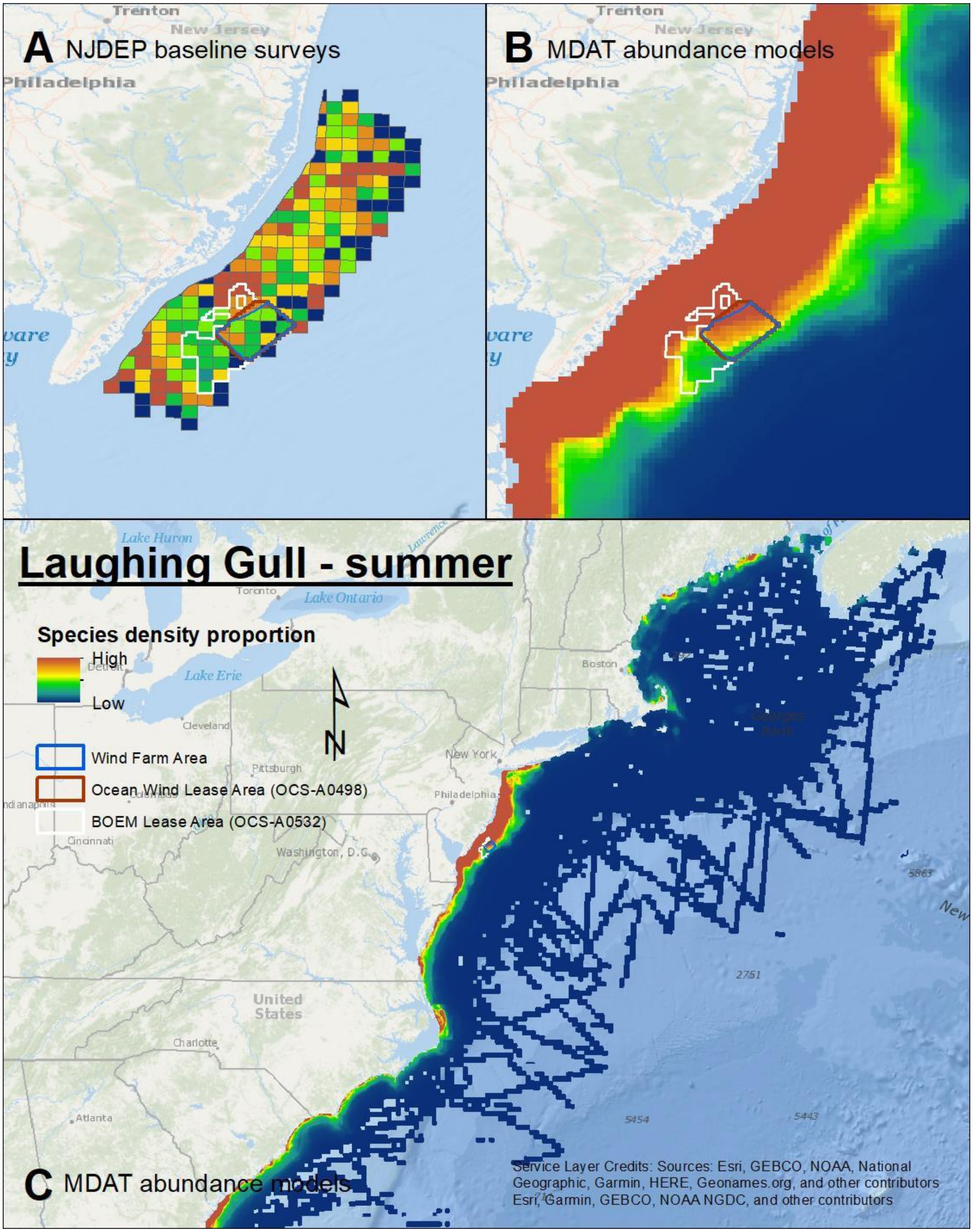
Map 87. Spring Little Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



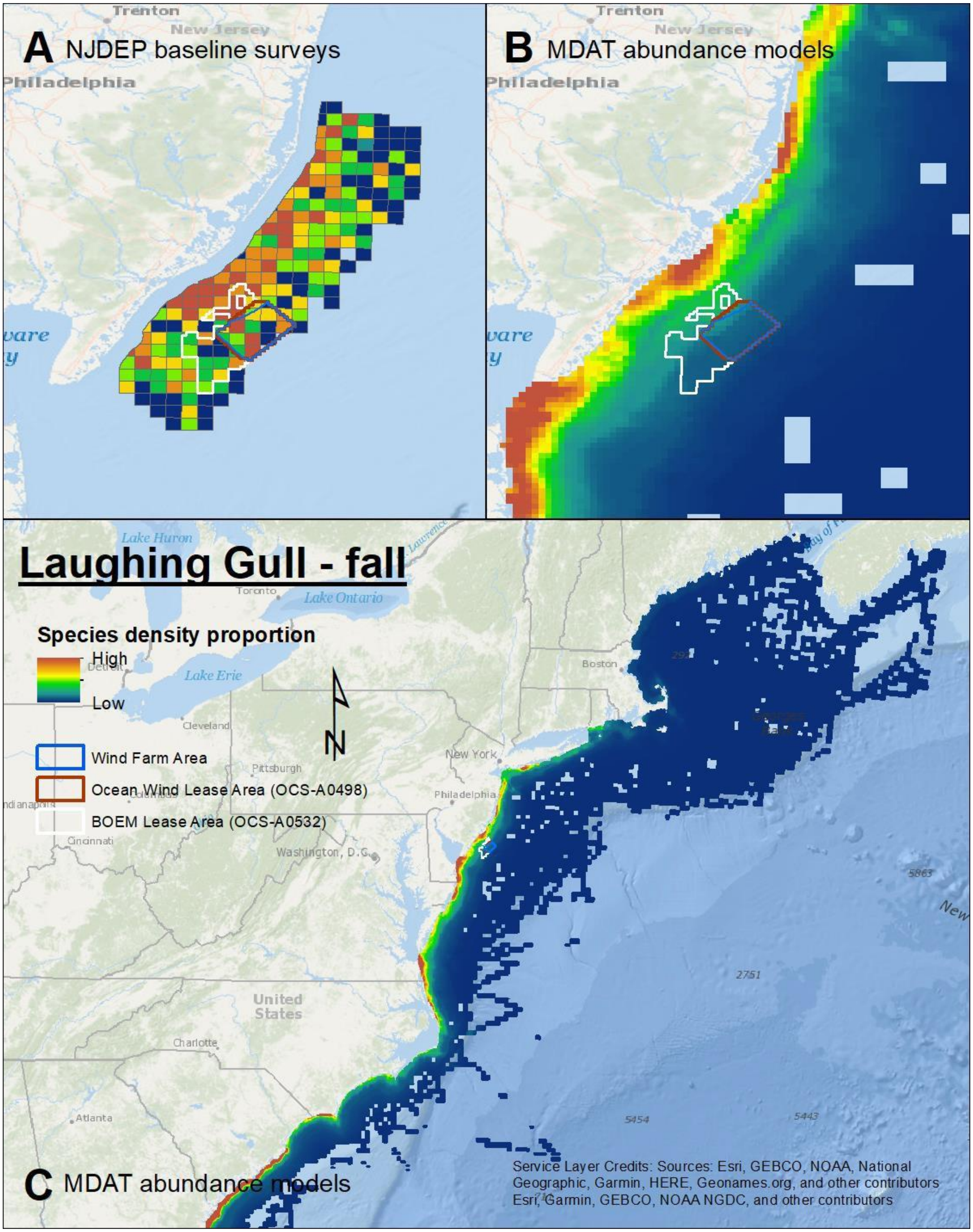
Map 88. Fall Little Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



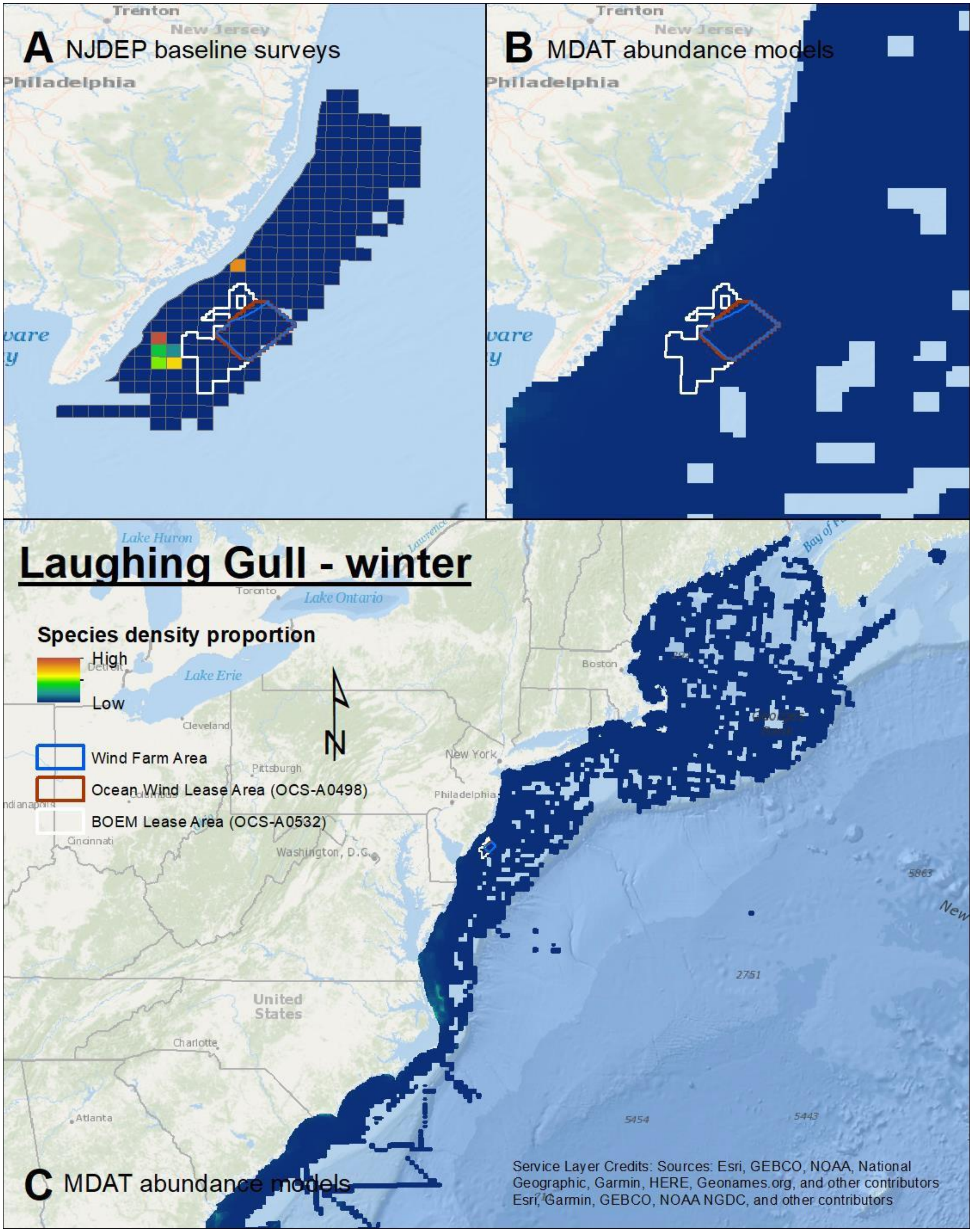
Map 89. Spring Laughing Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



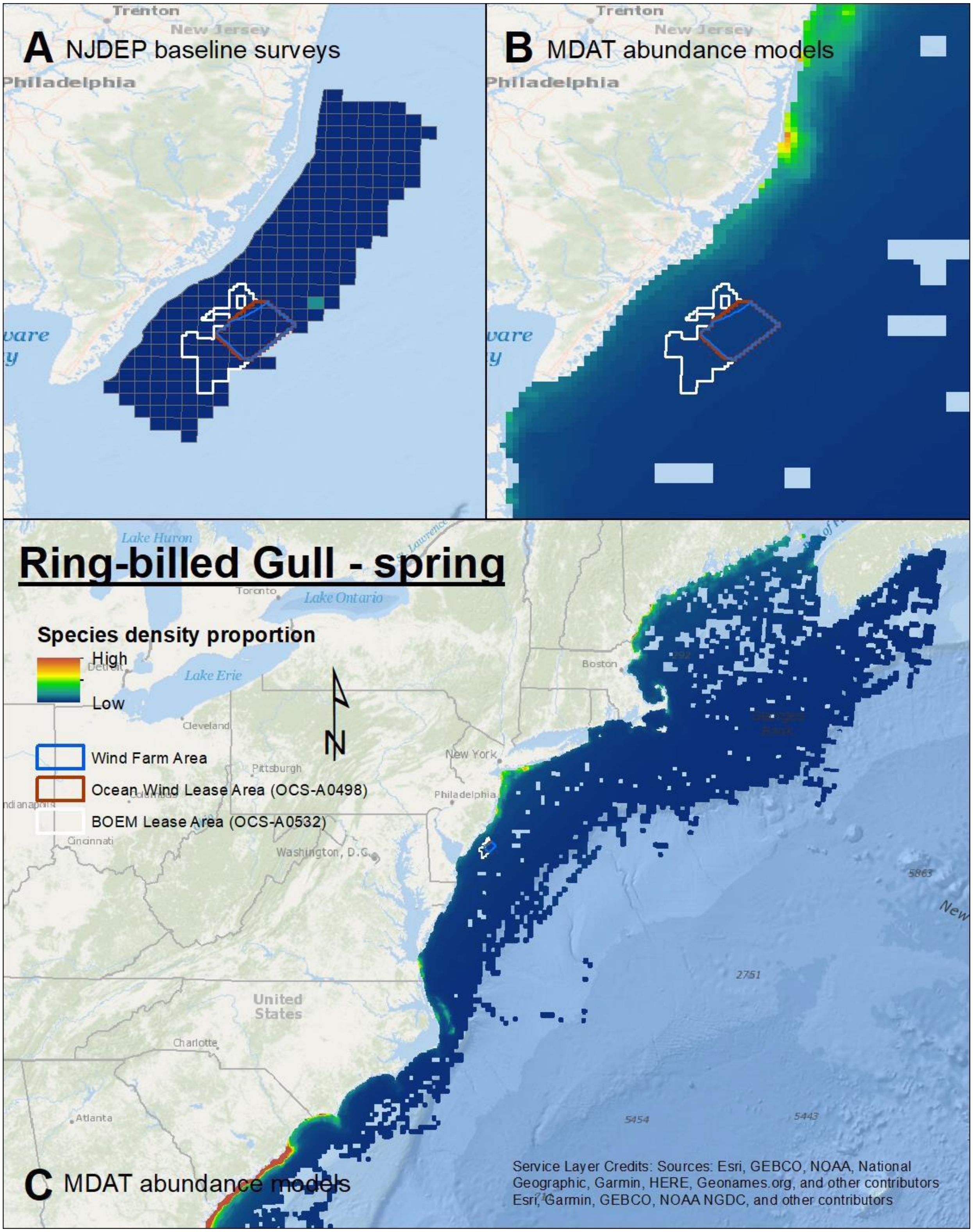
Map 90. Summer Laughing Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



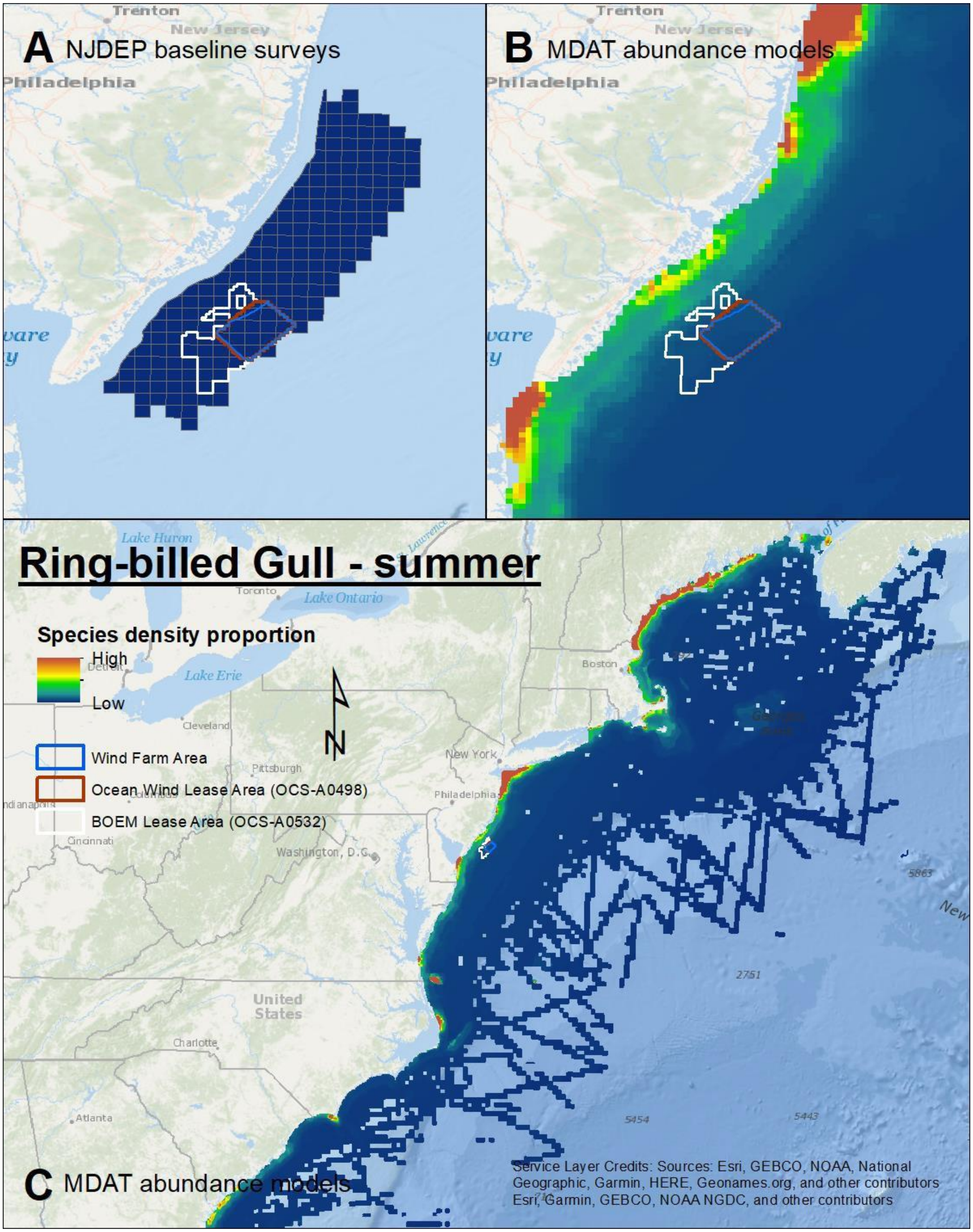
Map 91. Fall Laughing Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



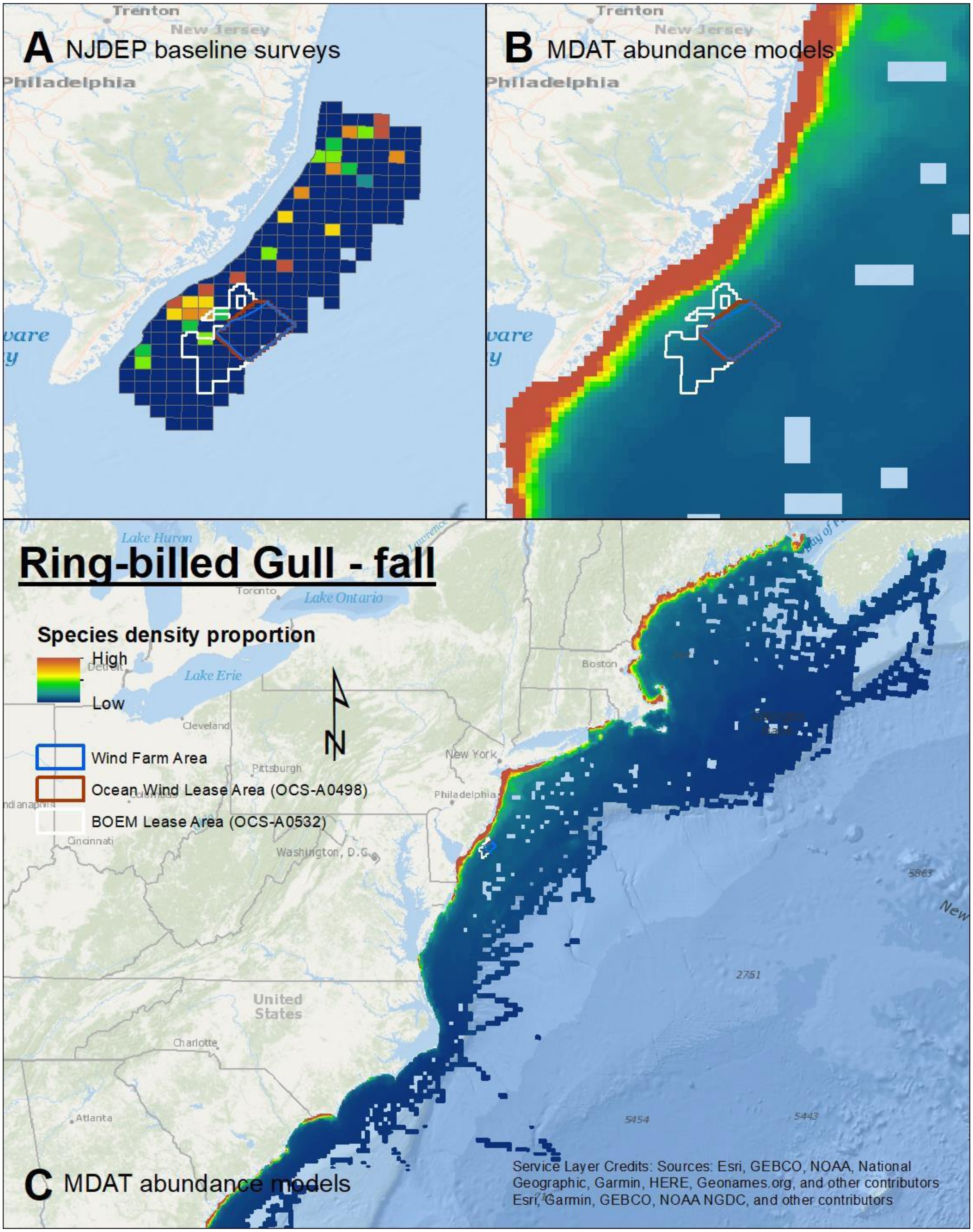
Map 92. Winter Laughing Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



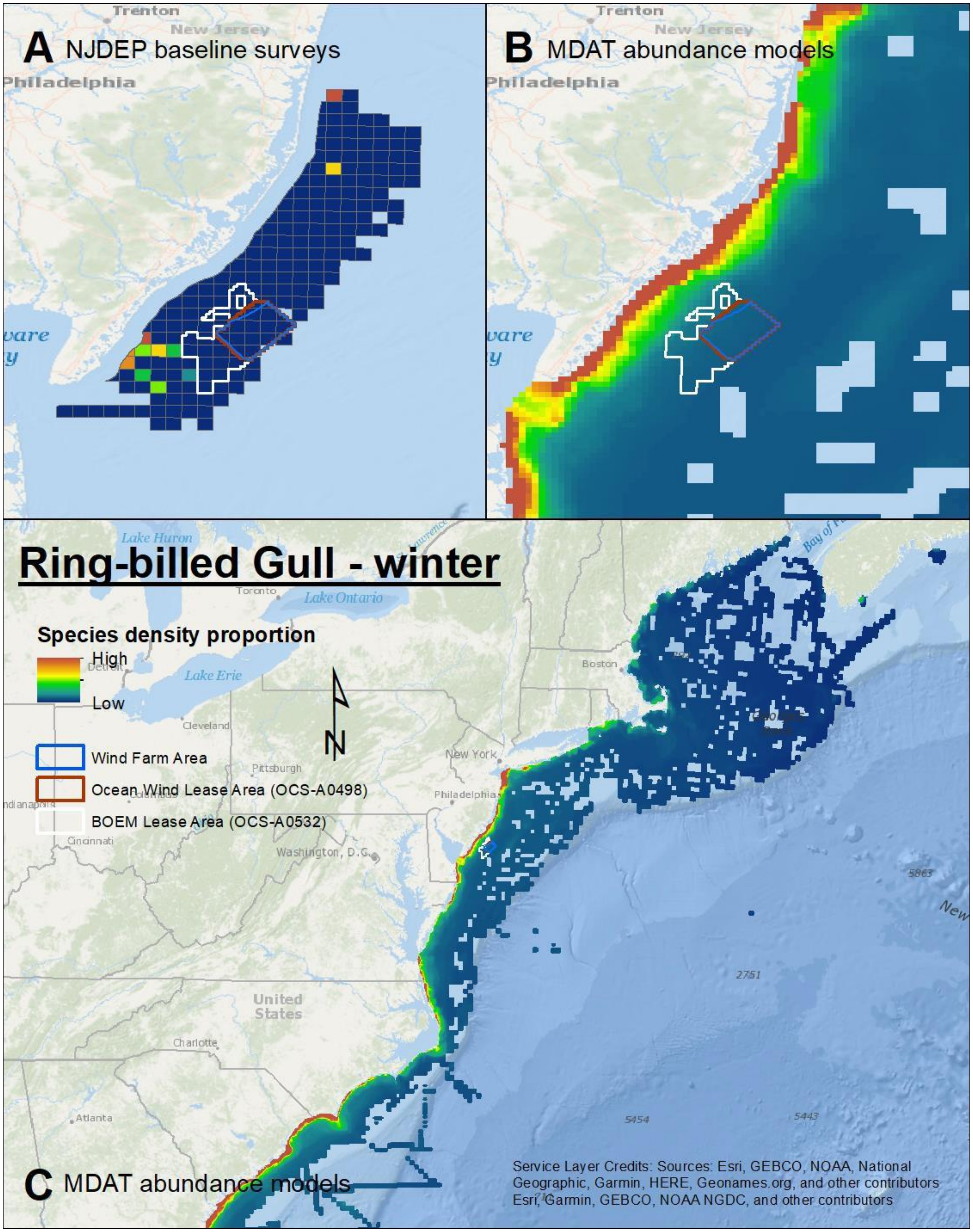
Map 93. Spring Ring-billed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



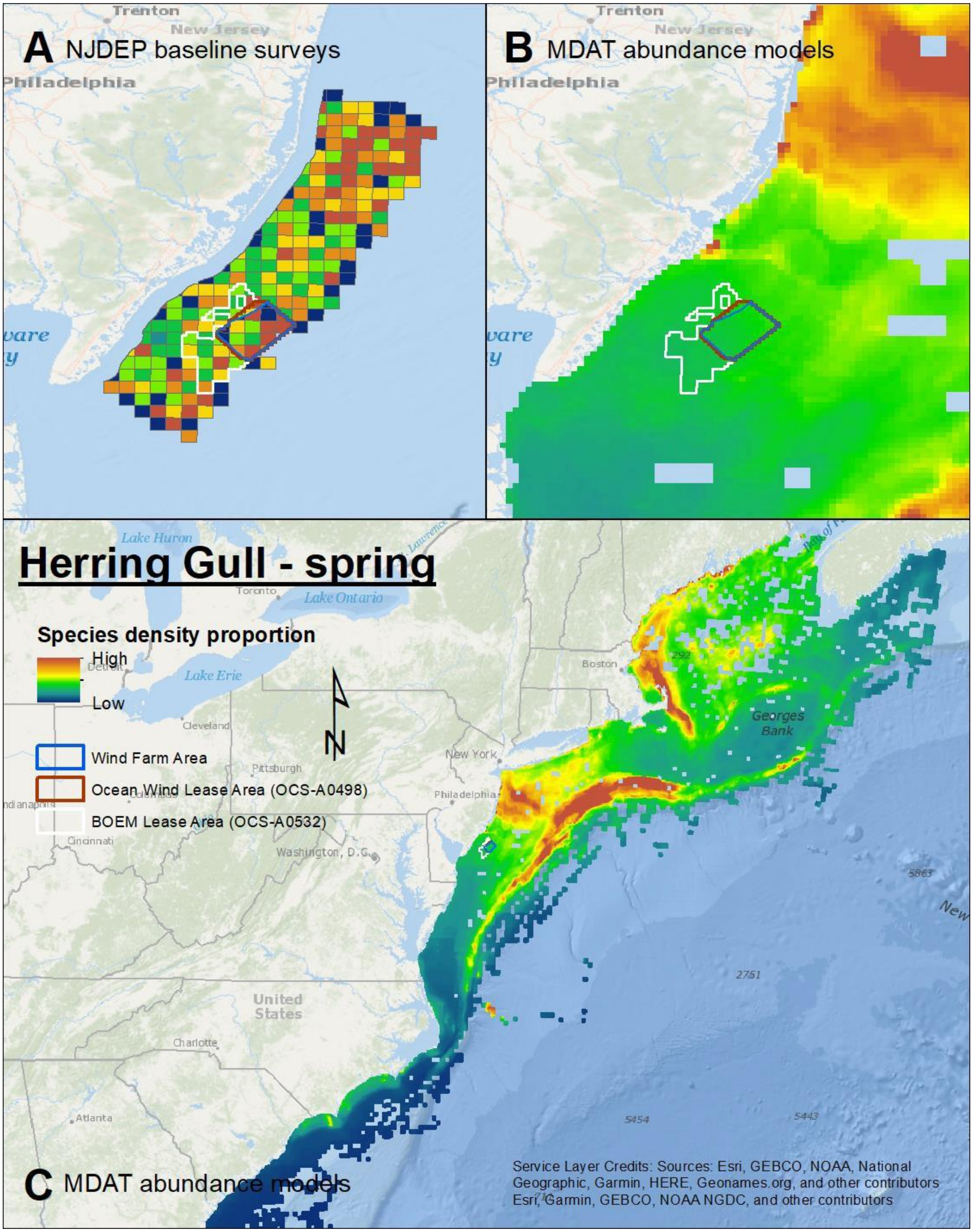
Map 94. Summer Ring-billed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



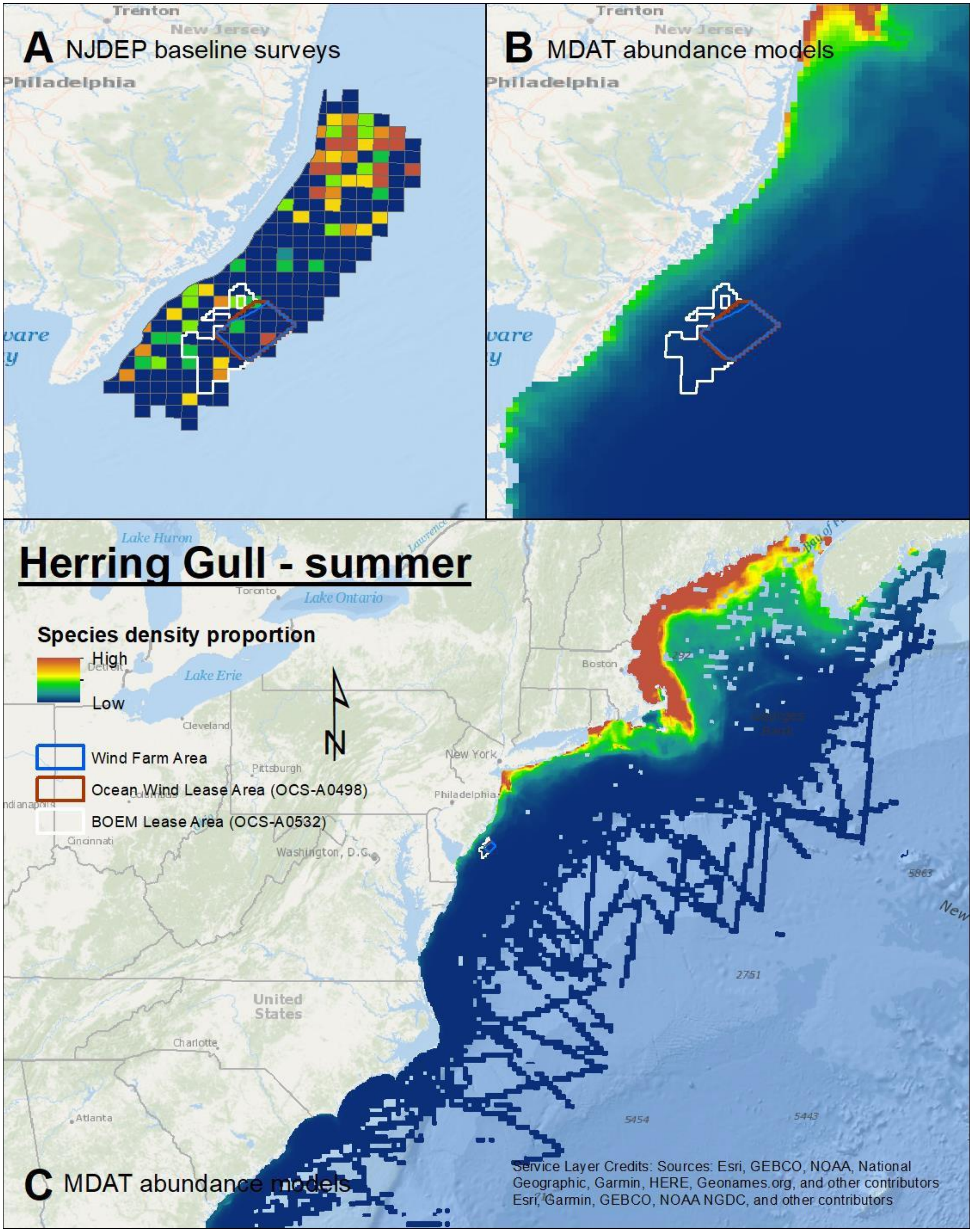
Map 95. Fall Ring-billed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



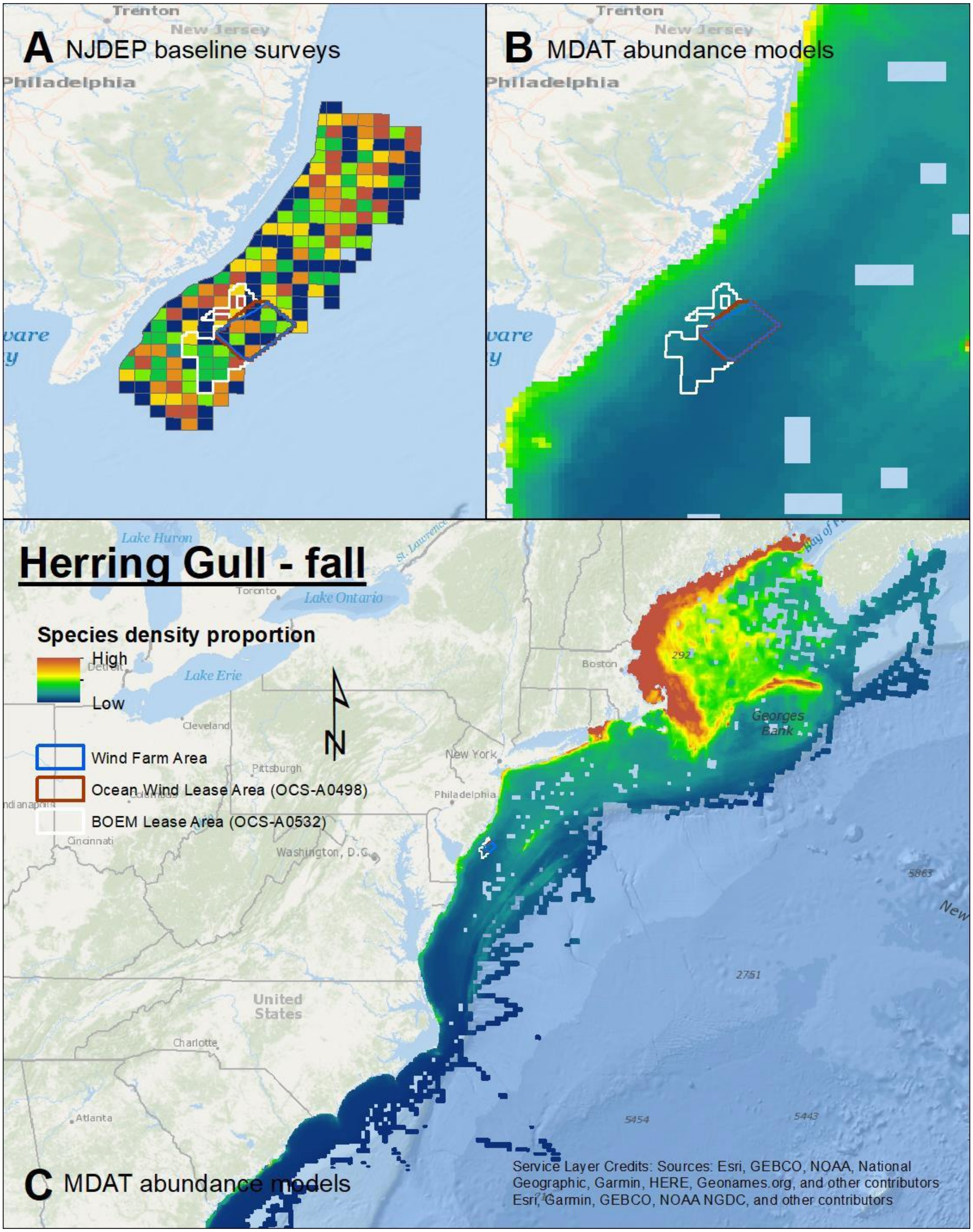
Map 96. Winter Ring-billed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



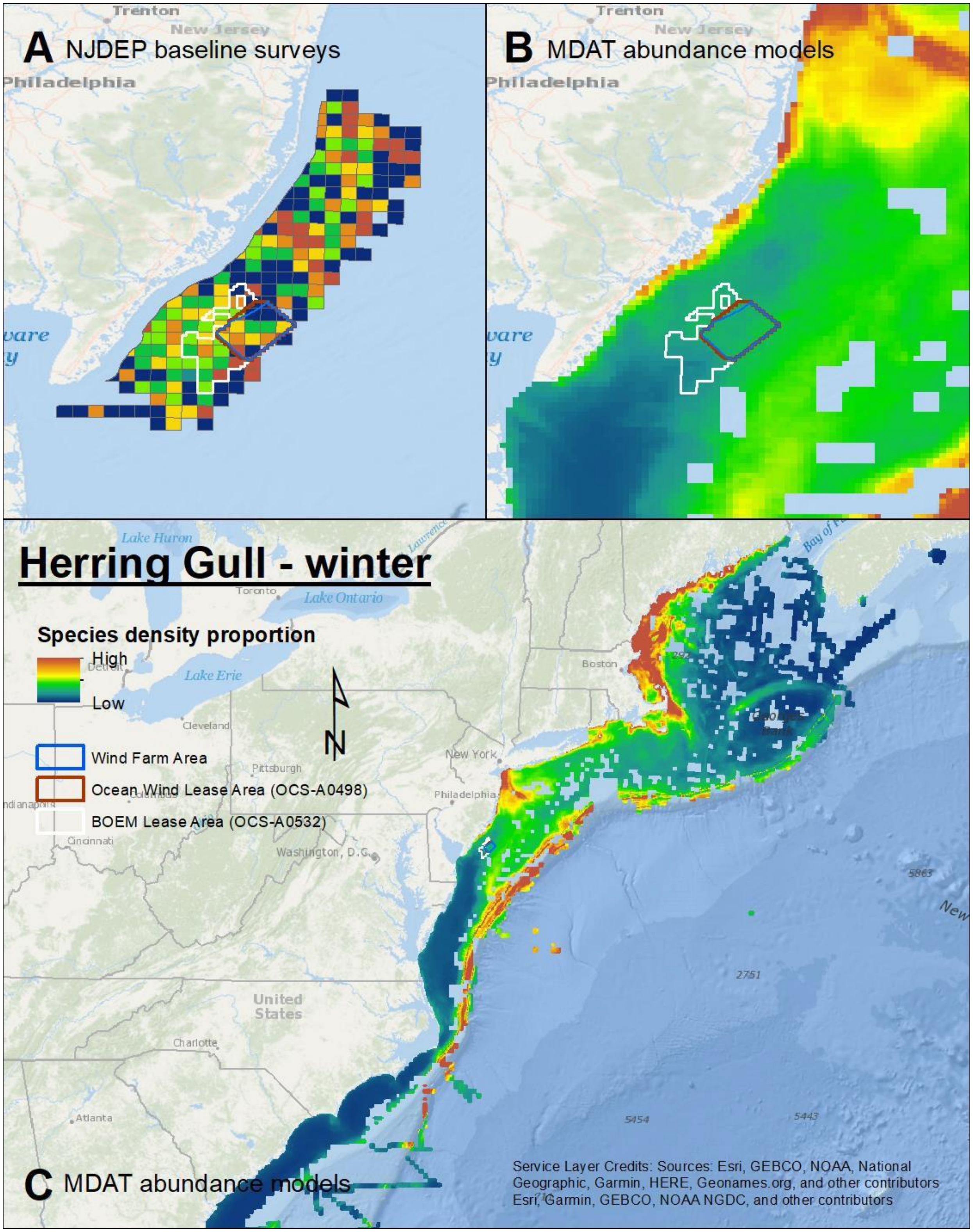
Map 97. Spring Herring Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



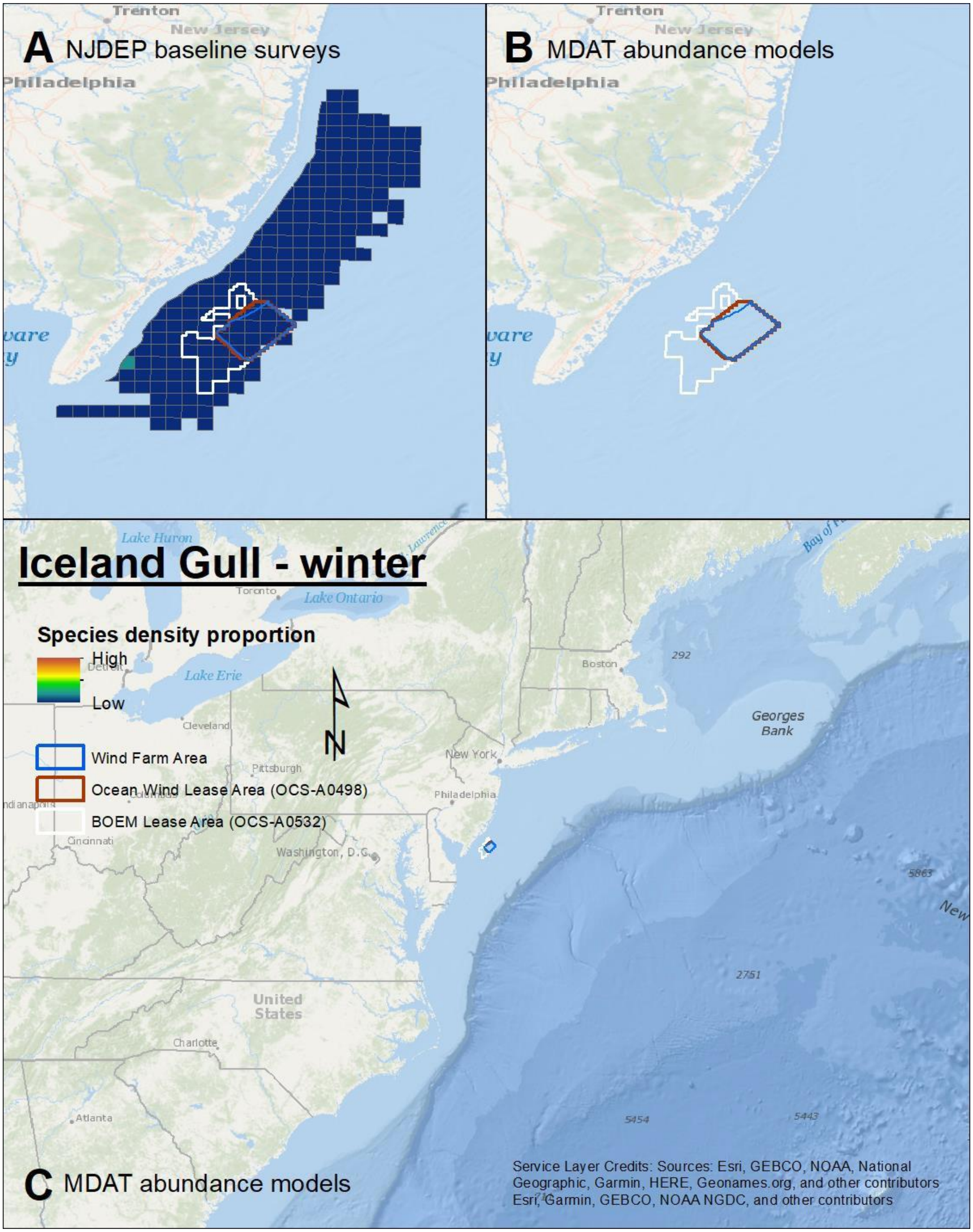
Map 98. Summer Herring Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



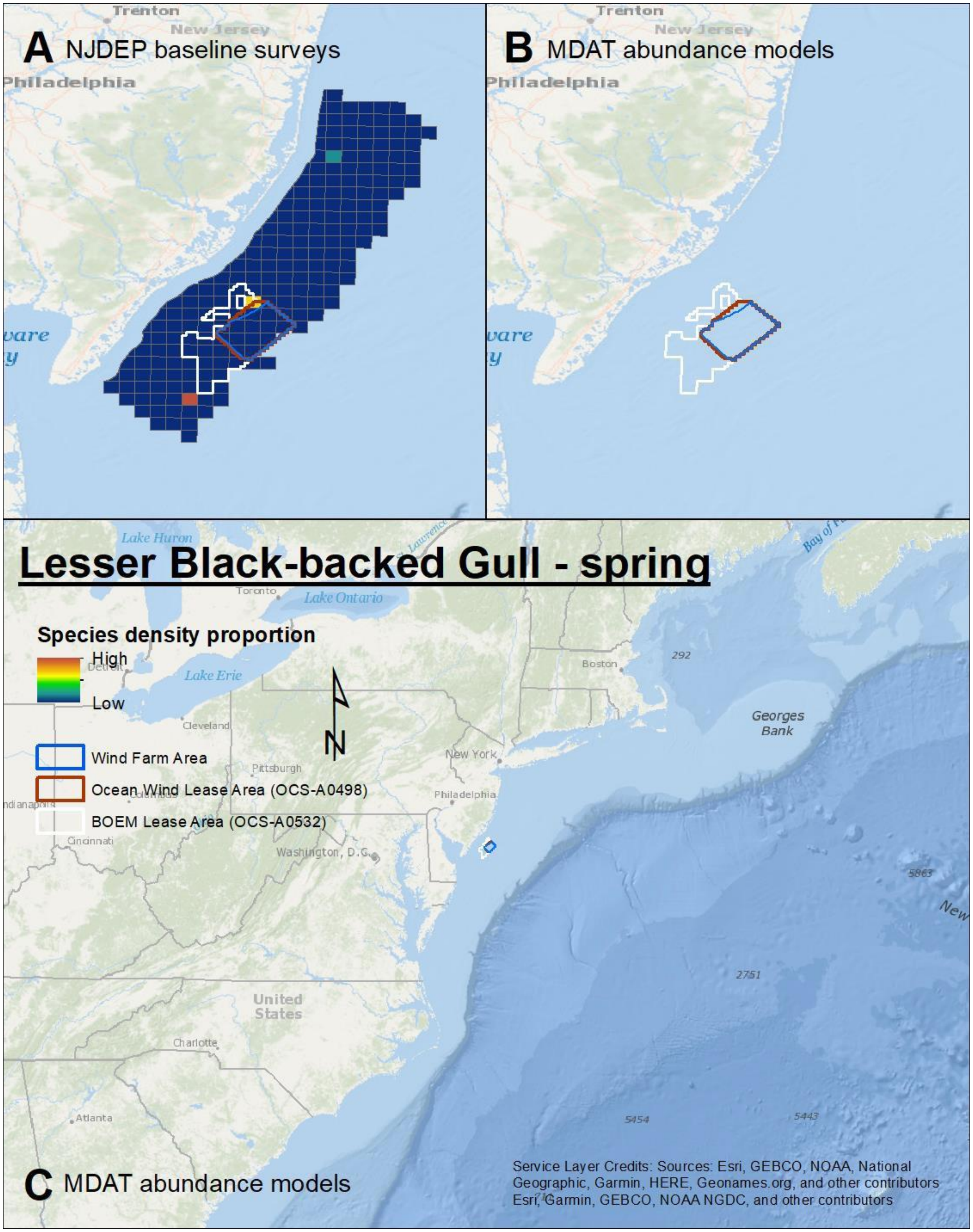
Map 99. Fall Herring Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



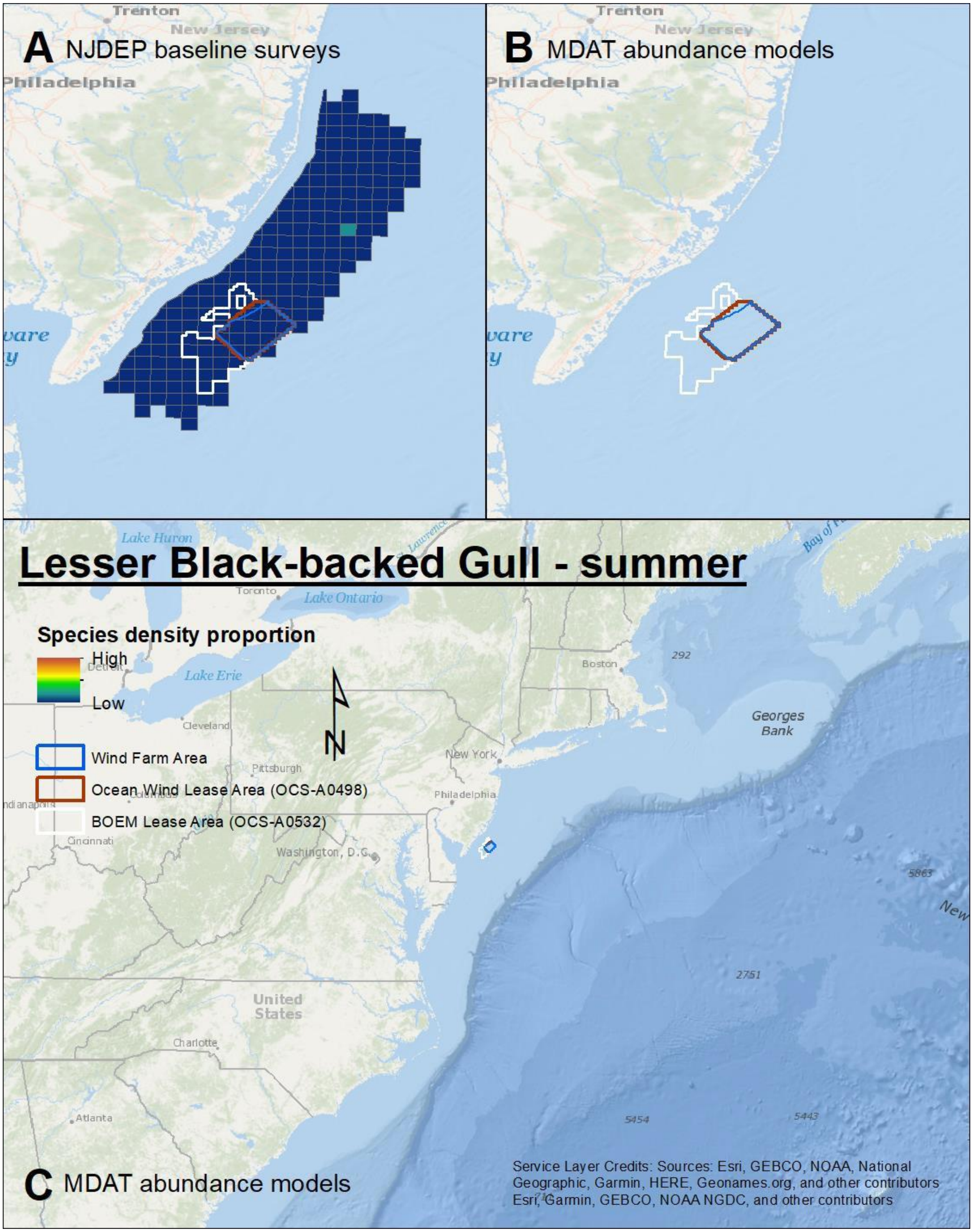
Map 100. Winter Herring Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



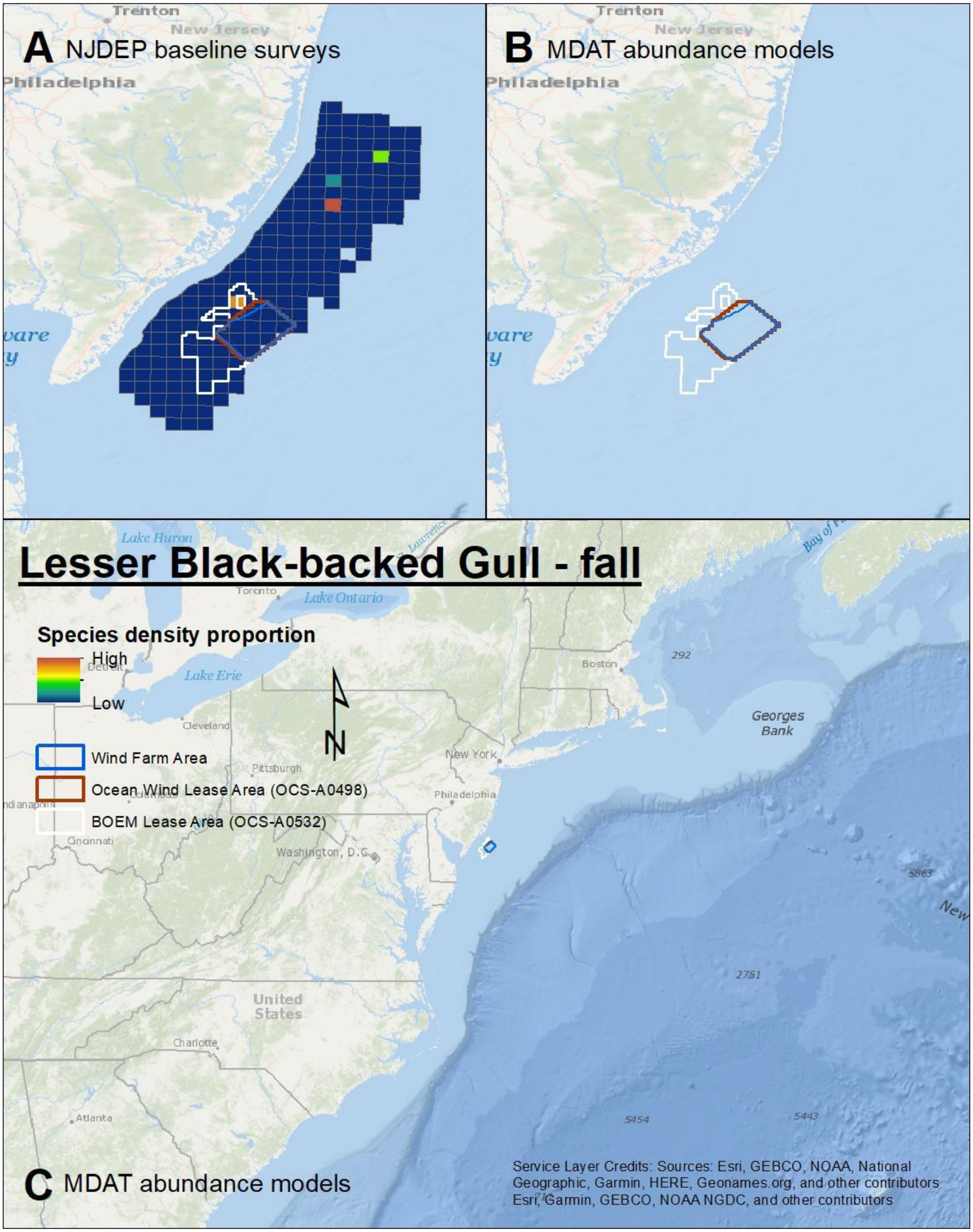
Map 101. Winter Iceland Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



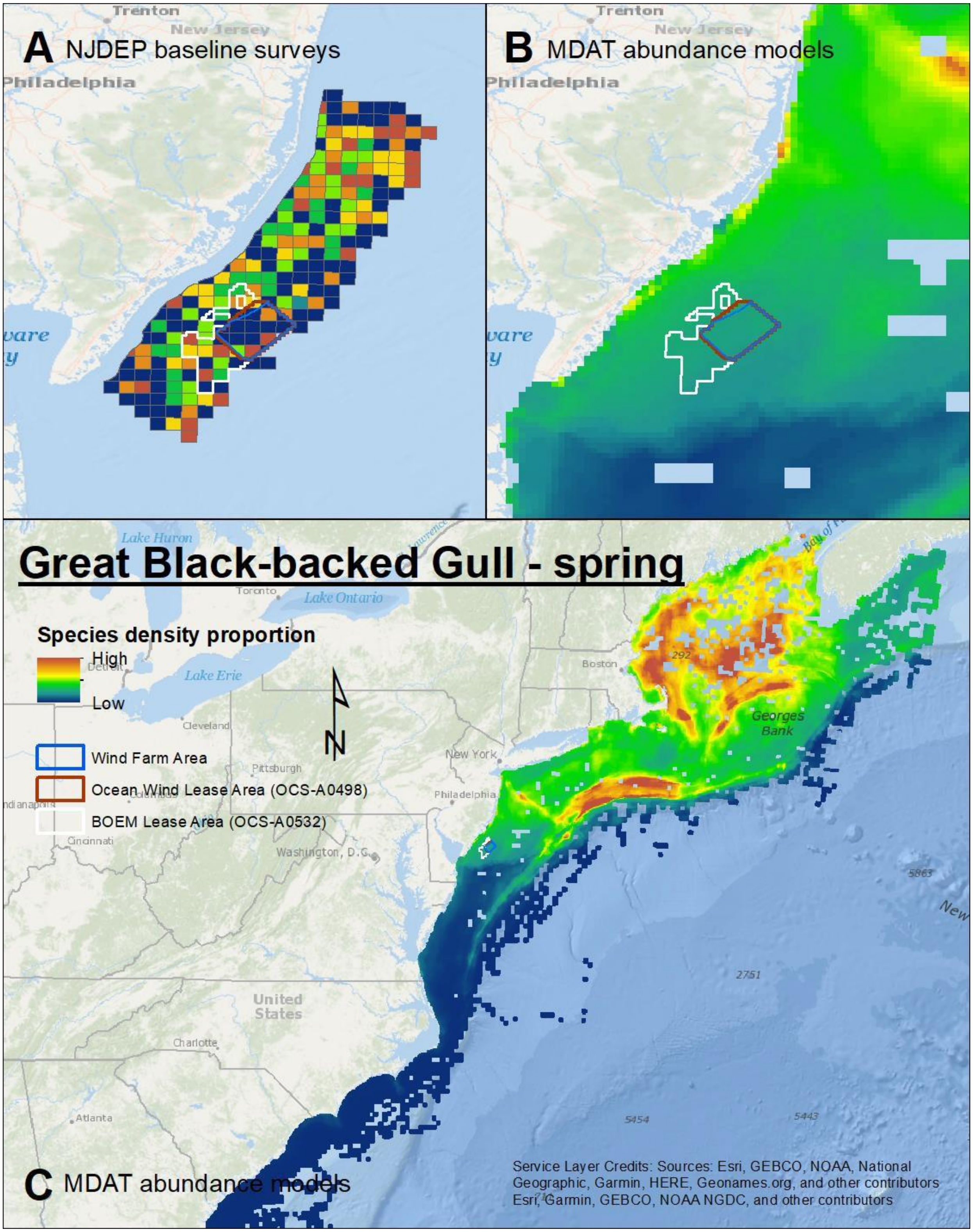
Map 102. Spring Lesser Black-backed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



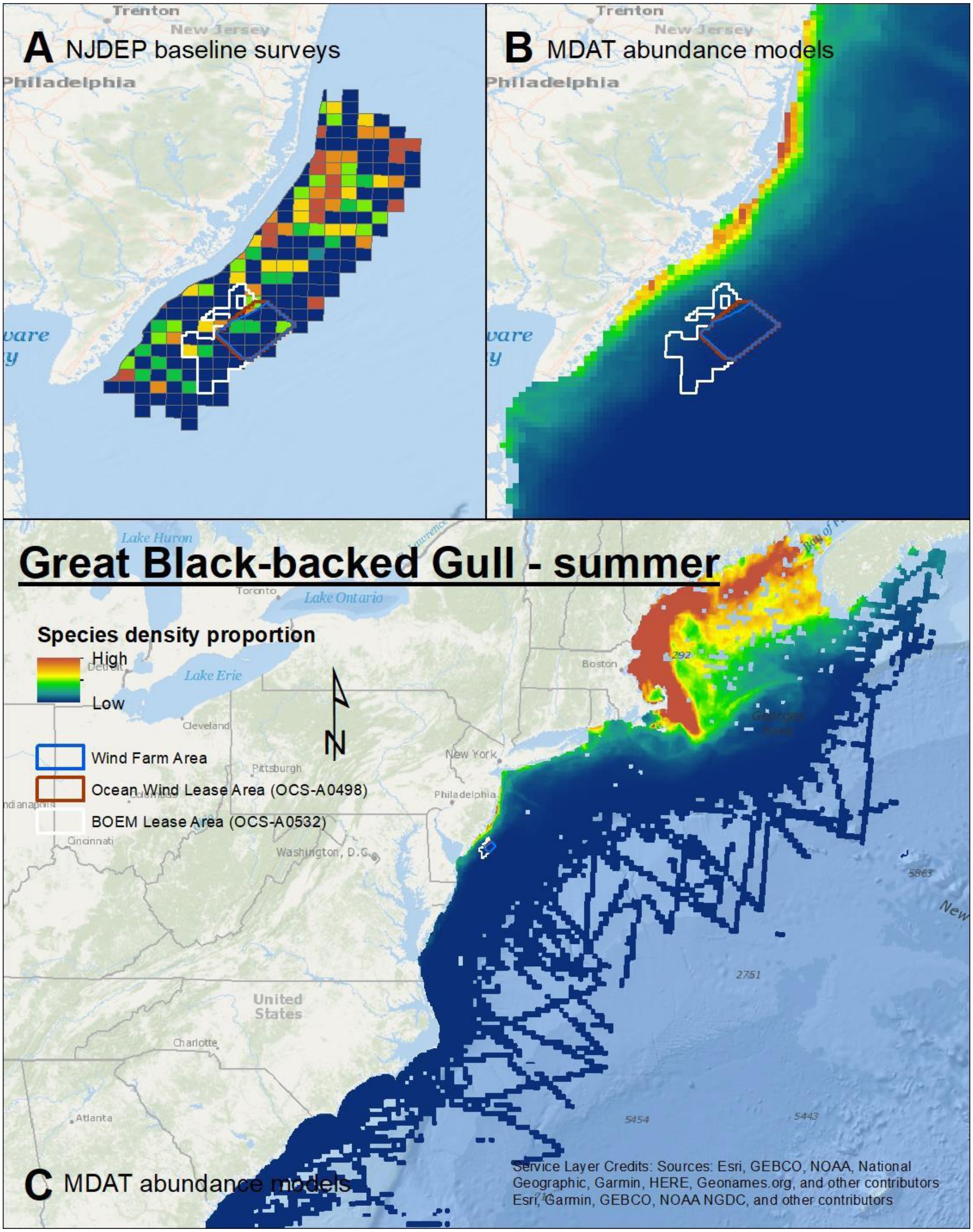
Map 103. Summer Lesser Black-backed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



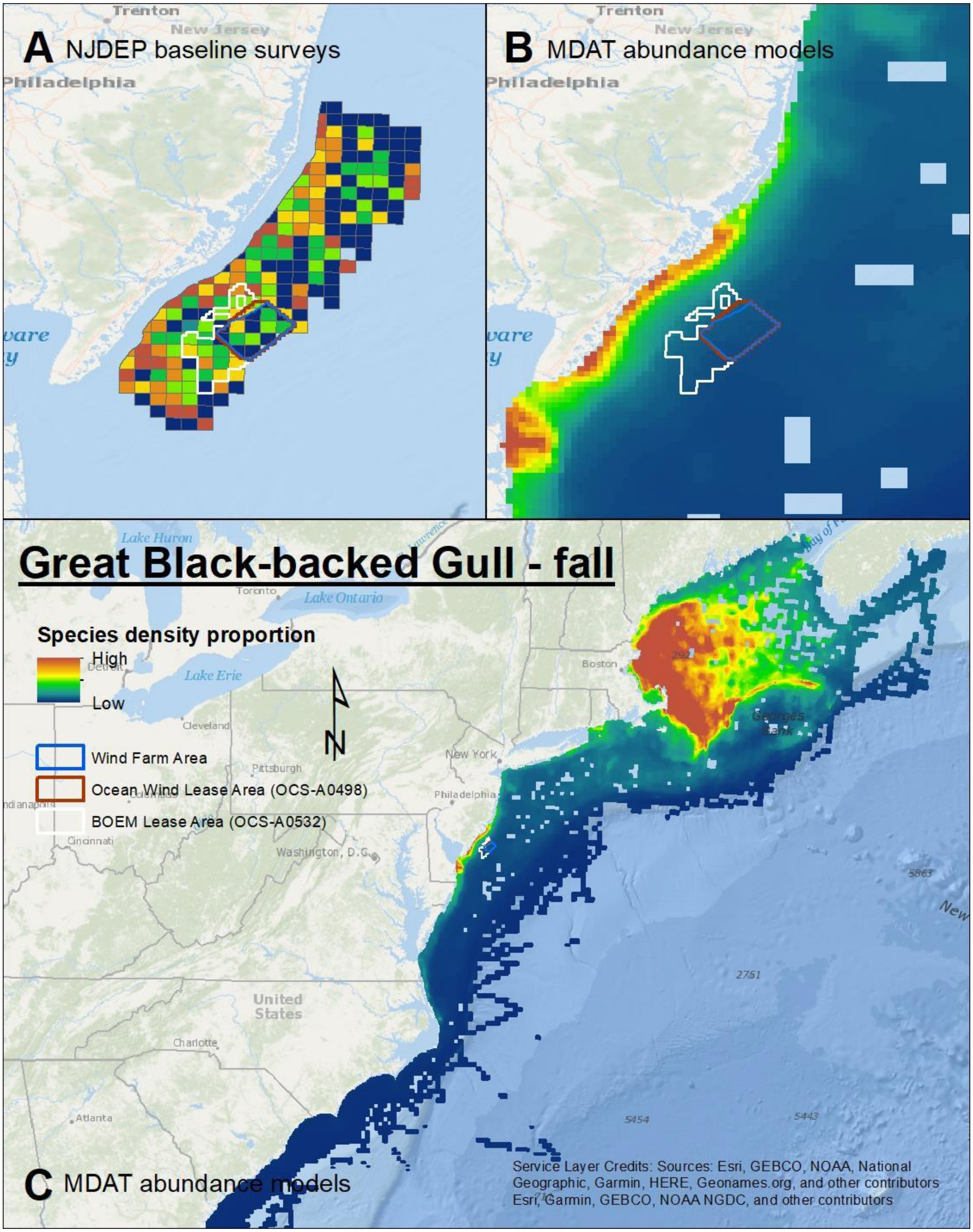
Map 104. Fall Lesser Black-backed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



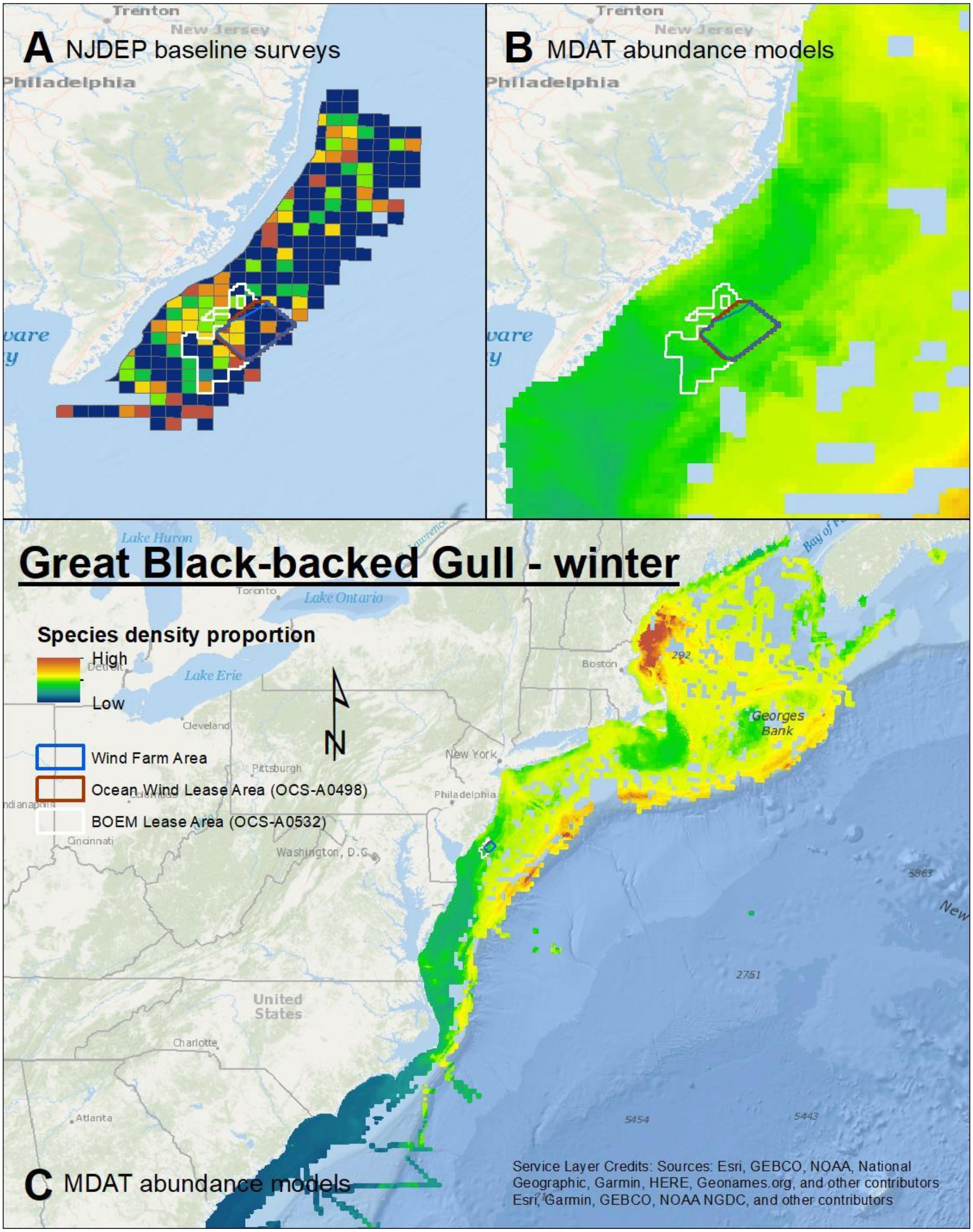
Map 105. Spring Great Black-backed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



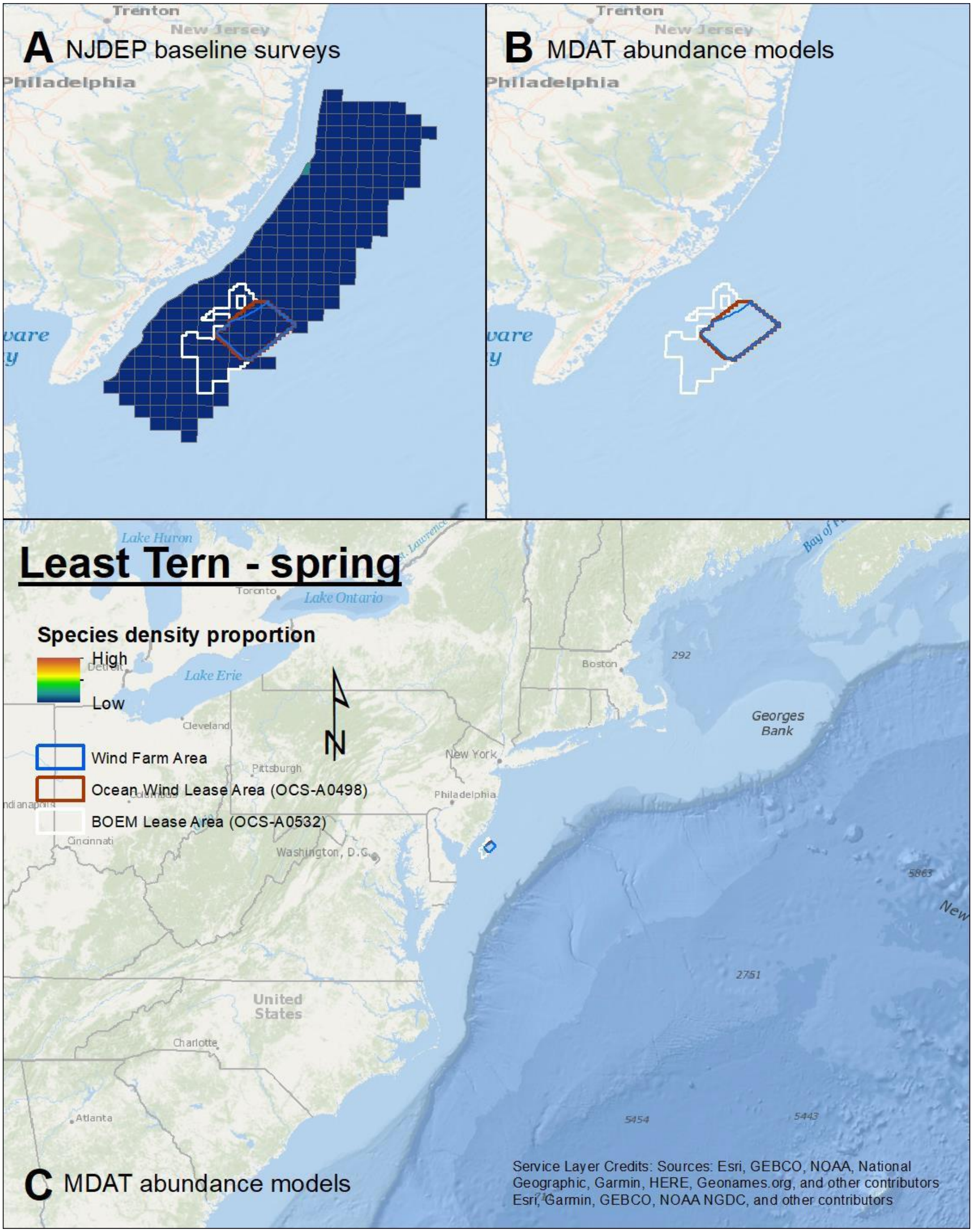
Map 106. Summer Great Black-backed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



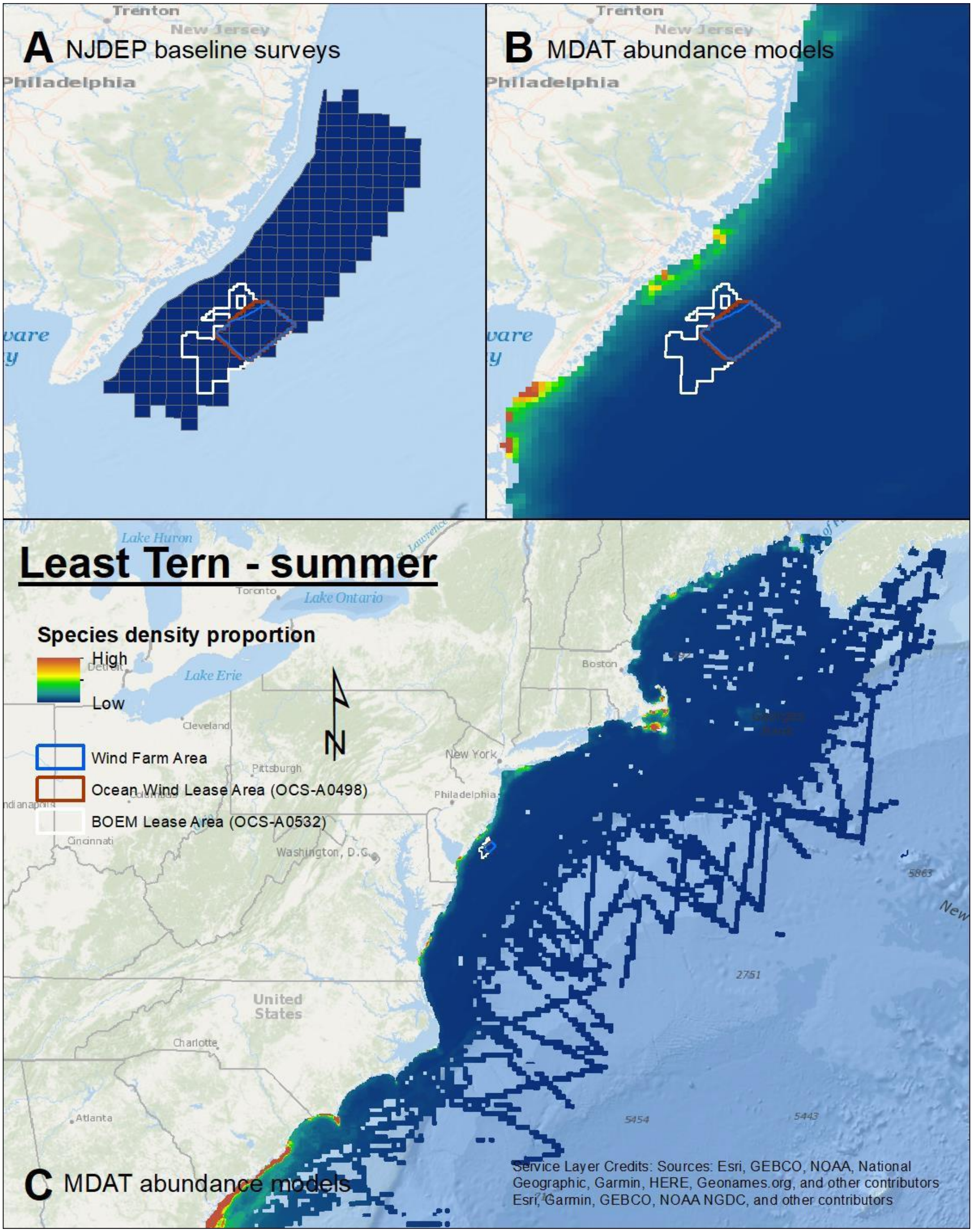
Map 107. Fall Great Black-backed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



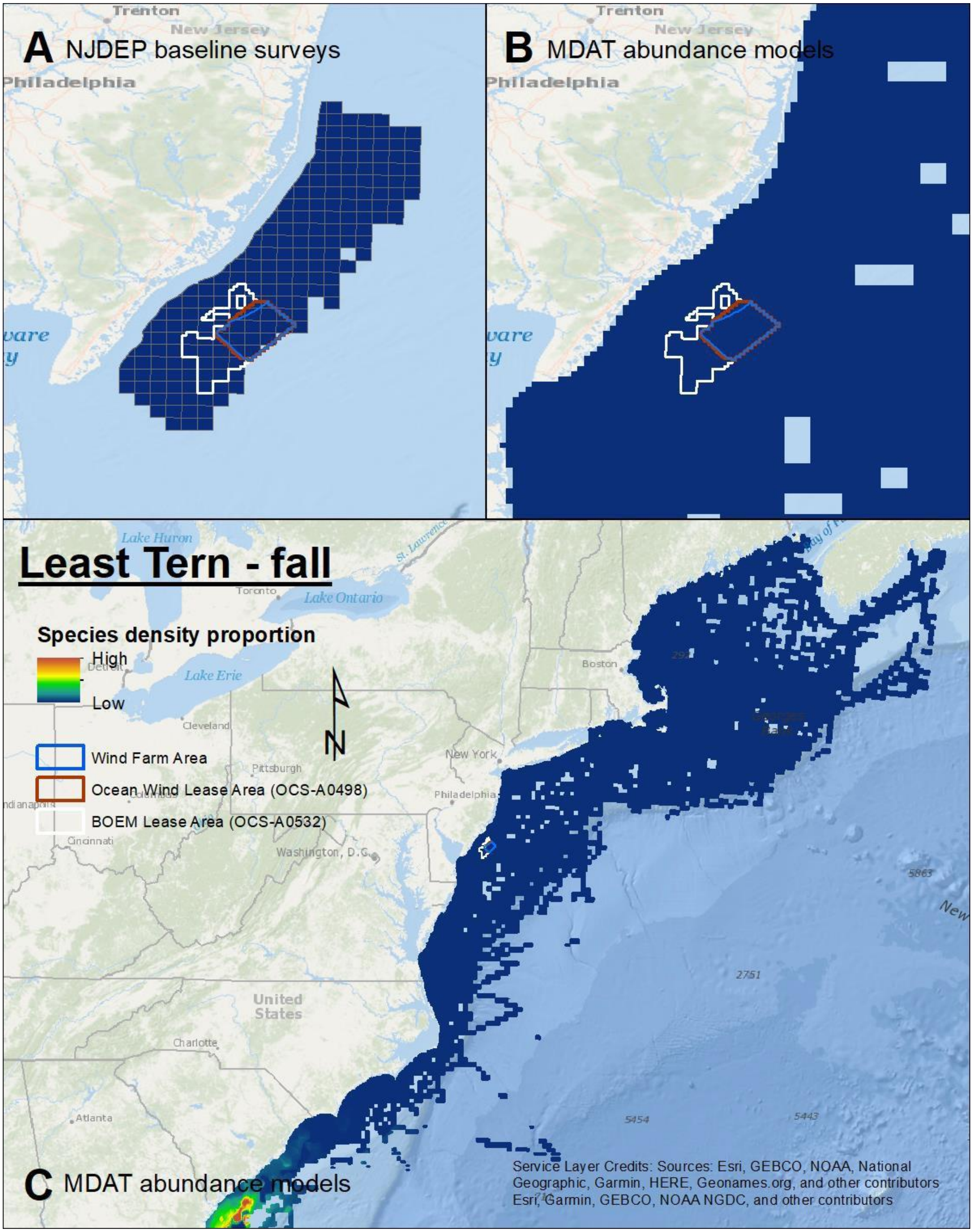
Map 108. Winter Great Black-backed Gull density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



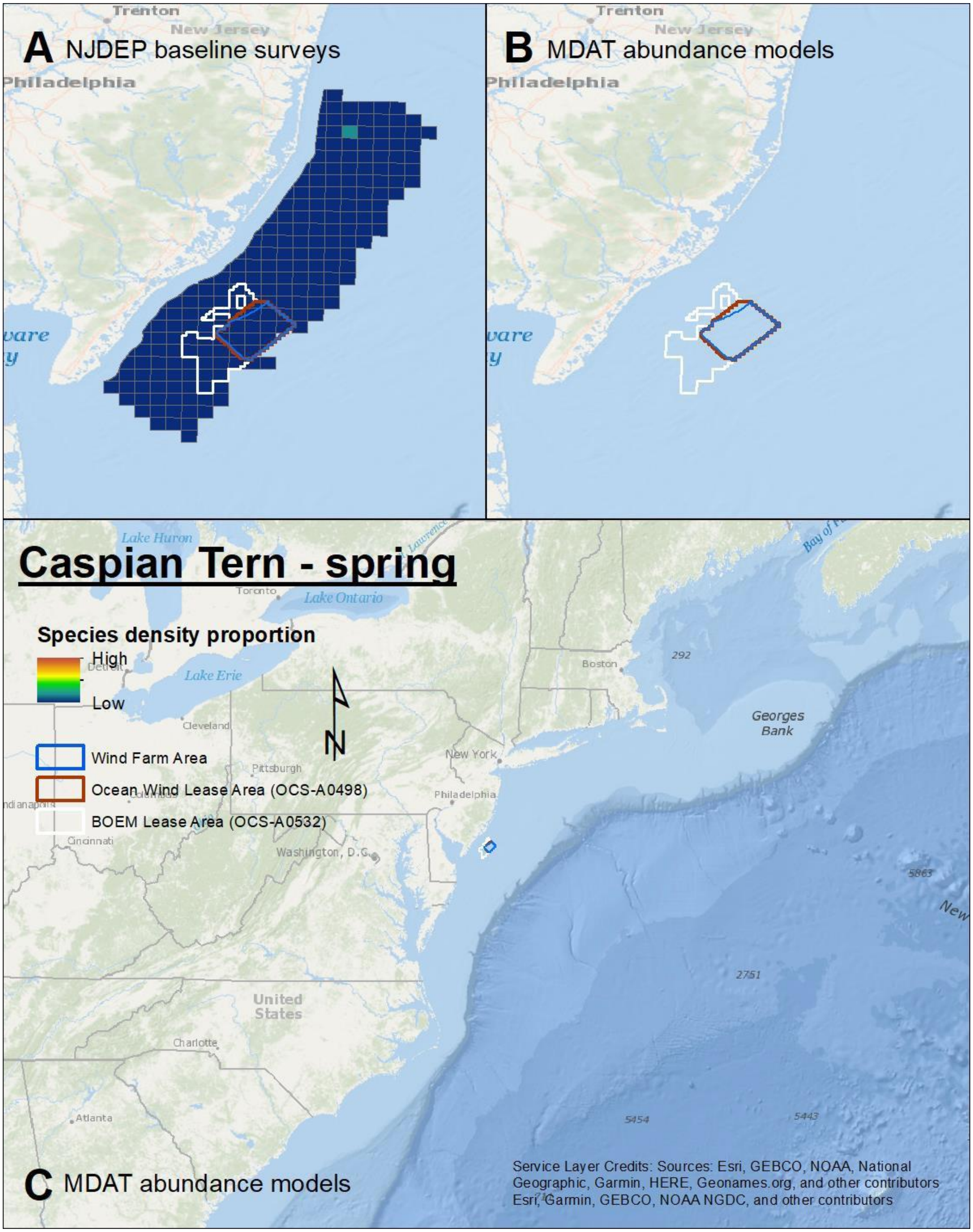
Map 109. Spring Least Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



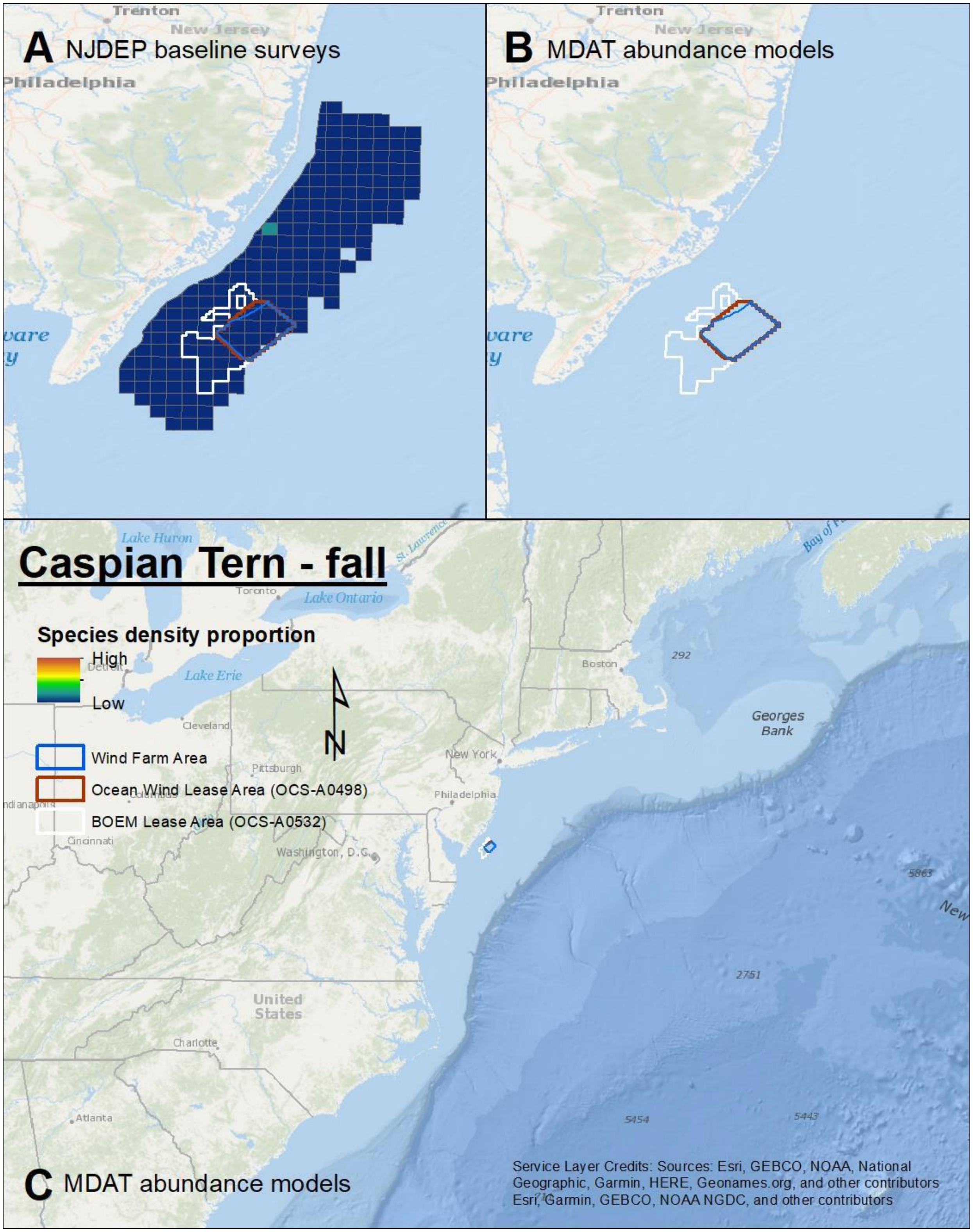
Map 110. Summer Least Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



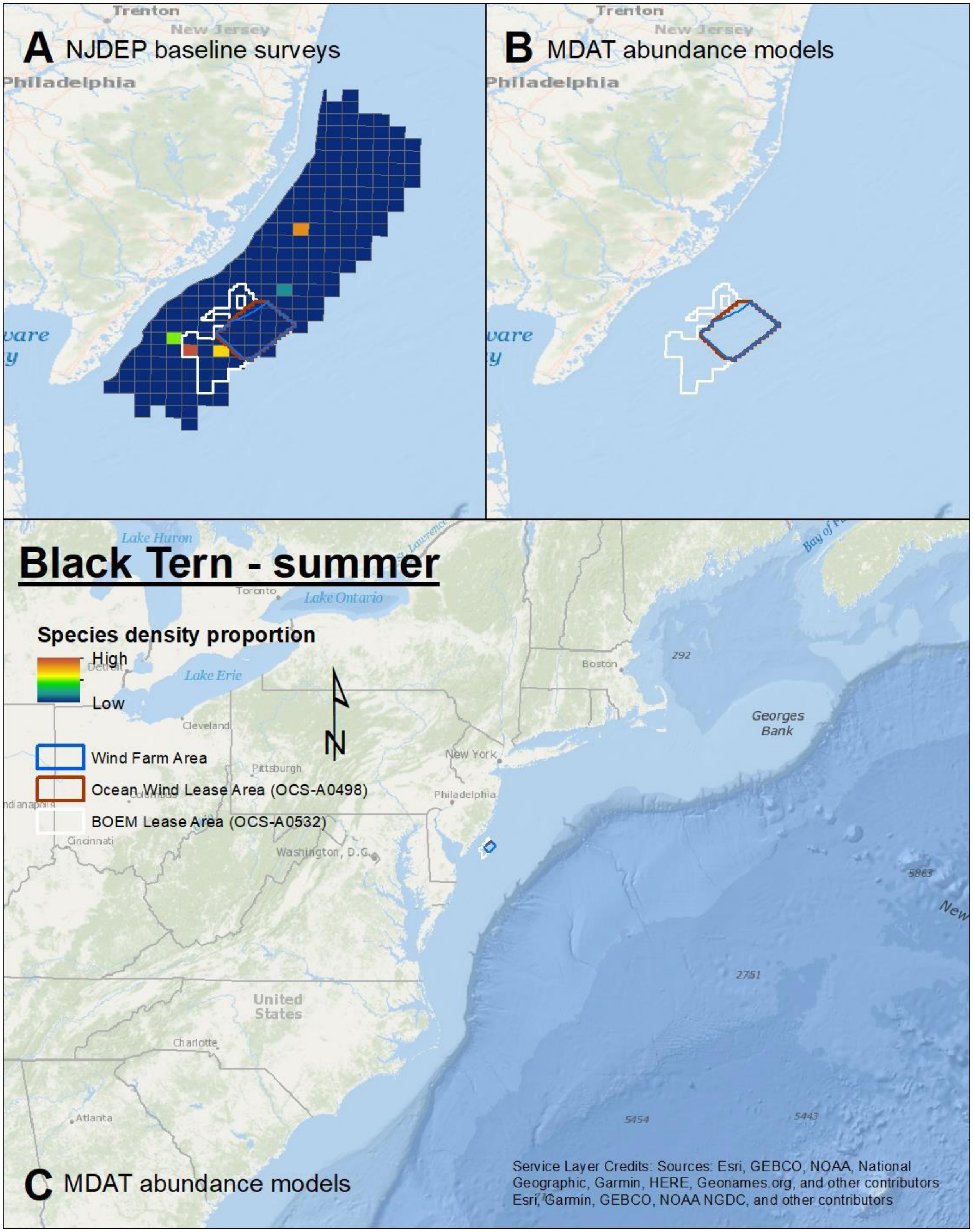
Map 111. Fall Least Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



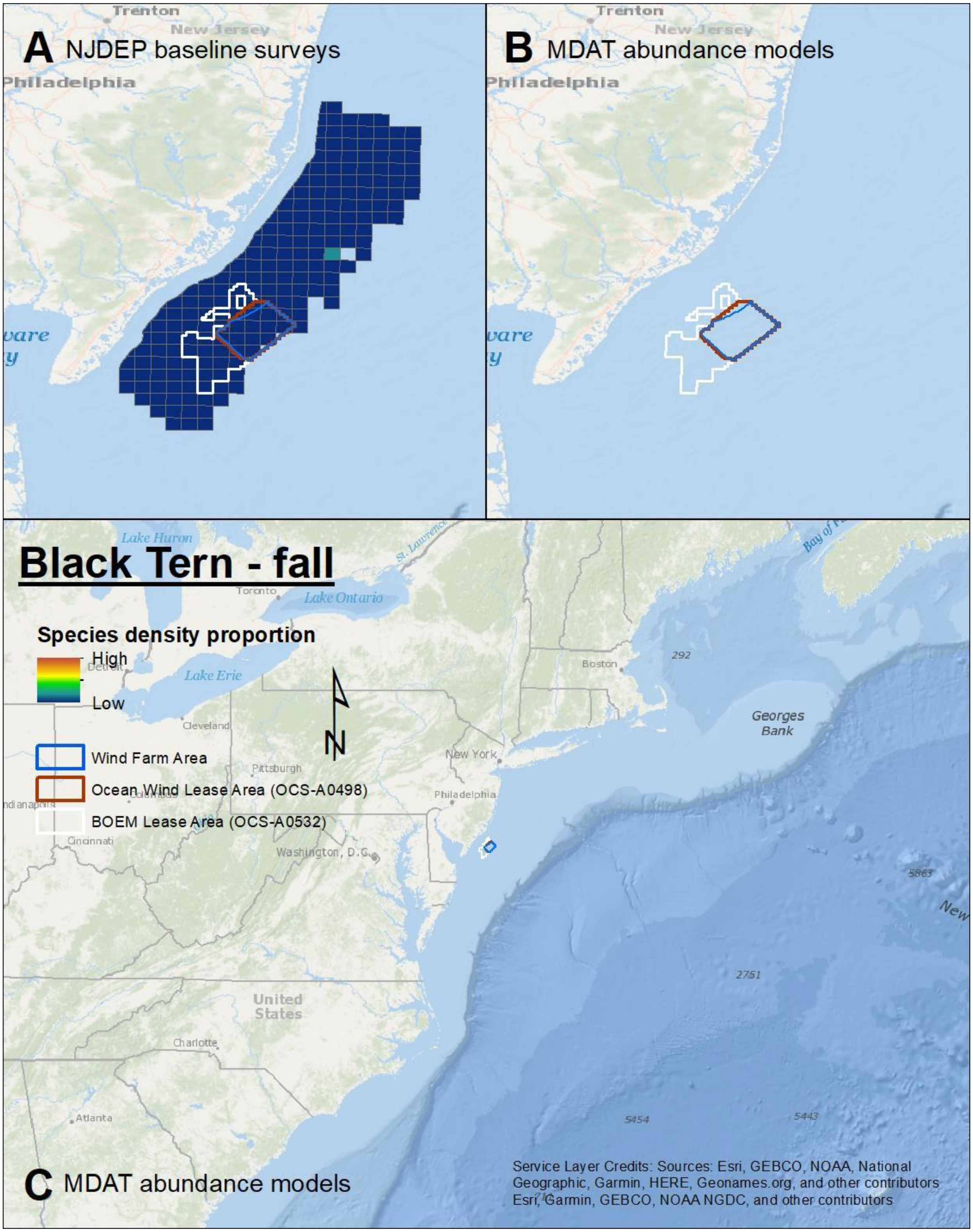
Map 112. Spring Caspian Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



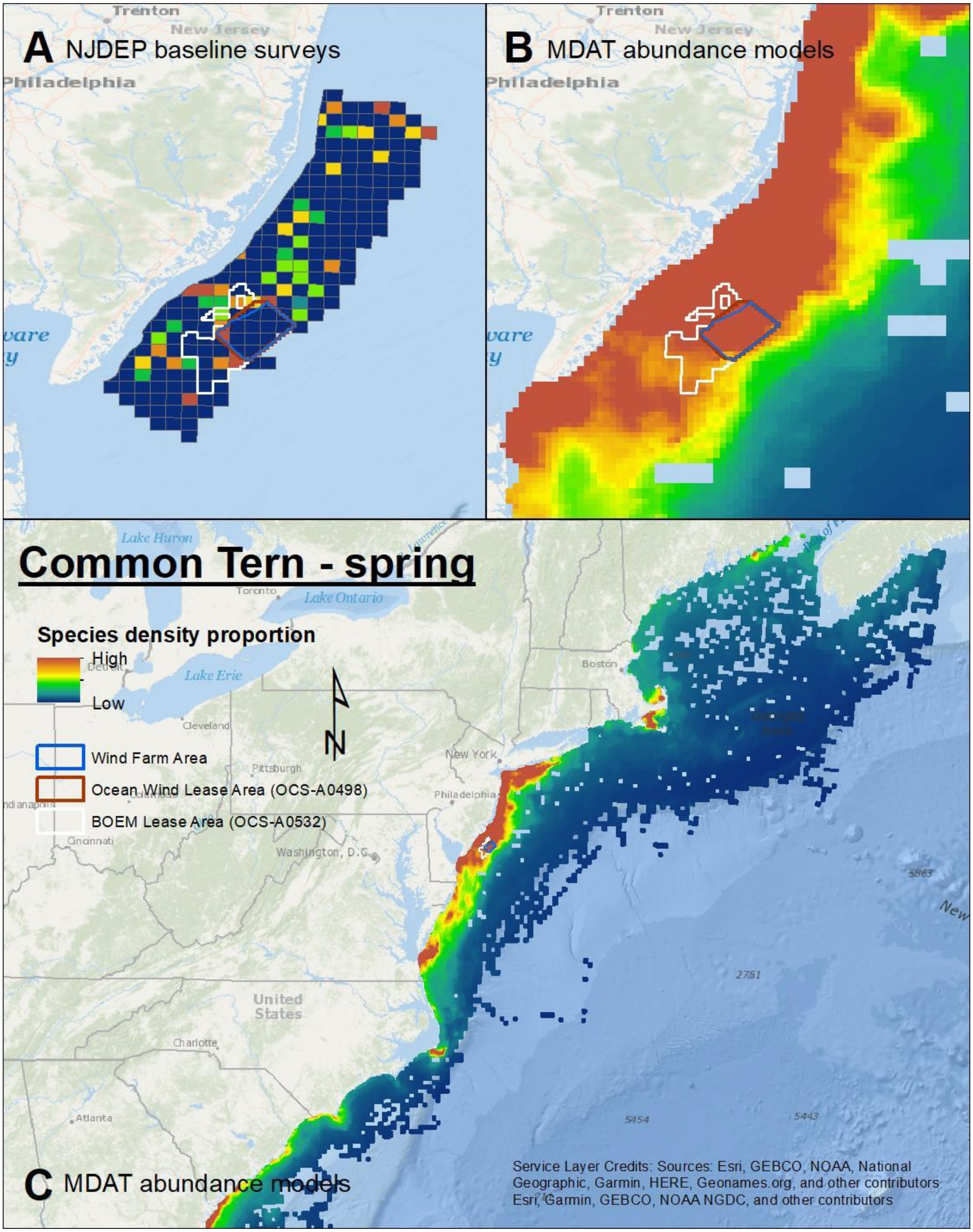
Map 113. Fall Caspian Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



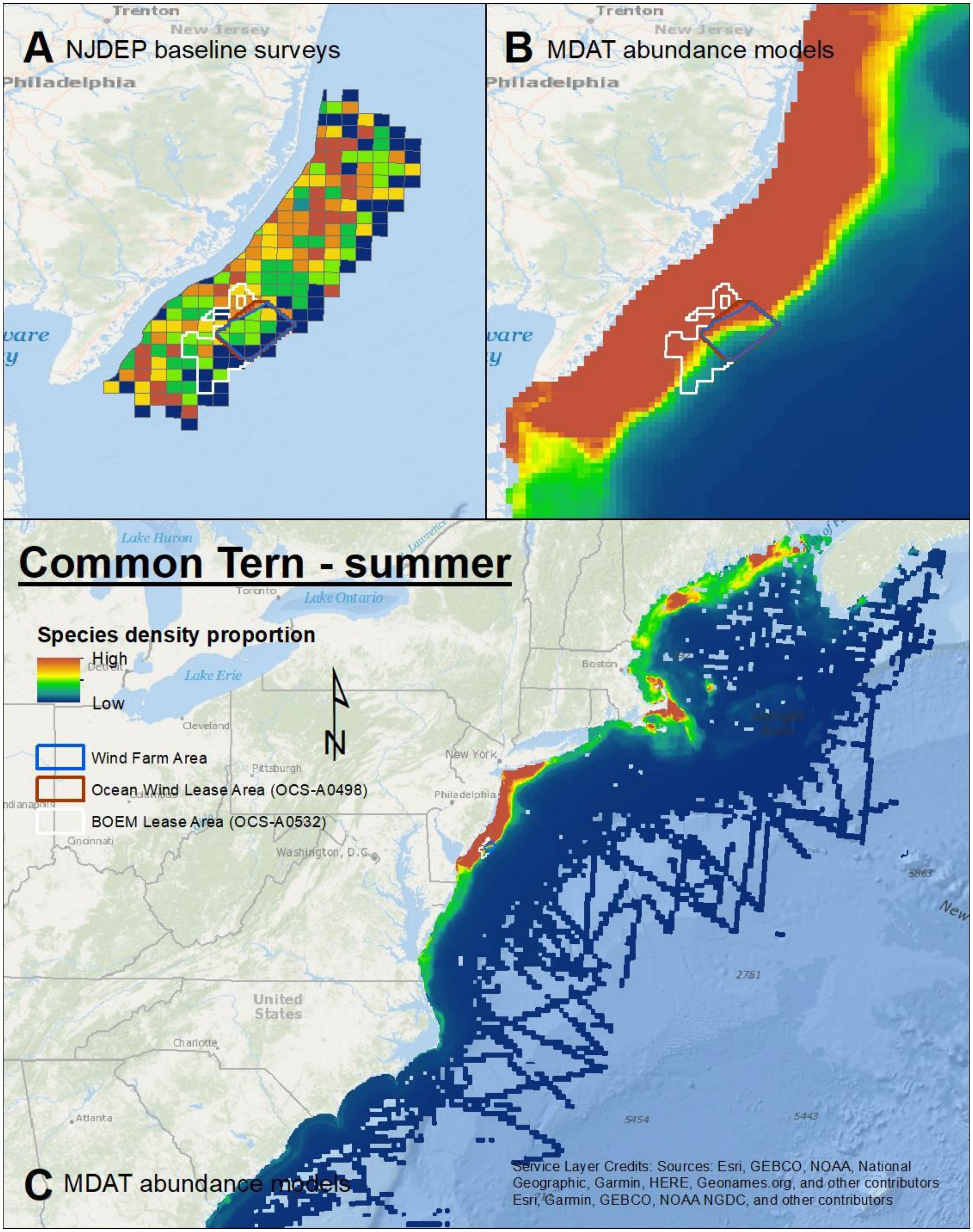
Map 114. Summer Black Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



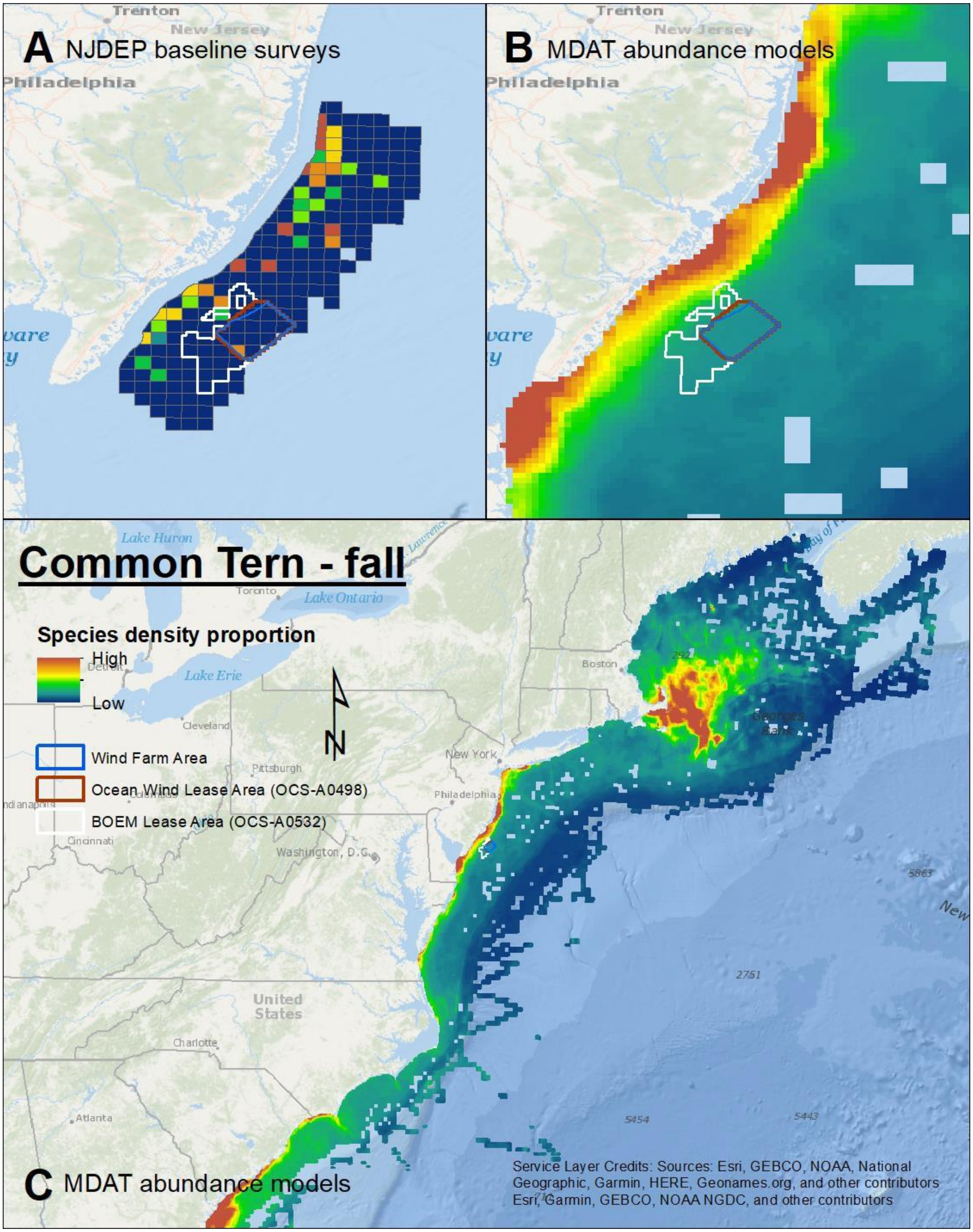
Map 115. Fall Black Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



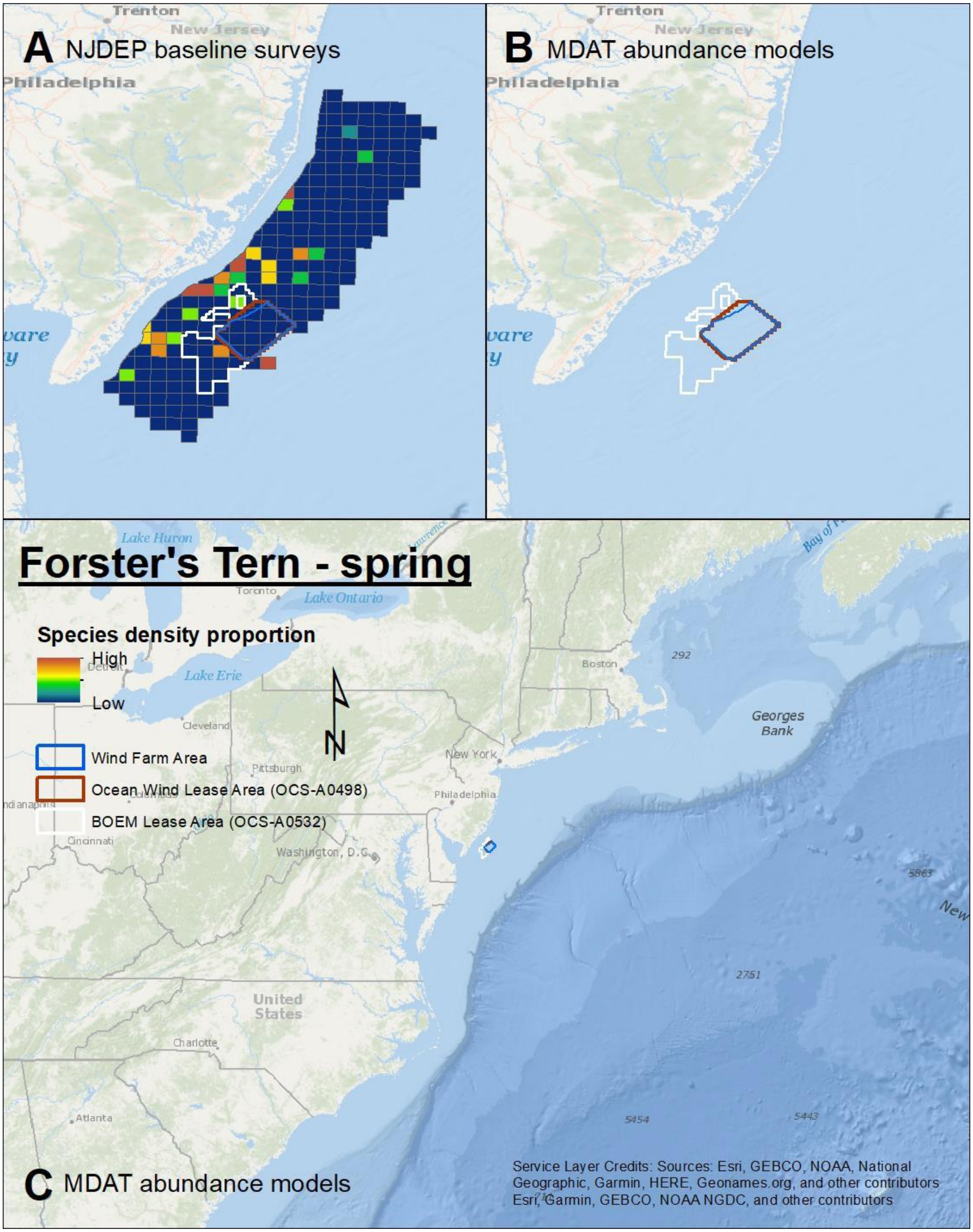
Map 116. Spring Common Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



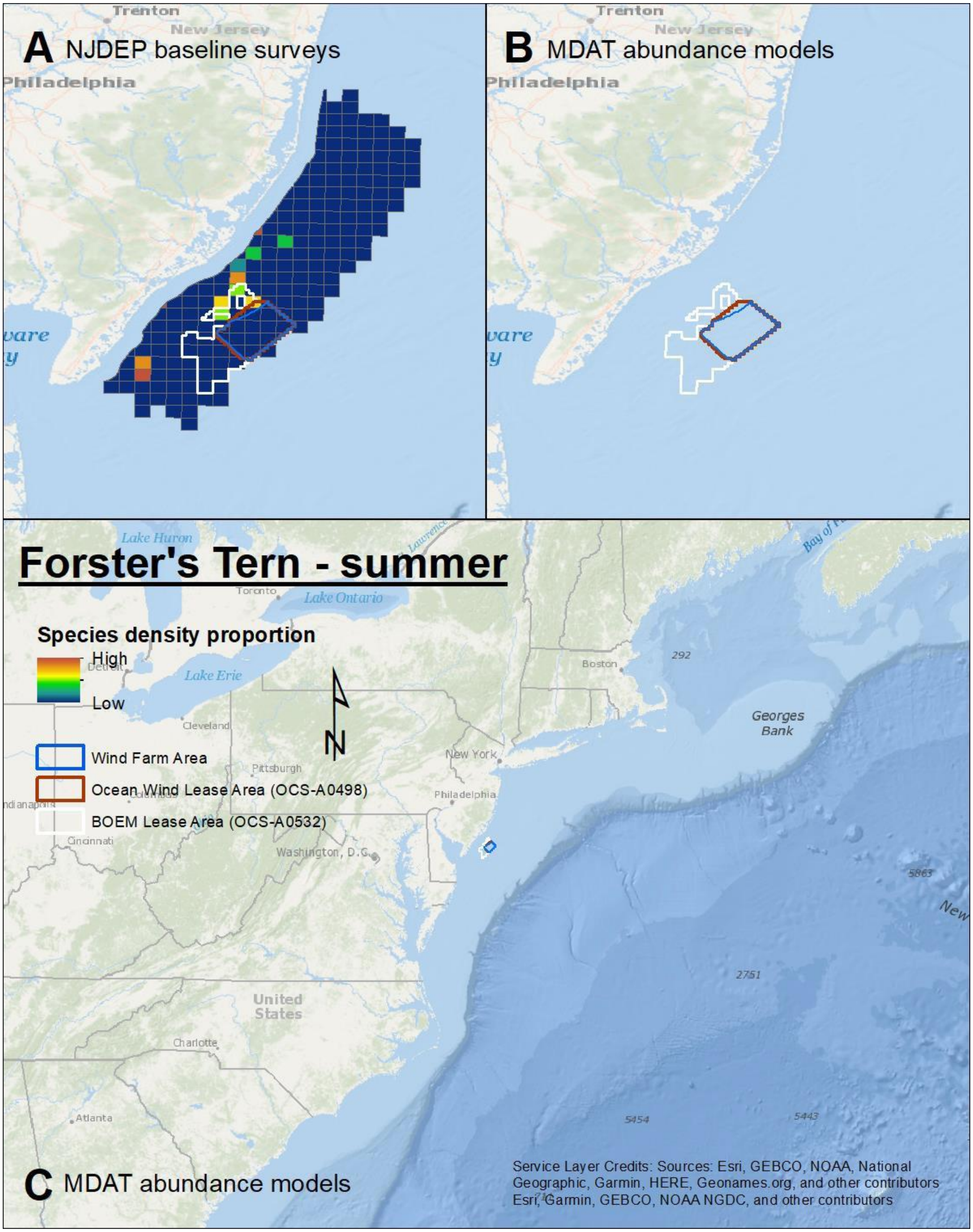
Map 117. Summer Common Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



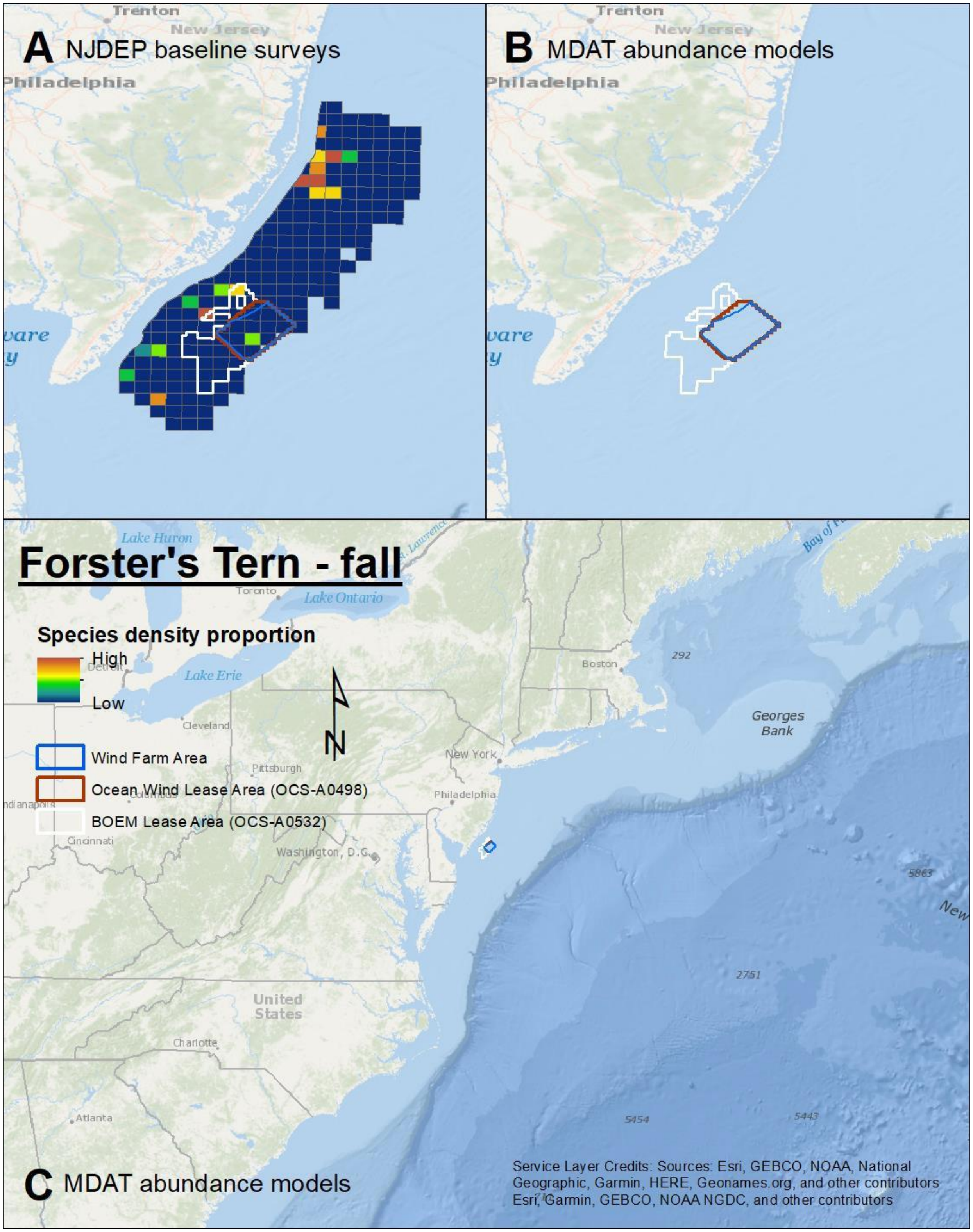
Map 118. Fall Common Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



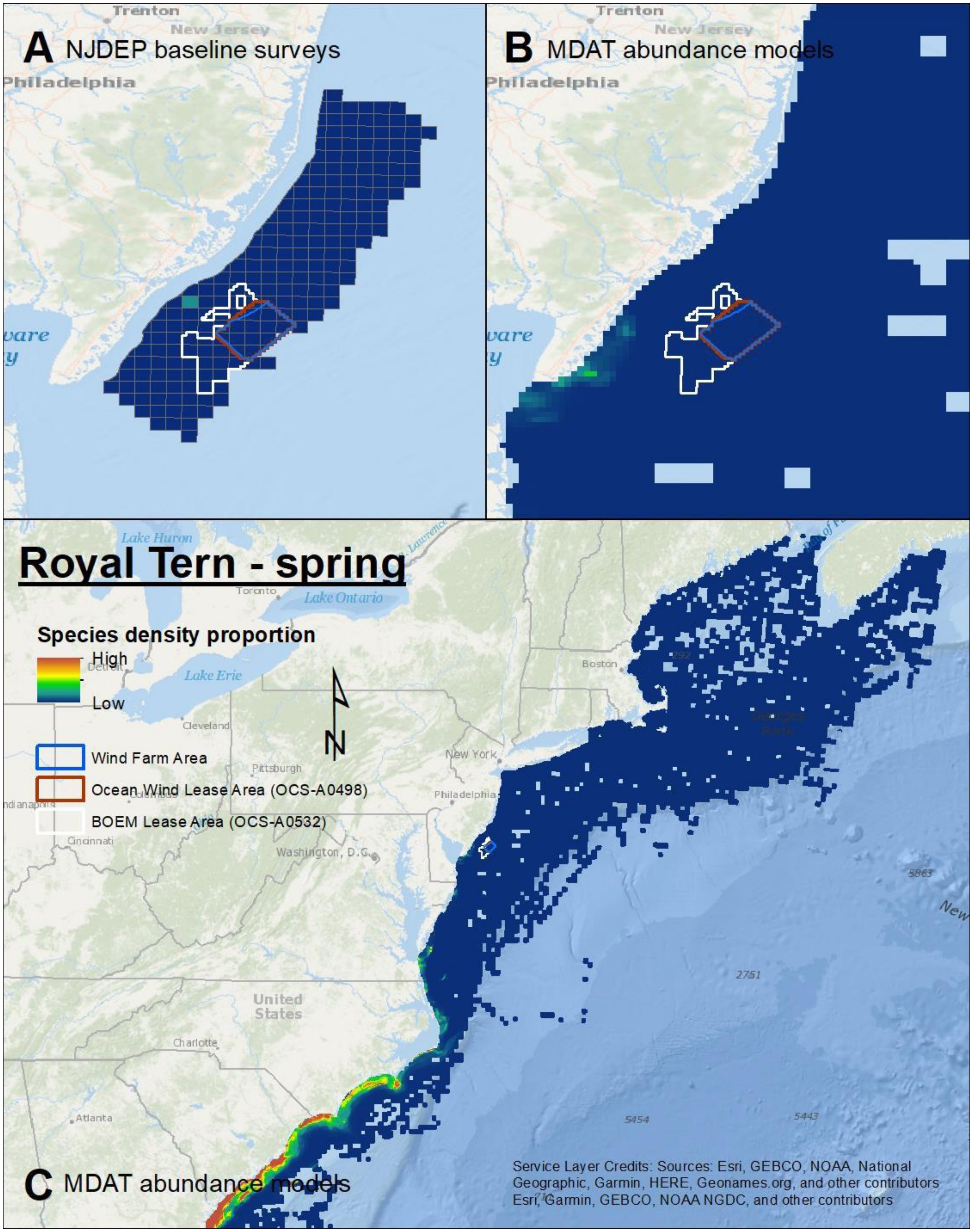
Map 119. Spring Forster's Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



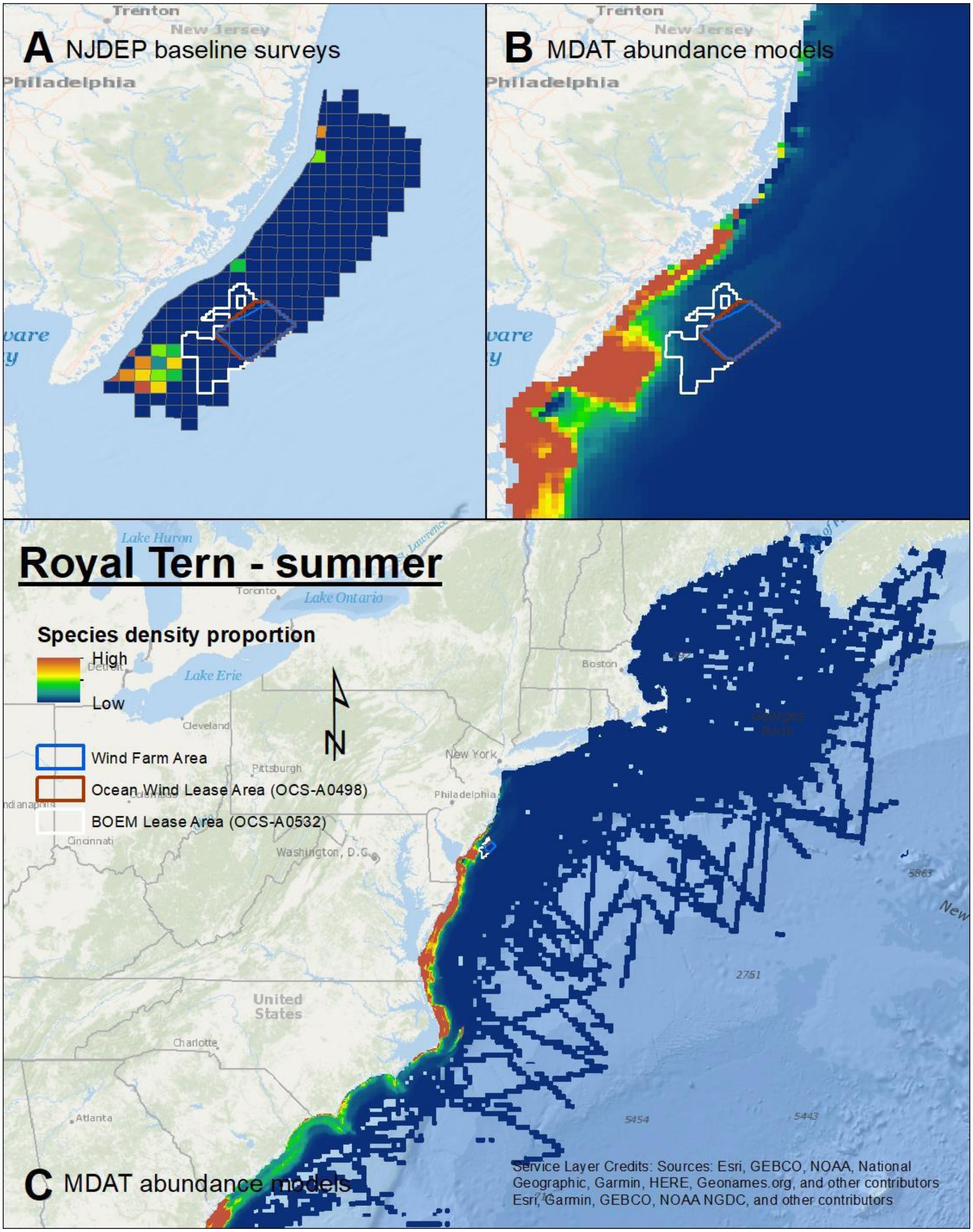
Map 120. Summer Forster's Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



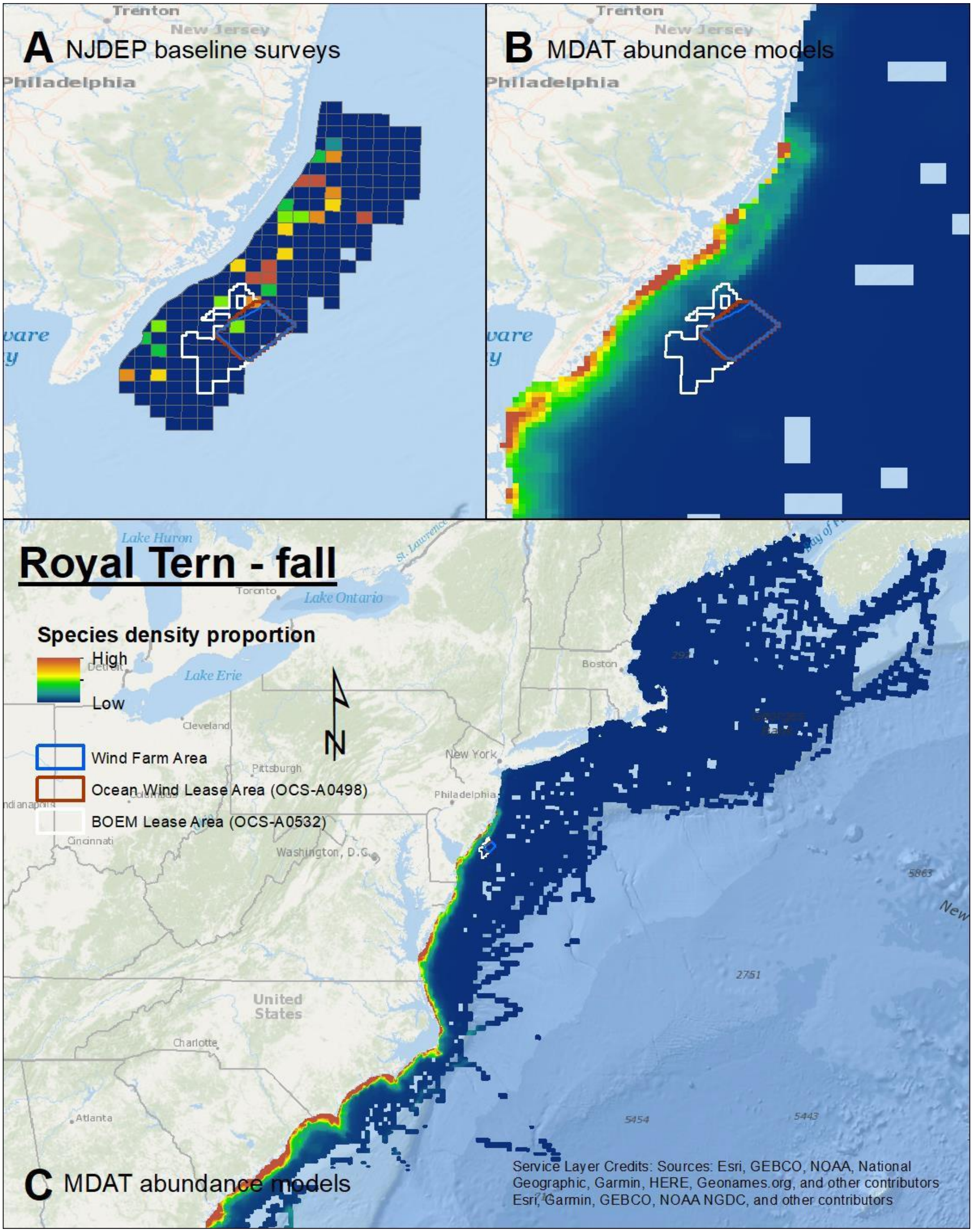
Map 121. Fall Forster's Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



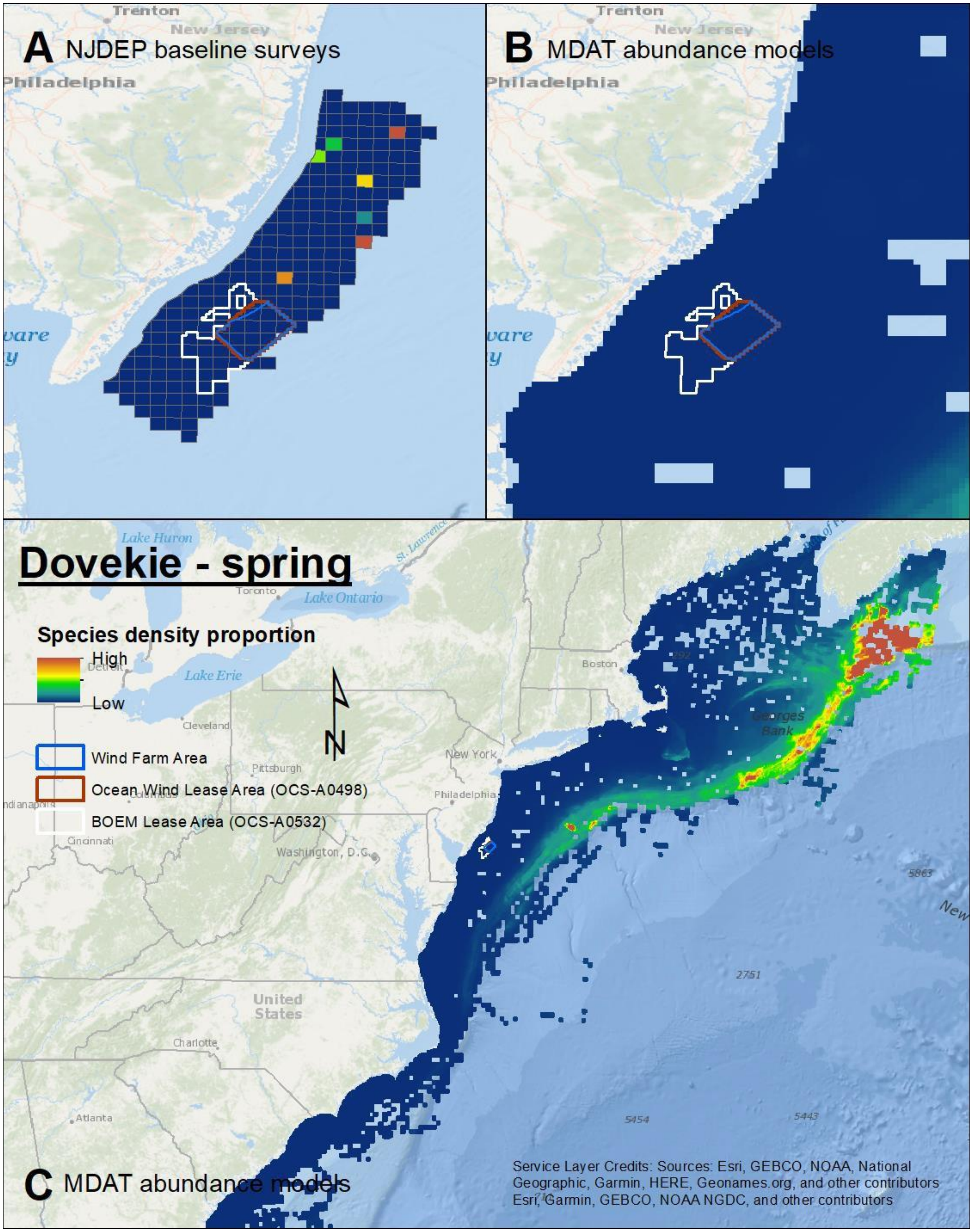
Map 122. Spring Royal Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



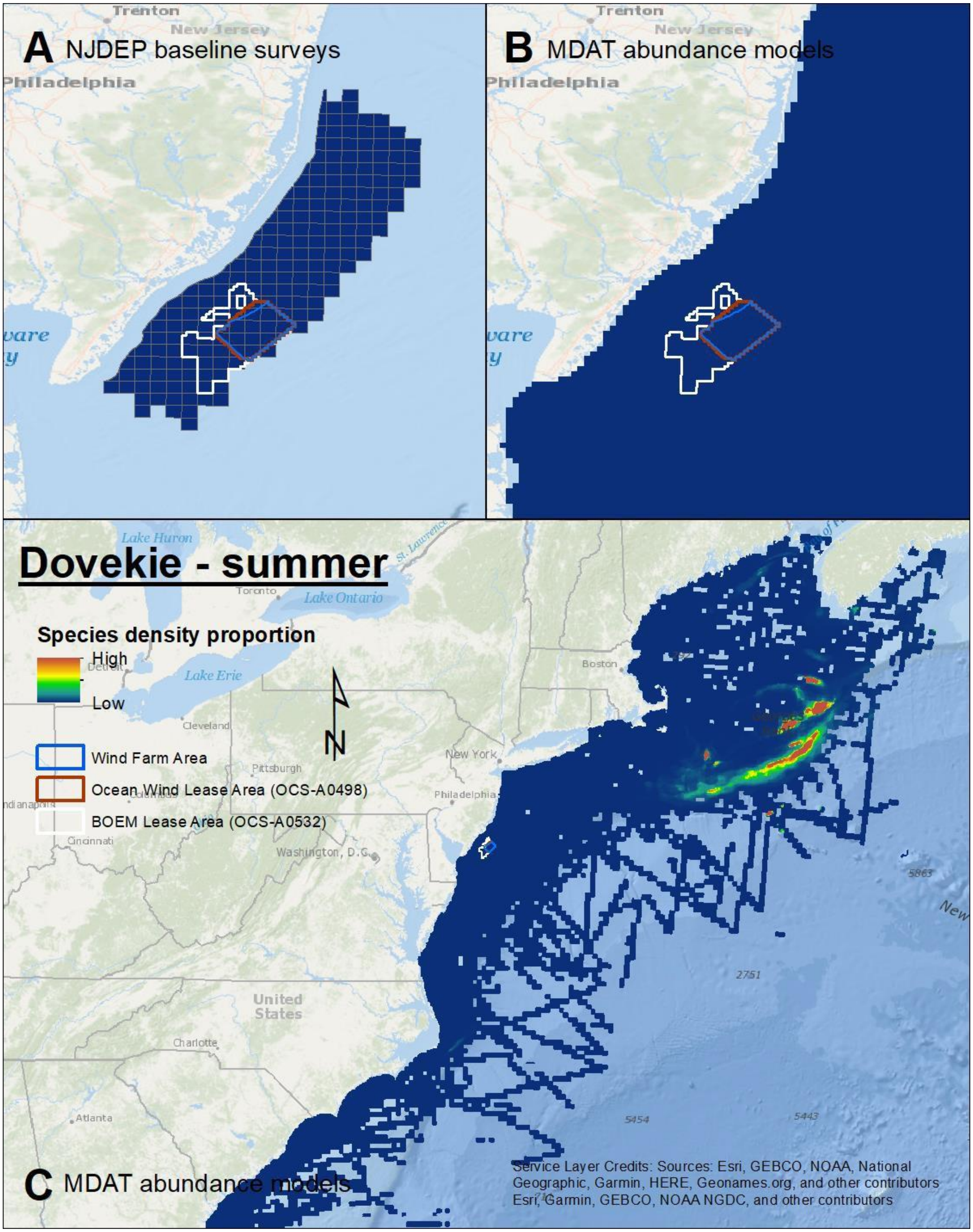
Map 123. Summer Royal Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



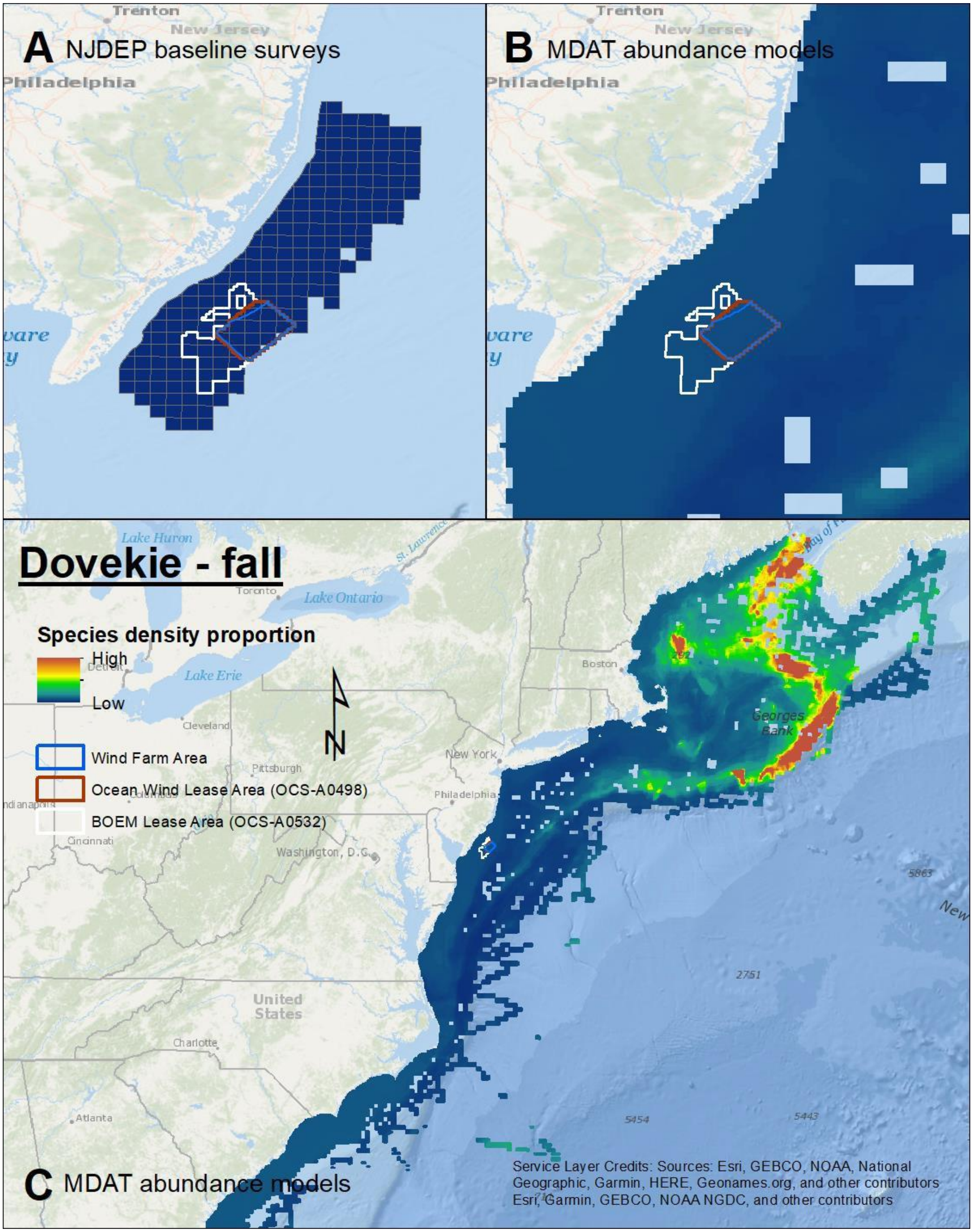
Map 124. Fall Royal Tern density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



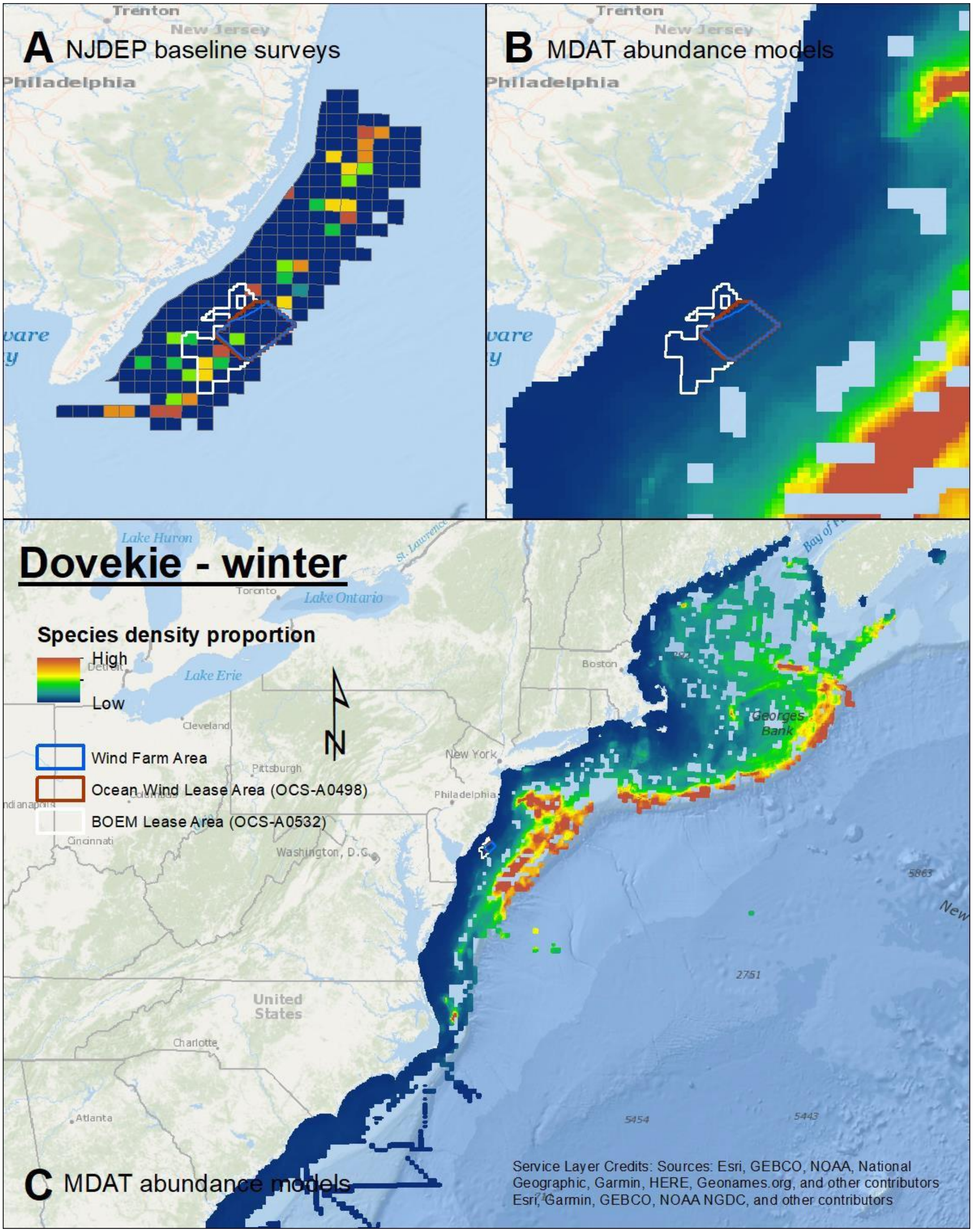
Map 125. Spring Dovekie density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



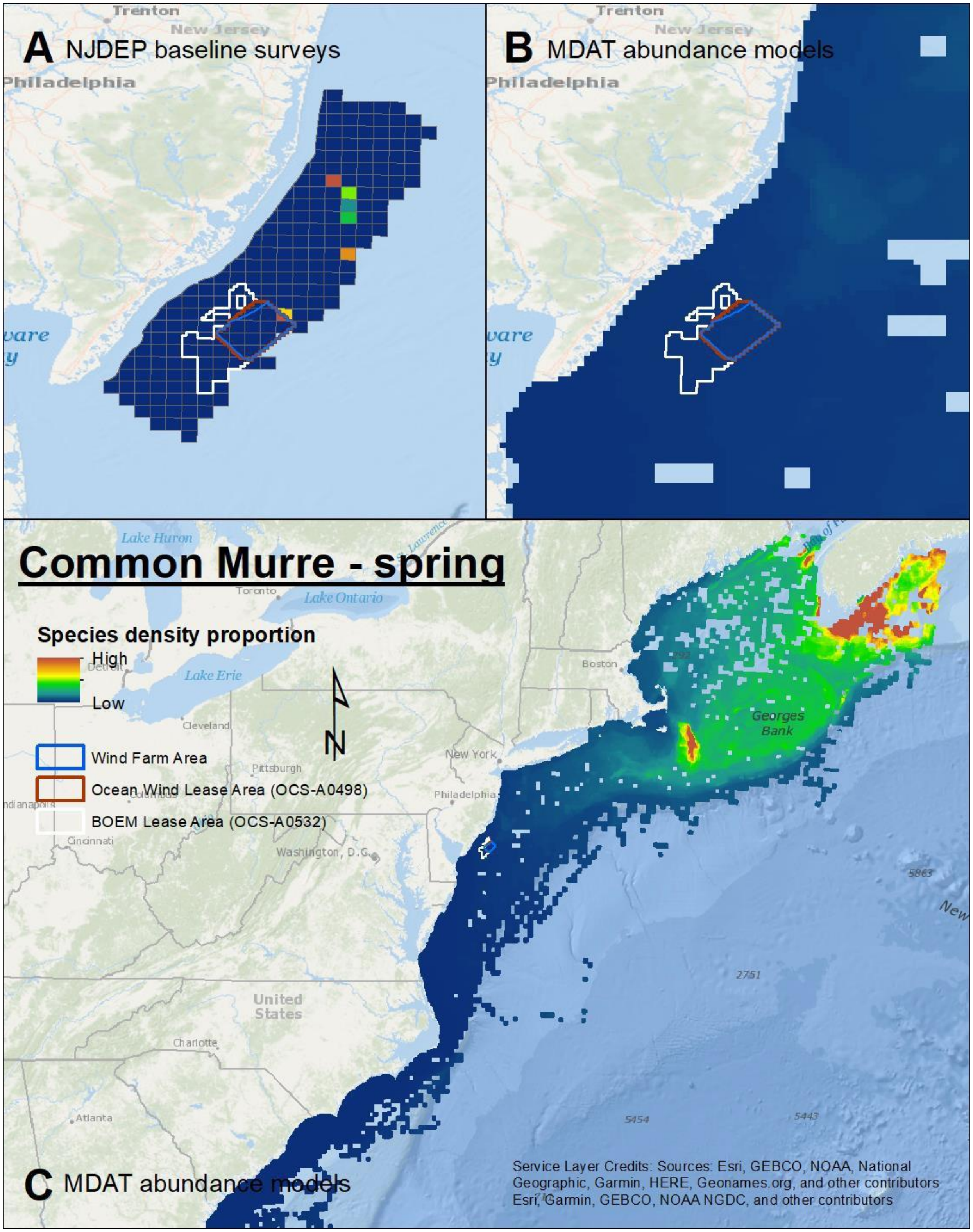
Map 126. Summer Dovekie density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



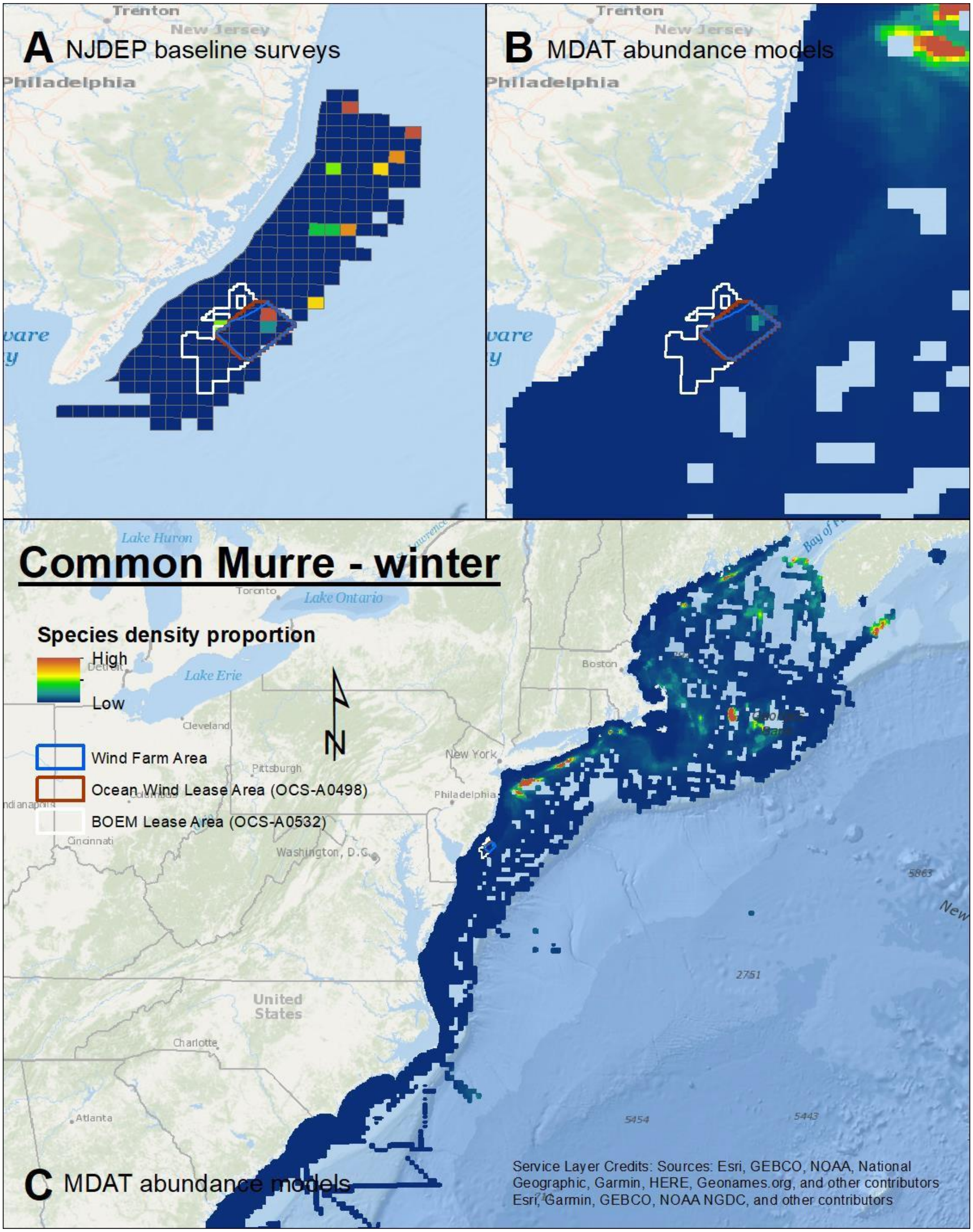
Map 127. Fall Dovekie density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



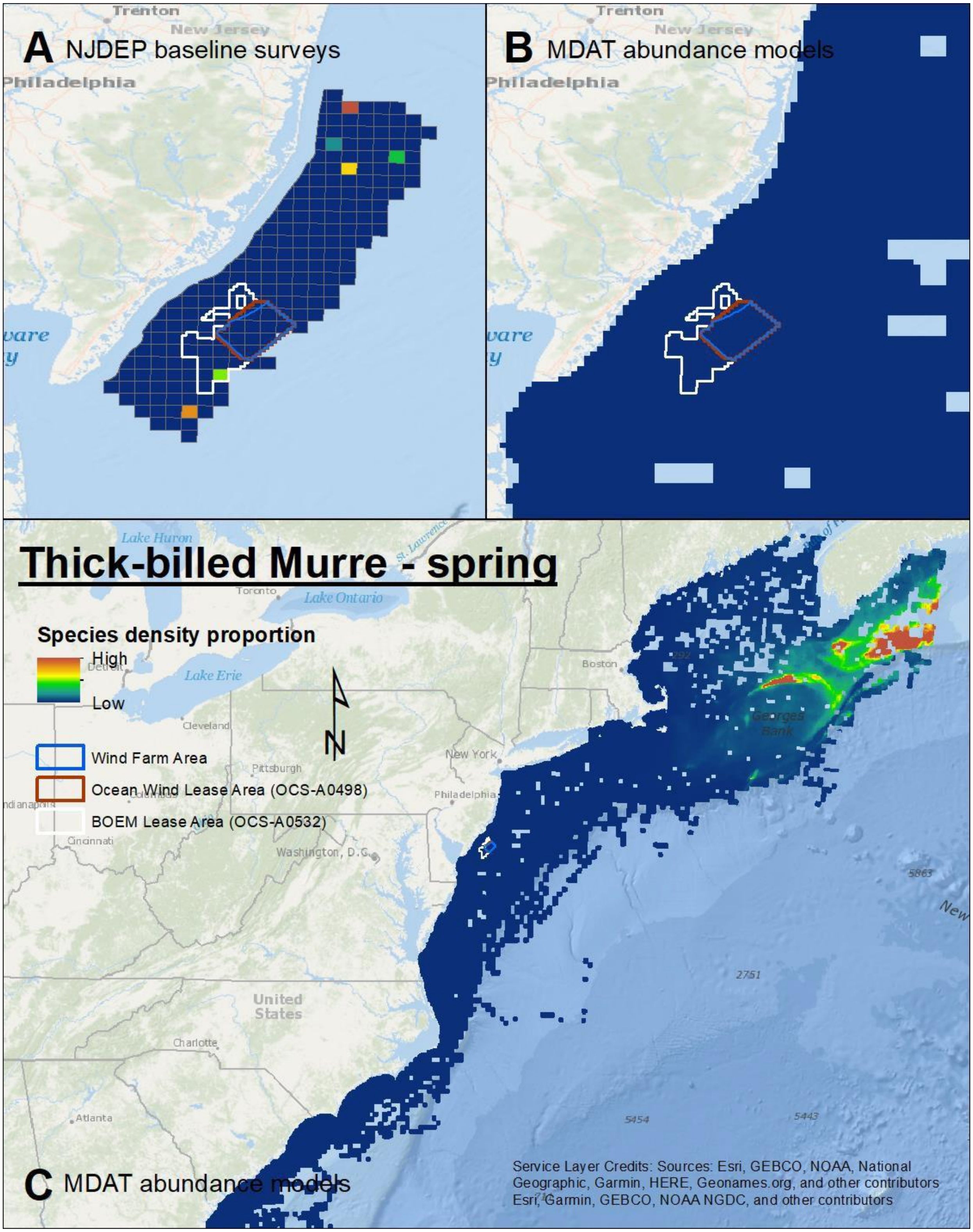
Map 128. Winter Dovekie density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



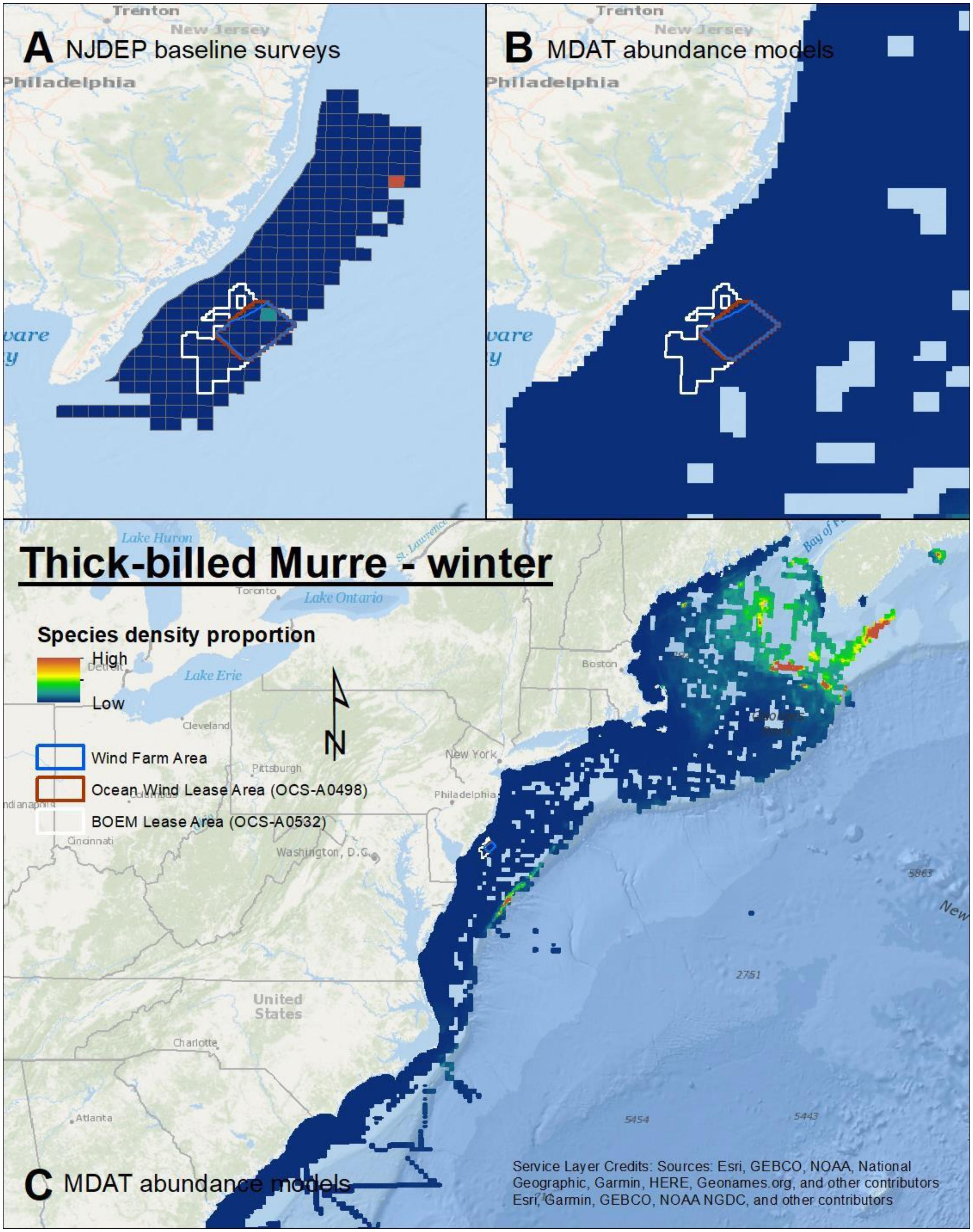
Map 129. Spring Common Murre density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



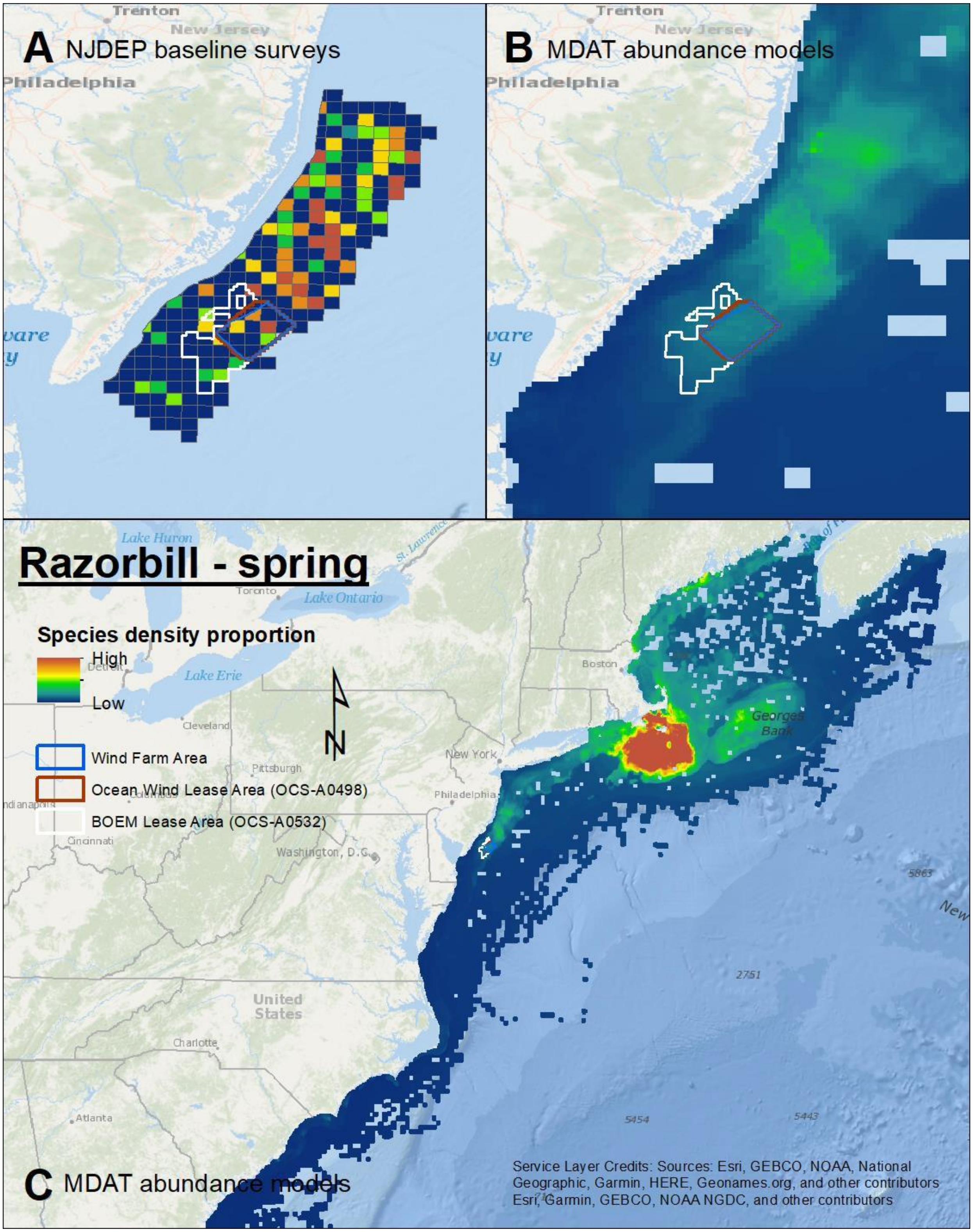
Map 130. Winter Common Murre density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



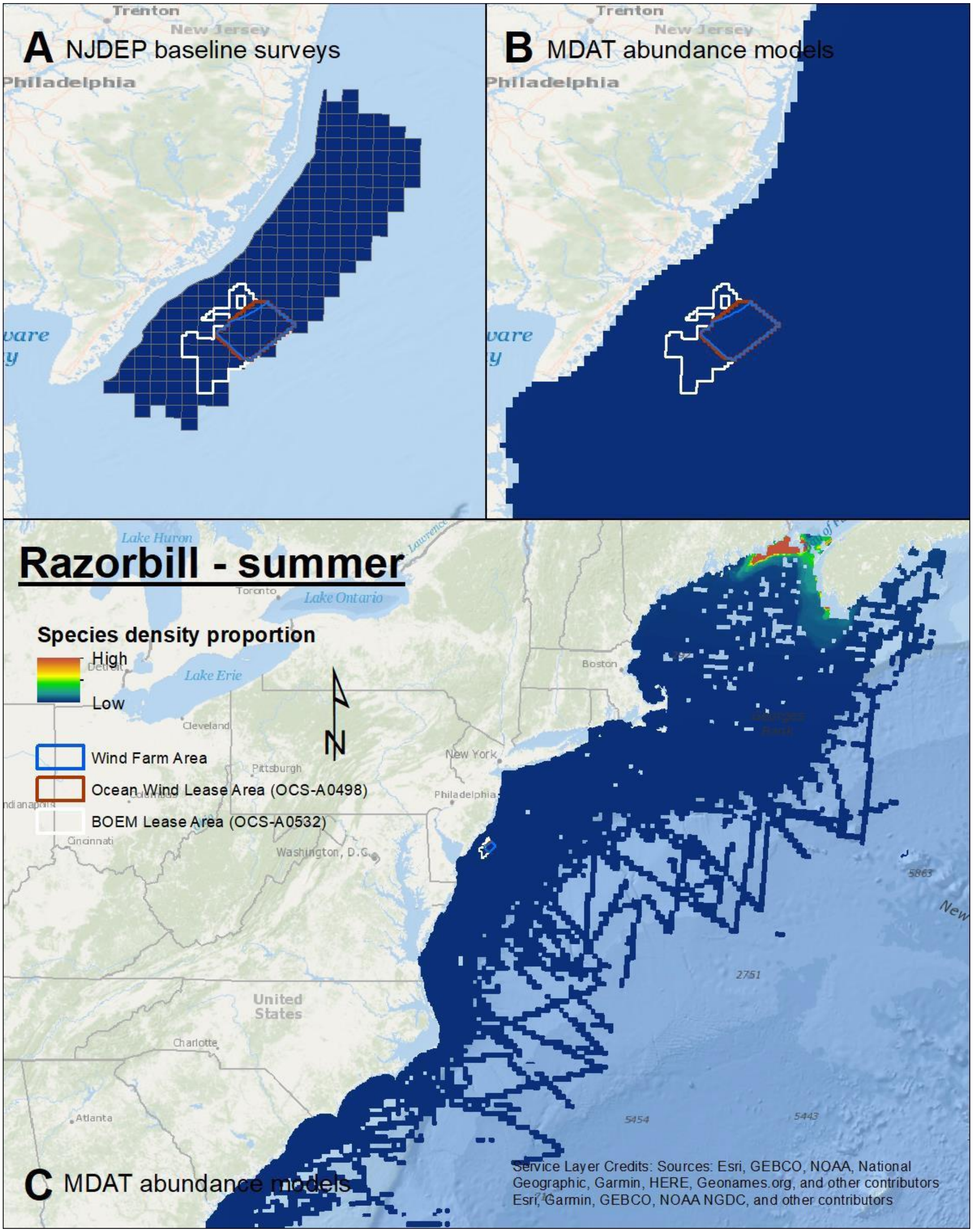
Map 131. Spring Thick-billed Murre density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



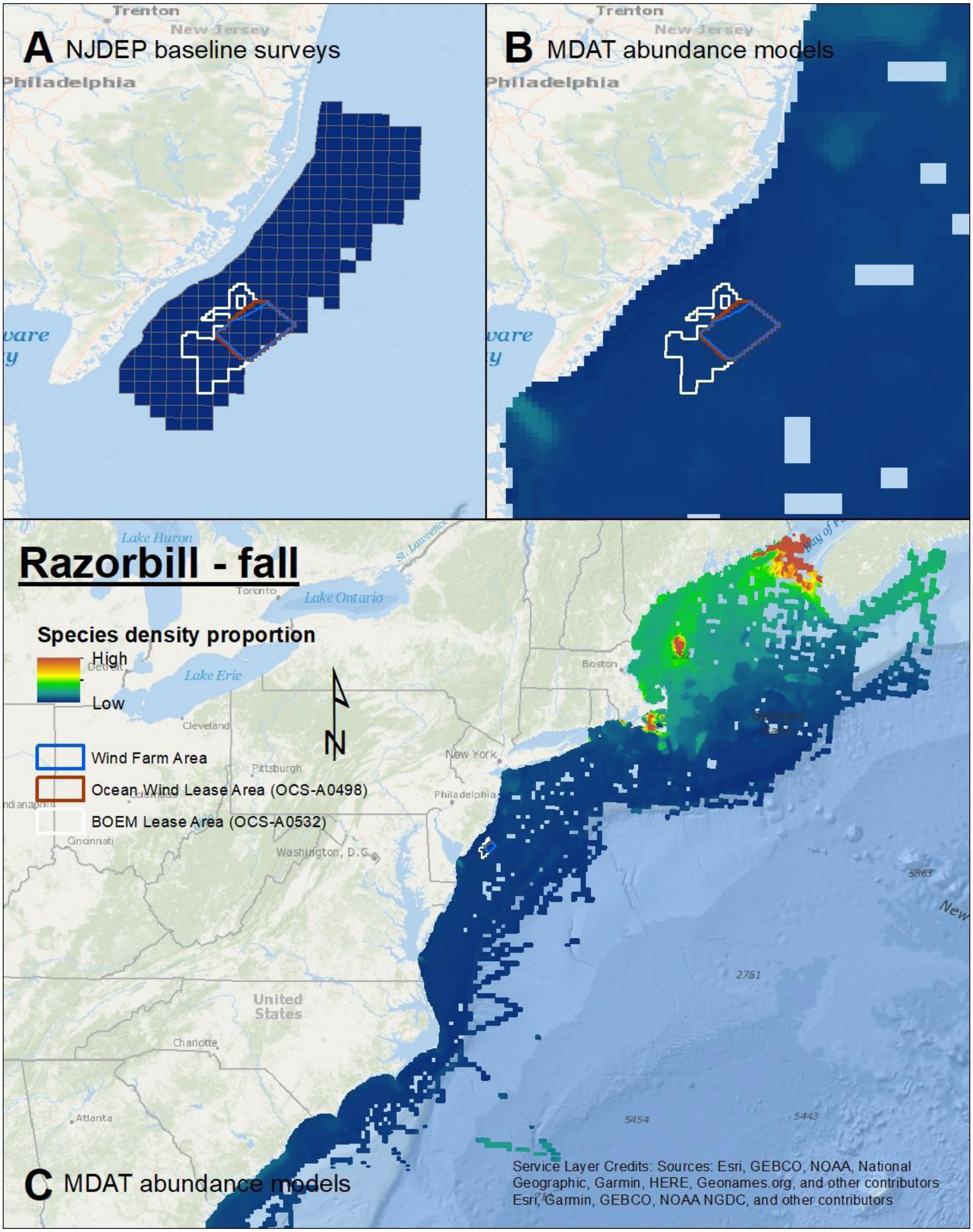
Map 132. Winter Thick-billed Murre density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



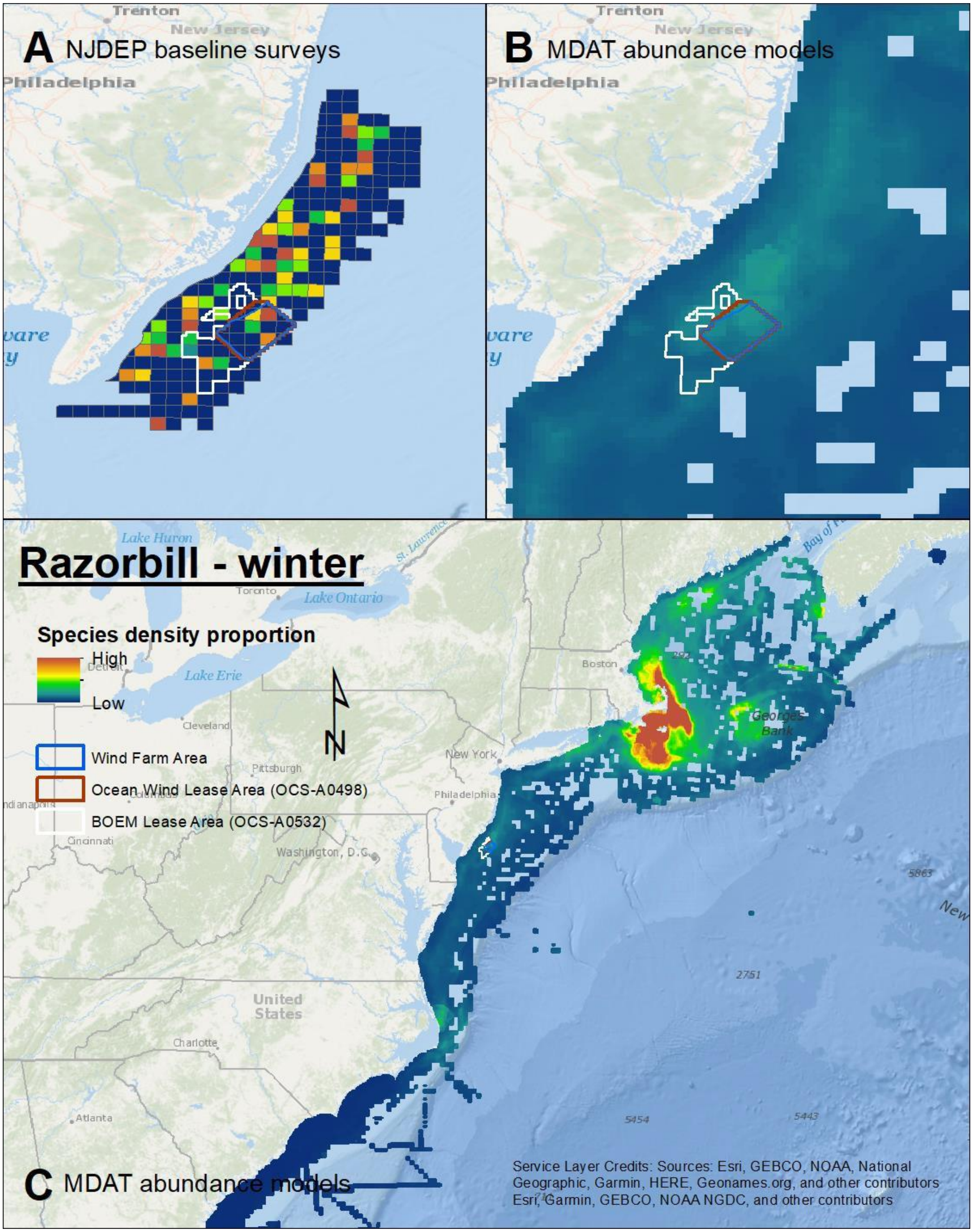
Map 133. Spring Razorbill density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



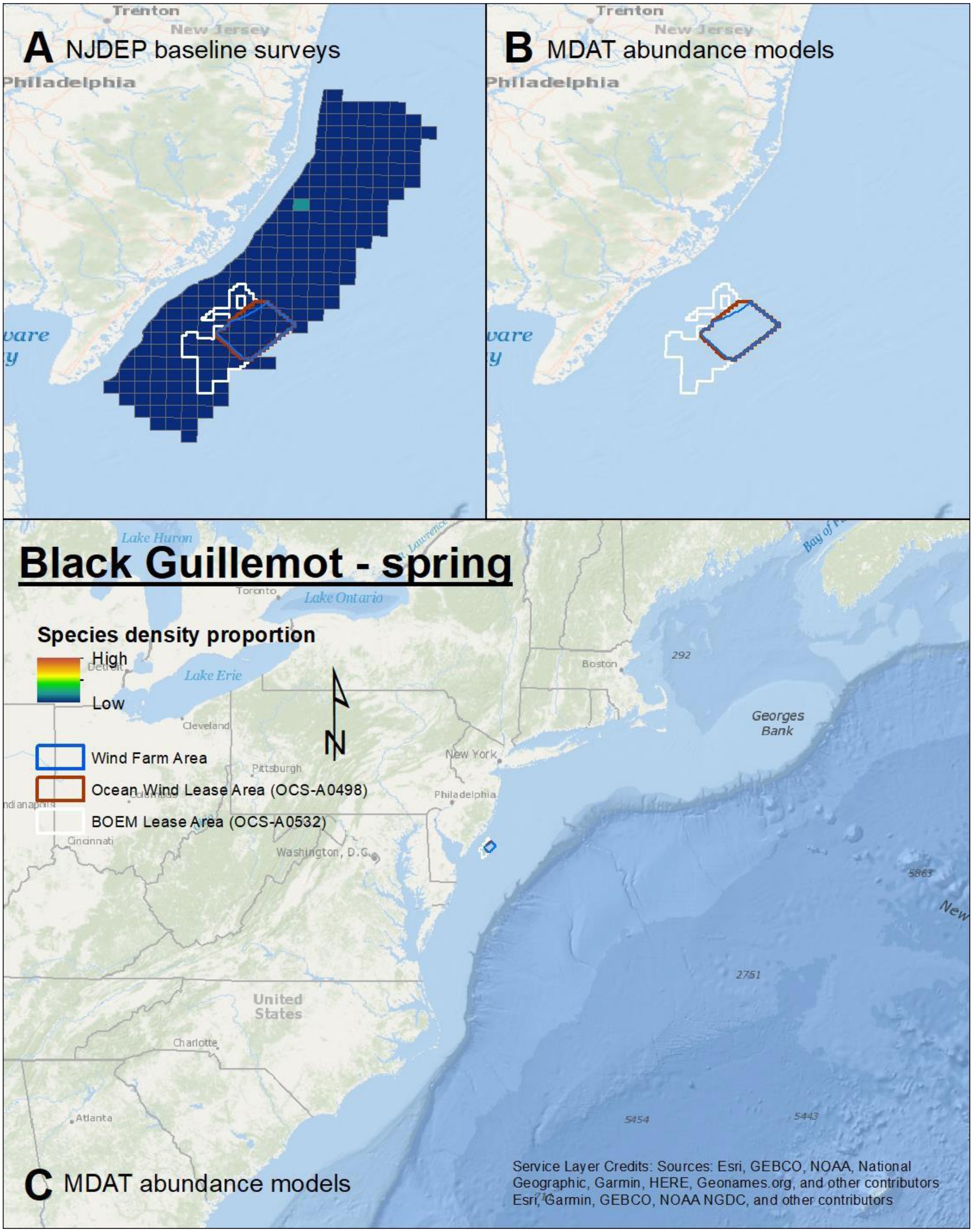
Map 134. Summer Razorbill density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



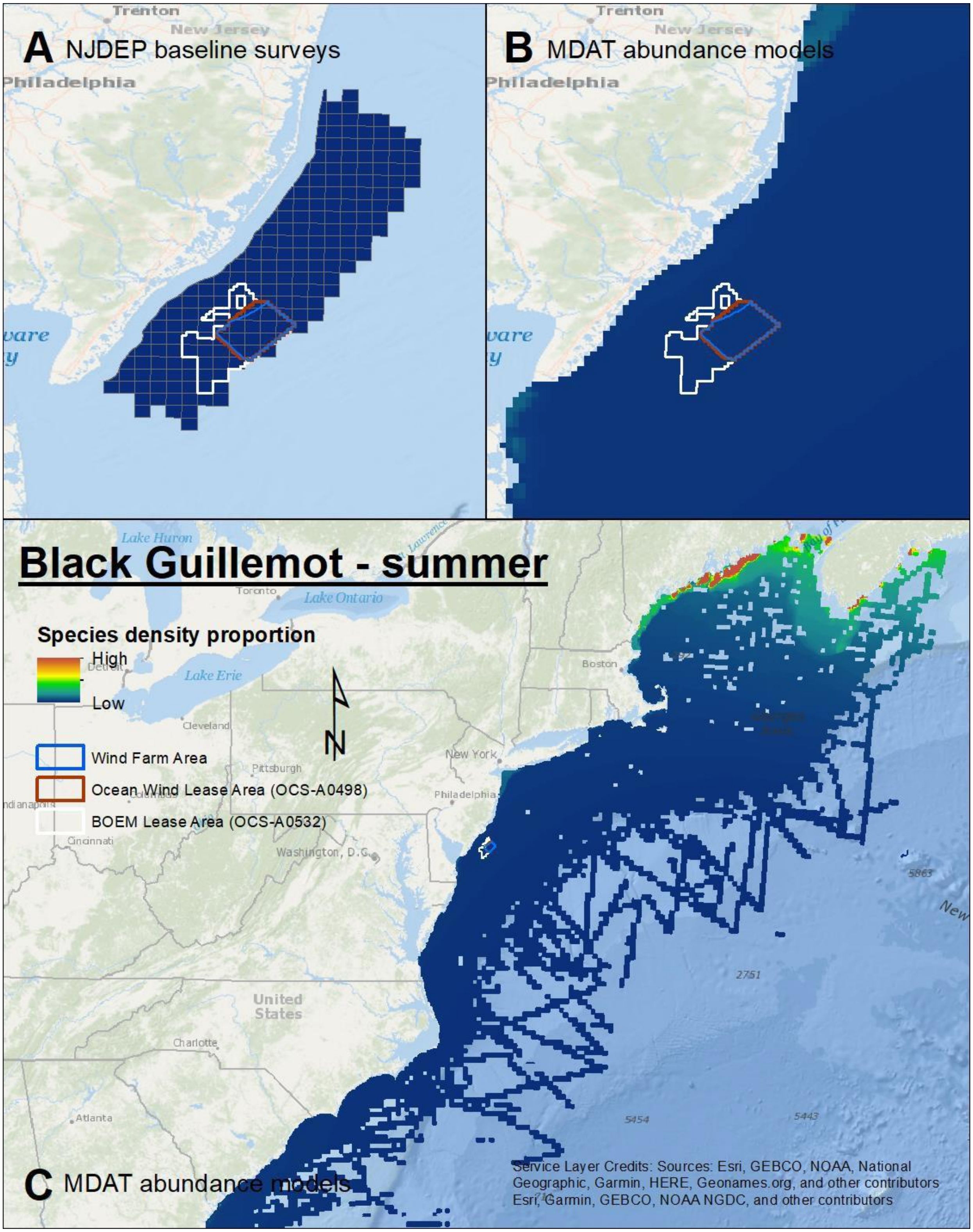
Map 135. Fall Razorbill density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



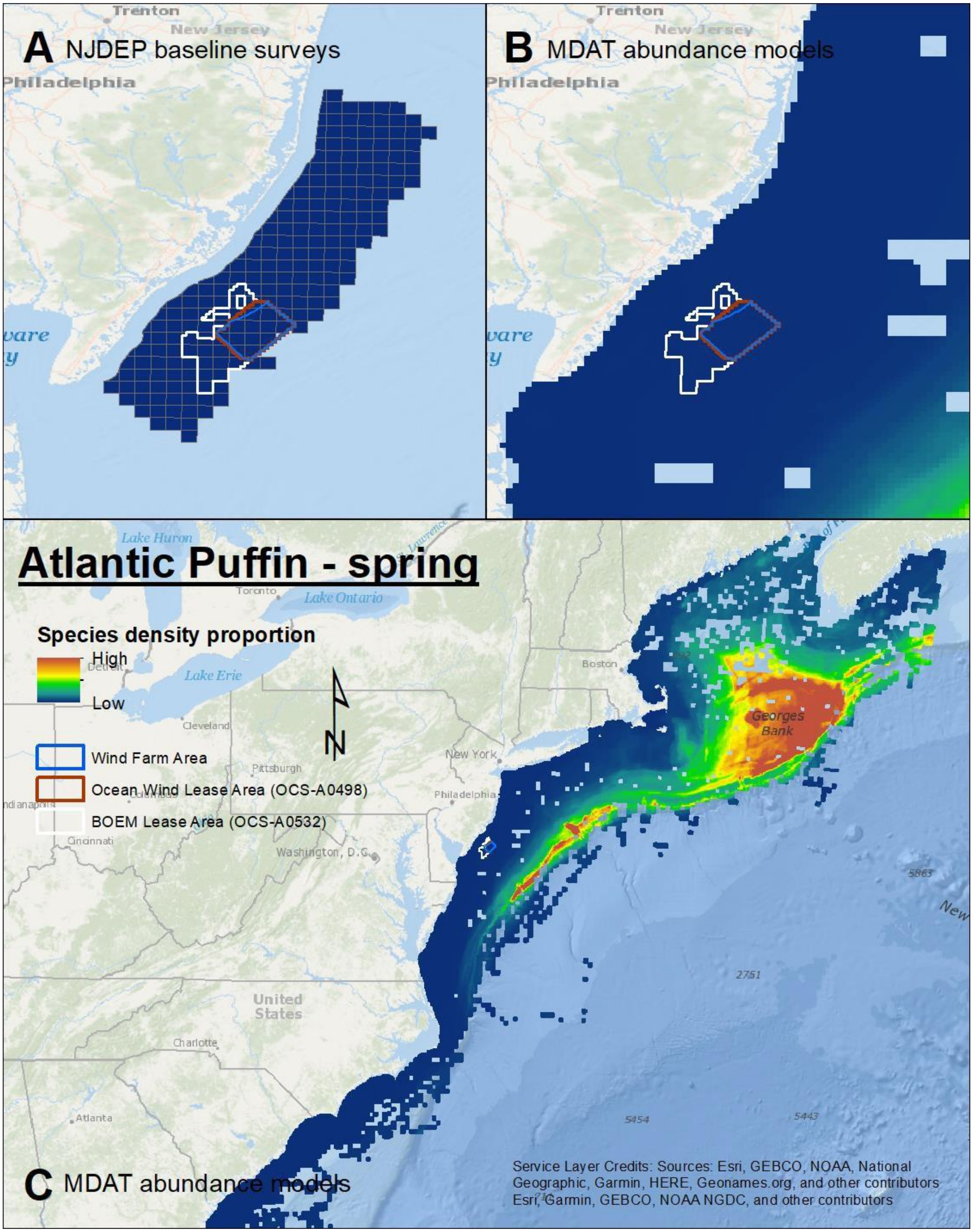
Map 136. Winter Razorbill density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



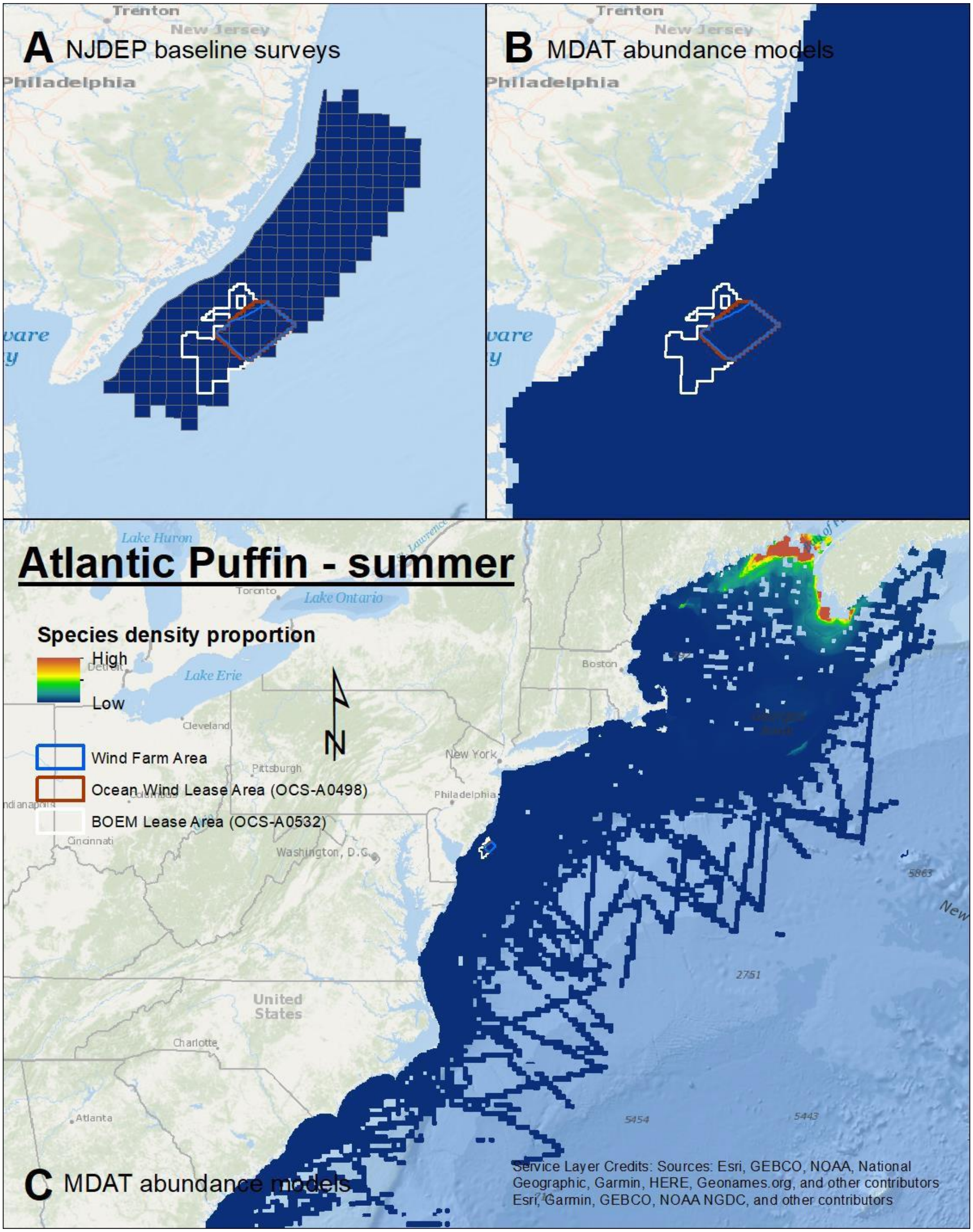
Map 137. Spring Black Guillemot density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



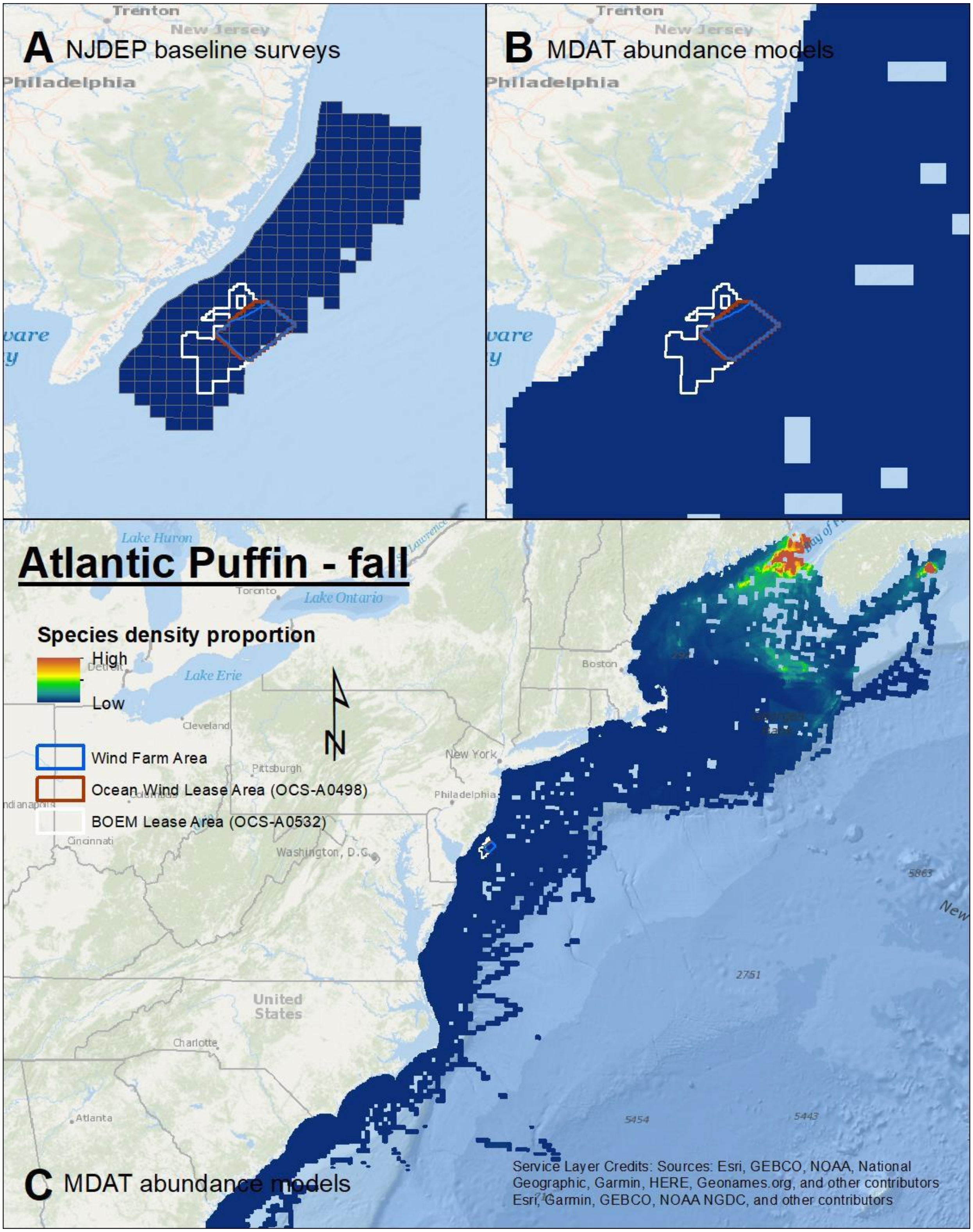
Map 138. Summer Black Guillemot density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



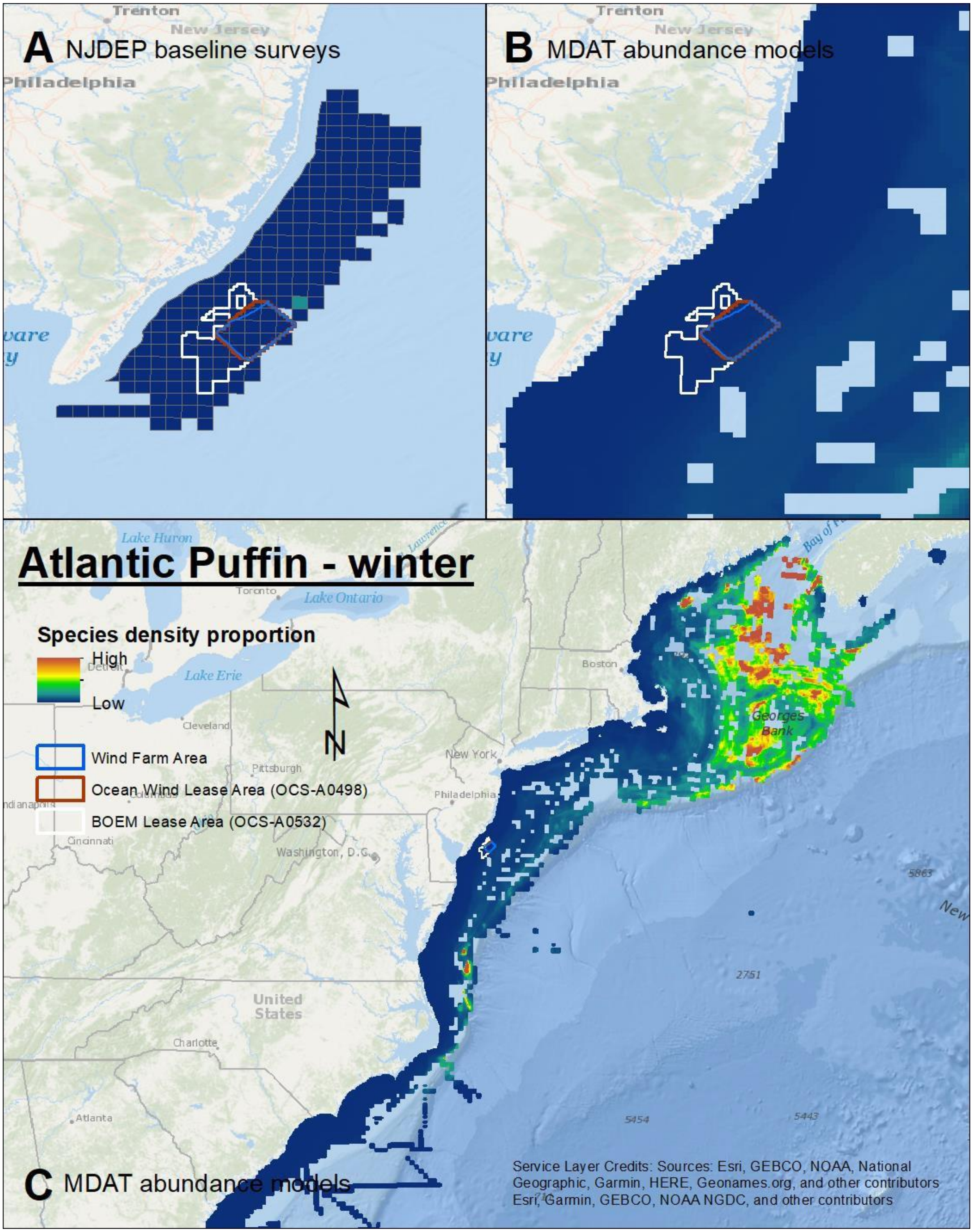
Map 139. Spring Atlantic Puffin density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



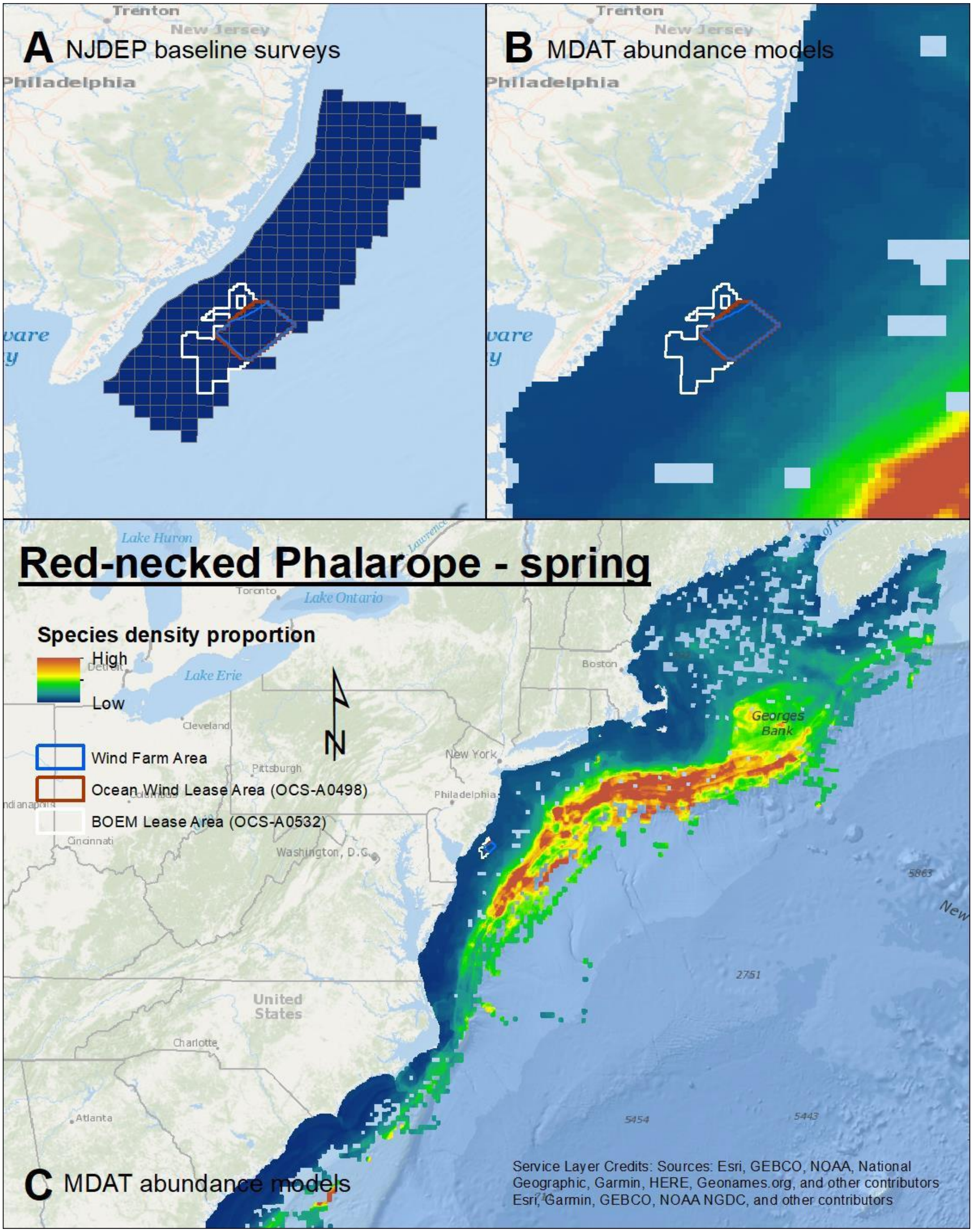
Map 140. Summer Atlantic Puffin density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



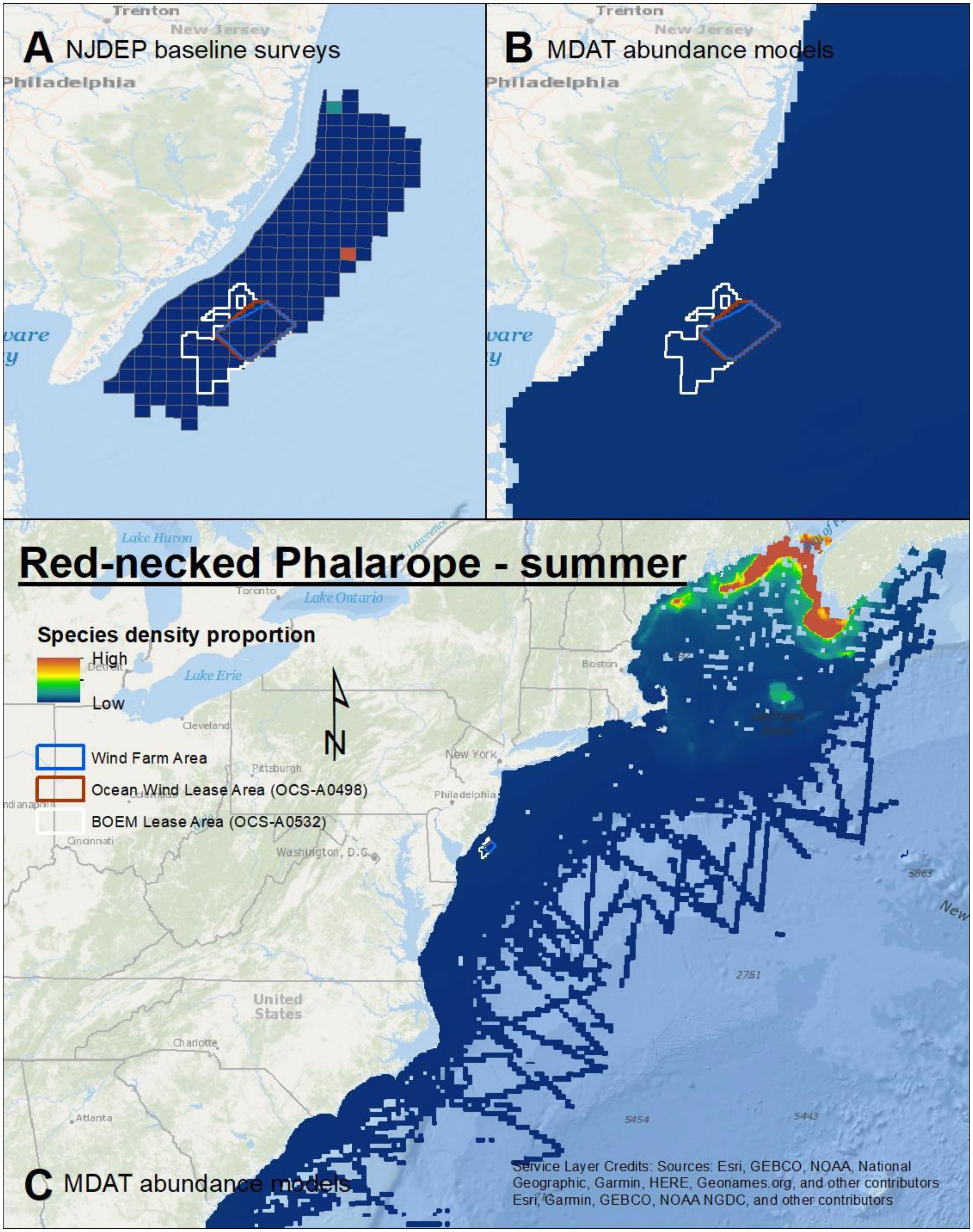
Map 141. Fall Atlantic Puffin density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



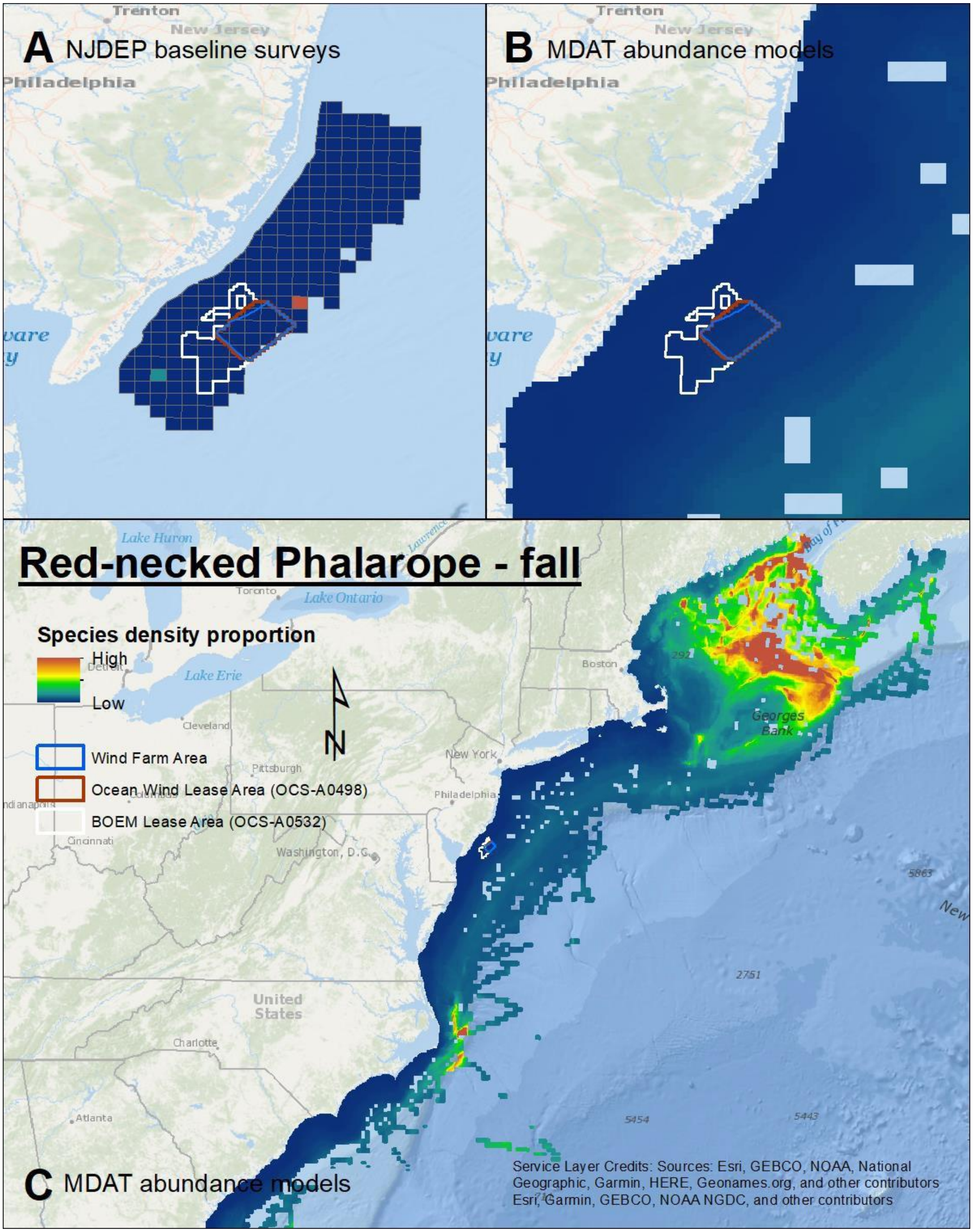
Map 142. Winter Atlantic Puffin density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



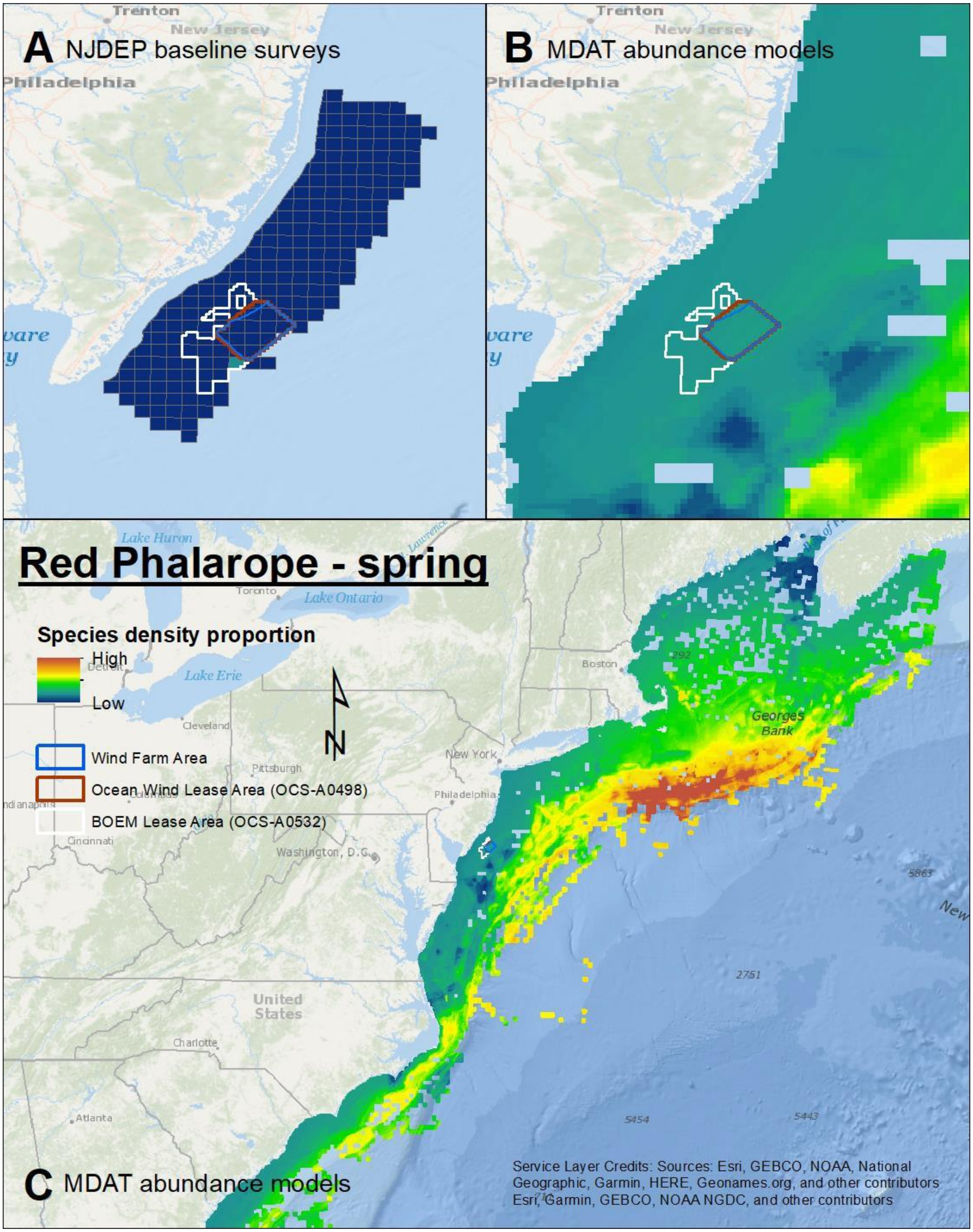
Map 143. Spring Red-necked Phalarope density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



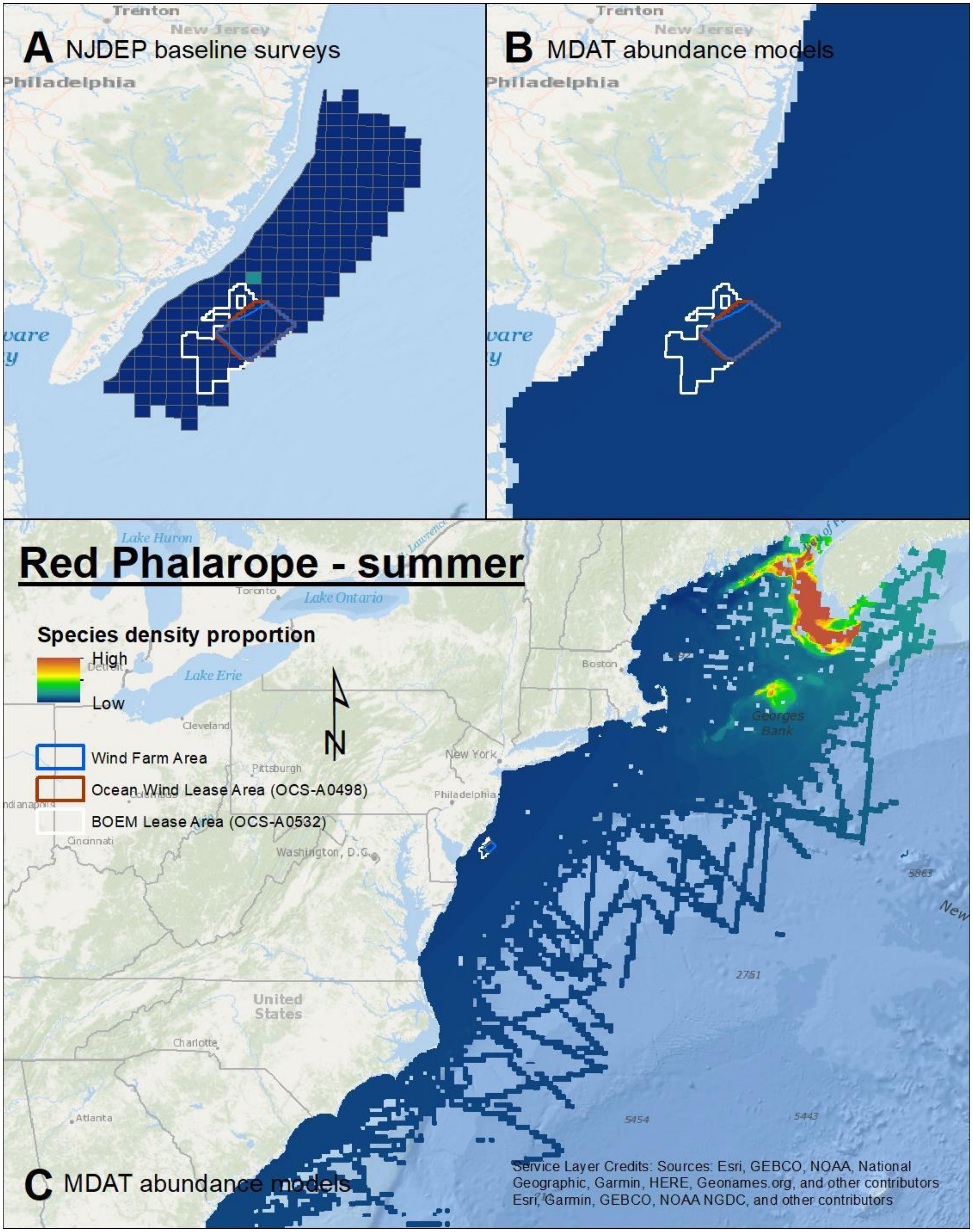
Map 144. Summer Red-necked Phalarope density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



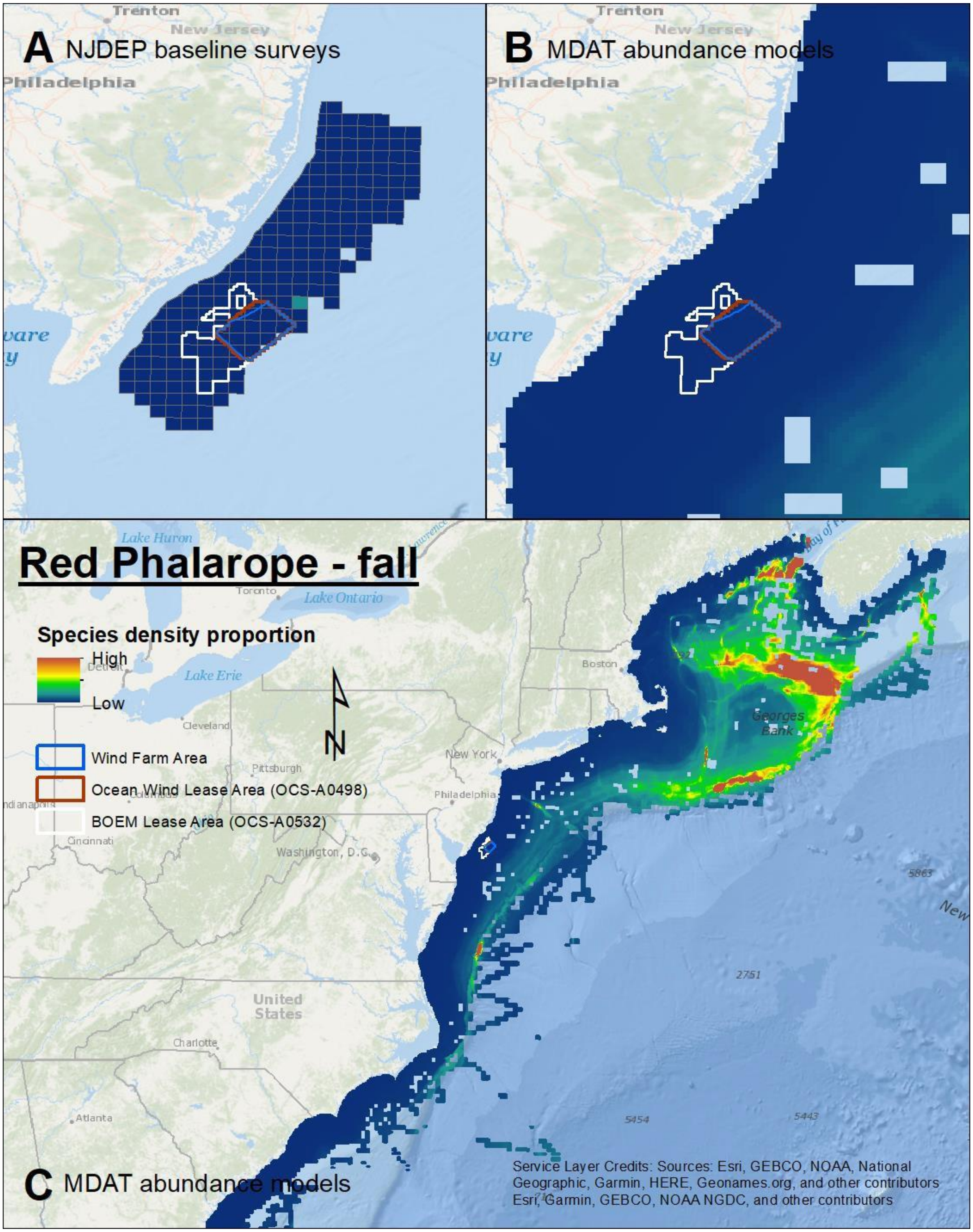
Map 145. Fall Red-necked Phalarope density proportions in the NJDEP baseline survey data (A) and the MDAT data at local (B) and regional scales (C). The scale for all maps is representative of relative spatial variation in the sites within the season for each data source.



Map 146. Spring Red Phalarope density proportions in the NJDEP 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 147. Summer Red Phalarope density proportions in the NJDEP 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 148. Fall Red Phalarope density proportions in the NJDEP 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.

Part VI: Seasonal Species Densities

Below are detailed the seasonal species densities (counts/km2 of survey transect) within the Ocean Wind Wind Farm Area and the NJDEP survey area on the Atlantic OCS. These data are only for marine birds and are supplemental to the annual counts detailed in Table 3-18 (Part III: Birds - Offshore).

Taxonomic Grouping	Species	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	Num. observations	Total count
		Mean densities (total count/sq. km)											
		Ocean Wind Wind Farm Area					NJDEP OCS survey area						
Seaducks	Common Eider	0	0	0	0	0	<0.001	0	0	0	0.004	3	6
	Surf Scoter	0.017	0	0	0	0.051	0.460	0.102	0.565	0	1.028	137	2574
	White-winged Scoter	0.056	0.355	0	0	0	0.038	0.120	0.056	0	0.006	59	238
	Black Scoter	0.035	0.055	0.218	0	0	0.283	0.222	0.473	0	0.475	103	1530
	Long-tailed Duck	0	0	0	0	0	0.083	0.276	0.160	0	0	61	393
	Red-breasted Merganser	0.005	0.063	0	0	0	0.004	0.009	0.004	0	0.003	9	18
	Unidentified Scoter	0	0	0	0	0	0.086	0.044	0.219	0	0.180	51	532
Loons	Red-throated Loon	0.071	0.045	0.225	0	0.053	0.229	0.369	0.449	0	0.071	651	929
	Common Loon	0.389	0.173	0.848	0.942	0.222	0.480	0.617	0.869	0.100	0.296	1619	2221
	Unidentified Loon	0	0	0	0	0	0.002	0.006	0.002	0	<0.001	7	9
Shearwaters and Petrels	Wilson's Storm-Petrel	0.149	0	0	0.436	0.043	0.477	0	0	2.478	0.143	1174	2566
	Leach's Storm-Petrel	0	0	0	0	0	<0.001	0	0	0.001	0	2	2
	Northern Fulmar	0	0	0	0	0	<0.001	0.001	0	0	<0.001	3	3
	Cory's Shearwater	0.025	0	0	0.030	0.087	0.042	0	0	0.140	0.034	174	220
	Sooty Shearwater	0	0	0	0	0	0.001	0	0	0.007	0	7	8
	Great Shearwater	0.004	0	0	0.012	0.007	0.005	0	0	0.006	0.016	31	33
	Manx Shearwater	0	0	0	0	0	0.001	<0.001	0.005	<0.001	0	5	6

Taxonomic Grouping	Species	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	Num. observations	Total count
	Audubon's Shearwater	0	0	0	0	0	<0.001	0	0	0	0.001	1	1
	Unidentified Shearwater	0	0	0	0	0	<0.001	0	0	0	0.001	1	1
	Unidentified Storm-petrel	0.004	0	0	0	0.016	<0.001	0	0	0.001	0.001	4	4
Gannet	Northern Gannet	0.663	0.406	1.123	0.133	1.125	1.595	1.768	1.976	0.274	1.822	4276	7478
Cormorants and Pelicans	Double-crested Cormorant	0	0	0	0	0	0.194	0.017	0.040	0.010	0.822	24	1348
	Great Cormorant	0	0	0	0	0	<0.001	0	0	0	0.002	1	3
	Brown Pelican	0	0	0	0	0	0.001	0	0	0.004	<0.001	7	8
Gulls	Pomarine Jaeger	0	0	0	0	0	<0.001	0	0	0	0.001	2	2
	Parasitic Jaeger	0.003	0	0	0	0.012	0.004	0	<0.001	0.002	0.013	23	24
	Black-legged Kittiwake	0.003	0.010	0	0	0	0.024	0.030	0	0	0.158	86	146
	Sabine's Gull	0	0	0	0	0	0.001	0	0	0.008	<0.001	2	2
	Bonaparte's Gull	0.074	0.167	0.206	0	0.050	0.121	0.187	0.179	0	0.132	188	554
	Little Gull	0	0	0	0	0	<0.001	0	<0.001	0	<0.001	2	2
	Laughing Gull	0.395	0	0.112	0.632	1.001	0.573	0.007	0.174	0.932	1.264	1654	3279
	Ring-billed Gull	0	0	0	0	0	0.015	0.018	0.002	0	0.065	49	59
	Herring Gull	0.450	0.691	1.046	0.052	0.198	0.555	0.554	1.028	0.086	0.481	1678	2605
	Iceland Gull	0	0	0	0	0	<0.001	0.001	0	0	0	1	1
	Lesser Black-backed Gull	0	0	0	0	0	0.001	0	0.002	<0.001	0.002	8	8
	Great Black-backed Gull	0.273	0.790	0.182	0.022	0.218	0.295	0.252	0.294	0.147	0.443	982	1259
	Unidentified small gull	0	0	0	0	0	0.002	0.004	0	0	0	1	3
	Unidentified Jaeger	0	0	0	0	0	<0.001	0	0	<0.001	0	1	1
	Unidentified Large Gull	0.022	0.103	0	0	0.009	0.022	0.042	0.017	0.001	0.017	40	105

Taxonomic Grouping	Species	annual	winter	spring	summer	fall	annual	winter	spring	summer	fall	Num. observations	Total count
Terns	Least Tern	0	0	0	0	0	0.002	0	0.001	0.004	0	2	2
	Caspian Tern	0	0	0	0	0	<0.001	0	<0.001	0	<0.001	2	2
	Black Tern	0	0	0	0	0	0.001	0	0	0.004	<0.001	6	9
	Common Tern	0.179	0	1.060	0.205	0.033	0.276	0	0.235	0.776	0.105	787	1484
	Forster's Tern	0.005	0	0	0	0.025	0.073	0	0.045	0.018	0.336	98	431
	Royal Tern	0.001	0	0	0	0.007	0.020	0	<0.001	0.052	0.029	66	79
	Unidentified small Tern	0.022	0	0.051	0.060	0	0.022	0	0.044	0.034	0.031	59	136
Auks	Dovekie	0.002	0.009	0	0	0	0.018	0.066	0.008	0	0	57	95
	Common Murre	0.010	0.028	0.032	0	0	0.006	0.018	0.009	0	0	20	22
	Thick-billed Murre	0.002	0.011	0	0	0	0.002	0.005	0.005	0	0	8	8
	Razorbill	0.056	0.108	0.271	0	0	0.107	0.145	0.362	0	0	255	677
	Black Guillemot	0	0	0	0	0	<0.001	0	<0.001	0	0	1	1
	Atlantic Puffin	0	0	0	0	0	<0.001	0.001	0	0	0	1	1
	Unidentified Alcid	0.002	0.006	0	0	0	0.010	0.016	0.015	0	0	22	36