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Ecological Baseline Studies of the US Outer Continental Shelf

Final Report



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Final Report

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ABOUT THE COVER

The cover is a collage of images obtained during ultra-high-resolution aerial digital surveys.

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List of Abbreviations and Acronyms

A51	Fish spawning area SMZ 51
A53	Fish spawning area SMZ 53
APEM	APEM, Inc.
BOEM	Bureau of Ocean Energy Management
CCA	Charleston Call Area
ESA	Endangered Species Act
ESPIS	Environmental Studies Program Information System
FAA	Federal Aviation Administration
FHC	Flight height calculator
GPS	Global Positioning System
GSCA	Grand Strand Call Area
GSD	Ground sampling distance
KH	Kitty Hawk
MARCO	Mid-Atlantic Regional Council on the Ocean
MCAS	Marine Corps Air Station
MOA	Military Operating Area
NM	Nautical miles
Normandeau	Normandeau Associates, Inc.
OBIS-SEAMAP	Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations
OCS	Outer Continental Shelf
OSW	Offshore Wind Energy
QC	Quality control
RSZ	Rotor-swept zone
SASA	South Atlantic Survey Area
SMZ	Special Management Zone
SPS	Standard Positioning Service
WE	Wilmington East
WEA	Wind Energy Area
WW	Wilmington West

1 Summary

One of the largest information gaps associated with offshore wind (OSW) energy and the potential for wildlife impacts is the lack of long-term, consistent baseline data on wildlife distribution and abundance. It is critical to collect information before development of OSW energy projects because these data can highlight natural trends and fluctuations in species' abundance and distribution, which helps interpret changes in wildlife patterns after any development, inform the potential for impacts, and assist in siting decisions. As part of the Bureau of Ocean Energy Management's (BOEM's) commitment to science-based management of offshore energy resources, BOEM contracted Normandeau and its teaming partner APEM Inc. to conduct high-resolution (1.5 cm at the ocean's surface) aerial digital surveys of the South Atlantic Survey Area (SASA). These surveys were designed to characterize baseline temporal and spatial abundance of marine animals across multiple taxa and are the largest and most complex surveys ever conducted in the world.

Aerial digital surveys were conducted using line transect surveys that covered 5% of SASA. In addition, the three wind energy areas (WEAs)—Wilmington East (WE), Wilmington West (WW), and Kitty Hawk (KH)—and the Grand Strand Call Area (GSCA) were sampled using a grid-based survey design with data analyzed to cover 10% of each area. SASA line transects were targeted or extended to fly through the Charleston Call Area (CCA) and two fish spawning Special Management Zones (SMZs). This report represents information from eight high-resolution aerial digital surveys performed in February 2018, February 2020, May/June 2018, May 2019, October 2018, September 2019, December 2018, and December 2019. Images from each survey were reviewed using a combination of manual and automated processes, and 10% of the blank images were reviewed manually for quality control (QC) of the target extraction processes. Targets extracted from each image were categorized into one of ten groups and sent to taxonomic experts for identification to the lowest taxonomic level possible. Taxonomic experts are considered to have at least 7 to 10 years as career taxonomists in their species group. At least 20% of all targets identified were reviewed by a second taxonomic expert. Species listed as endangered or threatened were flagged for additional review. When comparing abundance among seasons, we corrected for the differences in level of effort among surveys by dividing the raw number of observations in each season by the extent of the area surveyed, thus providing densities by km^2. This allowed meaningful comparisons among seasons when survey effort was different.

An average of 240,000 images were collected per season and roughly 90% of those images had no targets. Across all surveys, 185,983 animals were sent to taxonomic experts for identification including 148,074 birds, 4,191 marine mammals, 3,049 turtles, 3,034 sharks, 23,380 rays, and 4,255 large bony fishes. For targets sent to a second species expert, identification agreement reached 99% across all taxonomic groups. The following appendices are included to provide detail regarding species-specific information and details of the survey plan.

A Common and Scientific Names for Taxa Identified in All Surveys
B Animals Found During All Surveys By Taxonomic Group by Area
C Avian Species
D Turtle Species
E Marine Mammal Species
F Ray and Shark Species
G Large Bony Fishes
H Threatened and Endangered Species
I Survey Plan

Of the 148,074 birds identified across all surveys (64 species), the most abundant species groups were phalaropes (25%), gulls (24%), and loons (17%), but the relative abundance among species groups varied between surveys. The February 2018 survey was dominated by loons (26%), gulls (22%), phalaropes (22%), and auks (19%). The February 2020 survey was dominated by phalaropes (33%), gulls (27%), and auks (16%). During the May/June 2018 survey, terns accounted for 58% of the sample with *Sterna* terns and gulls comprising 16% and 15% of the sample, respectively. During May 2019, shorebirds were the dominant species group with 43% of the sample followed by terns (16%), and *Sterna* terns (12%). The most diverse season was October 2018 (18 species groups) and was dominated by *Sterna* terns (36%), terns (26%), and gulls (22%). During September 2019, *Sterna* terns (50%) and terns (36%) were dominant. The December 2018 survey was dominated by gulls (38%) and gannets (31%) and 14% of the observations being loons. December 2029 was dominated by phalaropes (41%) and gannets (24%) followed by loons (17%). Spatial patterns varied temporally for several species groups such as loons, gannets, gulls, and phalaropes, but many species groups had too few observations to make any definitive conclusions. Spatially, flight heights for gulls, northern gannet, and loons were similar across SASA with no discernable spatial patterns. Population- and displacement-sensitive species were most abundant off the coast of central and northern North Carolina and less abundant elsewhere; there were relatively few observations of collision-sensitive species.

Over the eight surveys and all areas, 3,049 turtles were identified in imagery representing four species and one species blend. Numbers of turtle observations were similar across all surveys in SASA except for December 2019 with almost double the observations: the lowest number of observations were in September 2019 (8%) and the highest number of observations were during December 2019 (22%). Loggerhead turtles were the most frequently encountered species (n=1,185) consisting of 39% of the total observations. In the February 2018 survey, peak encounters were loggerhead (n=148) and Kemp's ridley turtles (n=133). Out of the 353 turtles observed during the February 2020 survey, loggerhead (n=110), turtle-species unknown (n=96), and Kemp's ridley turtles (n=90) were the most frequently encountered species. For the remaining surveys, loggerhead turtles were the most abundant species except for December 2018, which was dominated by Kemp's ridley turtles, and December 2019, which was dominated by turtle-species unknown and Kemp's ridley turtles. Six green turtles were observed (two in February 2018, one in February 2020, one in October 2018, and two in December 2019). Sea turtles were observed throughout SASA throughout the year but were less common in northern North Carolina and KH during February and December compared to other surveys. South of Pamlico Sound, sea turtles were largely distributed homogenously among the four survey periods. Turtle travel direction predominately followed a WSW to SSW direction in the February, September/October, and December survey periods and a NE to SW direction in the May/June survey period.

Over the eight surveys, 4,191 marine mammals were identified in imagery across all areas, with most being dolphins (99%), >0.50% unidentified mammals, and >0.25% whales; there were two seal-species unknown observed during the May 2019 survey. During the February 2018 survey, whale observations included one north Atlantic right whale, one common minke whale, and one humpback whale. Humpback whales were the most observed species of whale (70%) and the only species observed during February 2020 (n=2), October 2018 (n=1), December 2018 (n=1), and December 2019 (n=2). There was also one unidentified whale in the October 2018 survey. There were no whales observed during the May/June 2018, May 2019, and September 2019 surveys. For dolphins, the most frequently encountered species was Atlantic spotted dolphin (n=1,022; 25%), with 33% of this species encountered in the February 2020 survey. The second most abundant species was bottlenose dolphin (n=561; 14%), found mostly in the February 2018 (n=167) and December 2018 (n=127) surveys. Whales showed a preference for the areas off the coast of northern North Carolina including KH; no whales were observed south of Pamlico Sound except at GSCA during December. Atlantic spotted dolphins, pantropical spotted dolphin, and bottlenose dolphins were widespread for all surveys, but common dolphin detections were limited to the area within

proximity of KH. Whale travel direction was to the west-east and north-south in February, to the north-south in September/October, and to the WNW in December. There were no whales observed during May/June. Dolphin travel direction showed no clear trends in May/June or December; however, there were strong northerly movements during February and September/October.

There were 23,380 rays and 3,034 sharks found in the imagery across all areas and surveys. Rays were observed during all surveys with densities greatest in the May 2019 survey (n=14,486; 62%), but only <0.01% of the ray observations occurred in the February 2018 (n=3) survey and <0.03% in the February 2020 (n=8) survey. Of the 23,380 rays recorded, 93% were cownose rays, 6% were identified as cownose/bullnose rays, and <1% represented Atlantic stingray, giant manta ray, giant devil ray, Chilean devil ray, Atlantic devil ray, spotted eagle ray, bullnose ray, and ray-species unknown. Ray encounters were highest during the May 2019 (62%), May/June 2018 (16%), and September 2019 (15%) surveys. Bullnose rays (n=7) were only observed in the May/June 2018 survey, Atlantic stingray (n=1) was only observed during the September 2019 survey, and Atlantic devil ray (n=1) was only observed during the May 2019 survey. Most shark observations occurred during the May 2019 (n=1,115; 37%) and May/June 2018 (n=608; 20%) surveys where 29% and 59% of the observations, respectively, were spurdog. Carcharhinidae (unid.) (n=332) was also dominant in the May 2019 survey with 30% of the survey. Two whale sharks were observed over all surveys (one in May 2019 and one in September 2019). Species that only occurred in one survey include silky sharks (n=1; February 2018), basking sharks (n=25; February 2018), thresher sharks (n=2; May/June 2018), blue sharks (n=4; May 2019), dusky sharks (n=1; May 2019), and bonnethead sharks (n=1; December 2019). Most ray species were found sparsely across SASA and occurred too infrequently to assess spatial trends; however, species such as the cownose ray occurred more frequently and were found across SASA, GSCA, and KH. Non-hammerhead sharks, white shark, and Carcharhinidae unidentified were found throughout SASA and the call areas during the year. Other shark species had too few observations to indicate any spatial trends, and many shark observations could not be identified to species. Travel direction for rays was primarily to the west during September/October and highly variable during May/June and December. Too few rays were observed during February and December to discern any patterns. Travel direction for sharks showed a SSW preference in December and was highly variable during other time periods.

There were 4,255 large bony fishes found in the imagery across all areas and surveys. Across all surveys, 60% of fish (n=2,556) were ascribed to species, and the most abundant species for all surveys was mahi-mahi (n=1,803). Densities for large bony fishes were highly variable among surveys. Abundance was greatest in the May 2019 (n=1,227; 29%) and October 2018 (n=989; 23%) surveys. The lowest abundance occurred during December 2018 (n=88; 2%) and December 2019 (n=156; 4%) surveys. Four flying fish (unid.) and bluefin marlin (n=1) were only observed during the October 2018 survey. Cobia were sparsely distributed across SASA. There was a cluster of mahi-mahi observed within WE during the February and May/June surveys, though no discernable patterns were evident during other surveys. Tuna were clustered east of Albemarle Sound and Pamlico Sound during the September/October surveys but generally evenly distributed during other times. Sunfish were primarily observed off the North Carolina coast during the May/June and September/October survey periods but off the South Carolina coast during the February and December survey periods.

Across all areas, 77% of the observations of listed species (n=3,973) were turtles (n=3,049), which were generally distributed evenly across all surveys (ranging from 241 to 421) except during December 2019 when there were 680 observations. These numbers are mainly driven by the most abundant species: loggerhead turtle and Kemp's ridley turtle. Loggerhead turtle (n=1,185) represented 30% of the total number of observations of listed species, Kemp's ridley turtle (n=669) accounted for another 17% of the total, and *Sterna* terns (n=106) accounted for 3% of listed species observations although no roseate terns

were positively identified during the eight surveys. Atlantic bluefin tuna (n=246) represented 6% of observations of listed species.

Results from high-resolution aerial digital surveys can provide insight into spatial and temporal animal distributions within a surveyed area. The approach allows large areas to be surveyed systematically and efficiently without the observer and detection biases present with human observers. Data from these surveys can inform wind turbine siting decisions at a high level and site-specific level through better understanding of species composition, relative abundance, and animal movements. This information can also be used in developing project-specific environmental documents such as Environmental Assessments and Environmental Impact Statements should the need arise.

2 Introduction

BOEM promotes responsible development on the Outer Continental Shelf (OCS), balancing energy independence and environmental protection through science-based management of offshore conventional and renewable energy and marine mineral resources.

OSW energy is coming to the USA with the approval of the first commercial scale wind project on the OCS and 17 currently active lease areas in the Atlantic. However, it is still unclear what impacts such development could have on wildlife including birds, bats, sea turtles, fish, and marine mammals. Information is critical to inform federal and state regulators on how to avoid or minimize potential impacts to wildlife from OSW development. There have been several efforts along the Atlantic coast to identify and fill data gaps in recent years, but additional information is still needed in areas of future development such as the Mid-Atlantic.

One of the most pressing research needs is baseline data on potential wildlife exposure. Knowledge about species presence and absence in development areas helps regulators form appropriate site-specific questions to be addressed by developers. Regional-scale baseline information on wildlife distributions, abundance, and movements by season can inform the relative biodiversity of the development sites. These types of surveys can also provide a better understanding of the potential effects of individual projects, as well as any potential cumulative effects of multiple projects. To help address this information gap, BOEM tasked Normandeau Associates Inc. (Normandeau) and their teaming partner APEM Inc. (APEM) to complete quarterly high-altitude aerial digital surveys of SASA defined as the federal waters in the area off the coast of North and South Carolina out to the −30-m contour line. The approximate size of the area is 11,000 square nautical miles (NM^2). Transect surveys were commissioned to cover a minimum of 5% of the SASA. In addition, a 20% transect resulting in a 10% grid-based survey of three WEAs plus a 1-NM buffer were also to be completed. A fourth call area (GCS) was planned to be covered by extending the SASA line that falls within its boundary. The planned image resolution was 1.5-cm ground sampling distance (GSD) at the surface of the ocean. Additional areas of interest identified by BOEM included fish spawning SMZs. Two of these areas were within the survey boundary and a flight line could be targeted through them. These surveys are the largest and most complex surveys ever conducted in the world.

3 Methods

The areas defined for survey were SASA, three WEAs (KH, WE, and WW), GSCA, CCA, and fish spawning area SMZ 51 (A51) and SMZ 53 (A53) (Figure 3–1). SASA was split into North and South for analyses purposes.

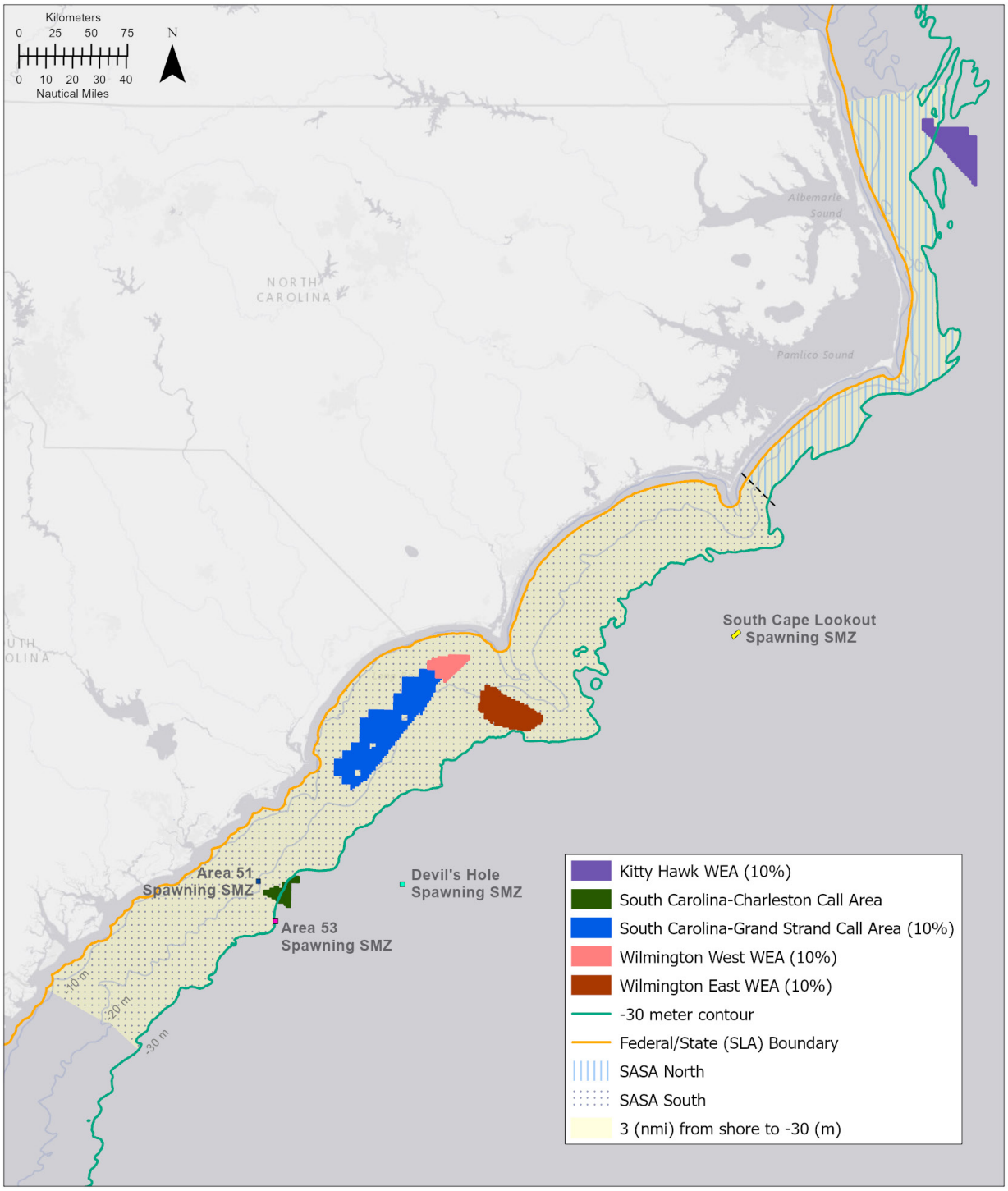

Figure 3–1. South Atlantic Survey Area (SASA) covered by a 5% transect survey, three Wind Energy Areas, and one Call Area (Grand Strand) covered by a 10% grid survey
The additional areas (Charleston Call Area and Spawning SMZ Areas 51 and 53) are incorporated into SASA surveys. SASA was split into North and South for analyses purposes.

3.1 Data Collection

Eight high-resolution aerial digital imaging surveys were completed over a two-year period covering February 2018 through February 2020 (Table 3–1). Data were collected from aircraft flying at 1,360 ft (414.5 m) capturing imagery at 1.5-cm resolution at the sea surface, following the survey design and methods defined within the Survey Plan, agreed with BOEM at the beginning of this project, and included at the end of this document (Appendix I: Survey Plan).

The surveys were completed using APEM flagship camera system Shearwater III. This system has an array of high specification sensors, which can be mounted in a variety of configurations to provide flexible surveying adapted for the needs and conditions of each study. Although the Shearwater III can capture imagery at 1-cm GSD, operating it at this resolution significantly reduces the survey footprint without increasing the data quality (i.e., the ability to identify small individuals to species such as piping plover). The system was designed to obtain optimum resolution for species identification while providing cost-effective large image footprints. Into this consideration the flight attitude was also included.

Shearwater III collected an array of still images from vertical (rather than angled) cameras. The imagery was captured in raw format producing sharp images. The shutter speed, aperture, and ISO were motored in flight by an APEM technician to ensure the correct setting was selected for the conditions.

Custom survey planning and management software preprograms the survey transects and grids, an integrated Applanix GNSS and inertial system ensure that surveys are flown as accurately as possible. APEM's GNSS system has a manufacturer quoted unprocessed SPS (Standard Positioning Service) RMS error of 1.5–3.0 meter. The navigational system was calibrated with aircraft control systems and continuously monitored. Image acquisition was automatic, removing human error and ensuring data capture occurs over specified locations. As data capture occurred, GPS data were automatically logged with each exposure including the xyz coordinate and heading of the camera at the point of capture along with line information. It is impossible to fly in a perfect line at constant altitude due to effects of weather and atmospheric pressure on aircraft during flight. Commonly, an aircraft moves up and down 10 to 30 m during surveys of long lines and consequently each captured image is likely to have some deviation from the planned vertical position. Spatial information collected automatically in real time, in particular the z coordinate (camera sensor height), is crucial to aid in species identification which relies partially on organism size and to allow determination of avian flight heights.

Specific details of camera sensors and sensor configuration is not available in this report. Such information is confidential and the intellectual property of APEM, Ltd.

There were differences in duration among surveys. Factors that affect survey duration include weather conditions, day length, and aircraft maintenance, and survey protocol followed as described below.

Table 3–1. Starting and ending dates and number of days to complete each survey

Survey #	Survey	Date Started	Date Completed	Days to Complete
Year 1				
1	2018 February	01/31/18	02/13/18	8
2	2018 May/June	05/25/18	06/17/18	8
3	2018 October	09/08/18	11/18/18	9
4	2018 December	12/16/18	12/22/18	4
Year 2				
5	2019 May	05/18/19	05/24/19	6
6	2019 September	08/29/19	09/29/19	11
7	2019 December	12/10/19	12/22/19	9
8	2020 February	02/02/20	02/12/20	7

Daily survey time maximizes crew hours and avoids mid-day when glare/glint was most prevalent. Surveys were not conducted when Douglas sea scale was ≥4, cloud base was <426.7 m (<1,400 ft), visibility was <5 km (3.1 mi), or wind speed was >30 knots (34.5 mph). The onboard camera technician continuously monitored the images and if they ceased to be of sufficient quality, image acquisition stopped until suitable conditions returned. At each capture point, surplus images are collected to allow for replacement of any image found unsuitable for analysis. Location and flight height accuracy is monitored by multiple GPS sensors, and overall location accuracy reaches 2.5 m on X and Y locations and 5 m on the Z location. Data collected included a 1-NM buffer. All data capture points within the buffer are included for analysis. The shape of the survey area sometimes means that a small part of the very large image might be outside of the buffer. Following each daily survey, sample imagery was evaluated to make sure it was of good quality for analysis. Data were backed up daily and shipped for analysis.

3.1.1 Survey by Transect

For SASA, linear transects were flown to cover a minimum of 5% of the area's sea surface. The transects followed a saw tooth pattern along the coastline such that the outbound and inbound line were perpendicular to the shoreline. This consisted of approximately 47–60 transects of an approximate total length of 2,880 km (Figure 3–2). Imagery was generated across a 702-m-wide swath with abutting imagery for a total image footprint of 0.077 km^2, or 2,022 km^2 overall.

Two designs were proposed: one considered the restricted access around the three Military Operating Areas (MOAs)—Hatteras Foxtrot, Core, and Pamlico B MOAs—that make up the Marine Corps Air Station (MCAS) Cherry Point airspace; Figure 3–2 represents the survey design when permission to turn inside the Cherry Point airspace was granted. Figure 3–3 represents the survey design if the Cherry Point airspace was limited. Figure 3–4 shows detail of the survey transect lines that passed through the CCA and A51 and A53.

3.1.2 Survey by Grid

For each WEA and the GSCA including a 1-NM buffer for each, the grid imagery footprint was a minimum of 524 m × 219 m (0.114 km^2). A minimum of 20% of the WEA plus the 1-NM buffer was collected. Only half of the images (representing 10% of the WEA area) were analyzed (Figure 3–5). The remaining unanalyzed data can be accessed later if needed, which would revert the survey design from a 10% grid design to a 20% transect design.

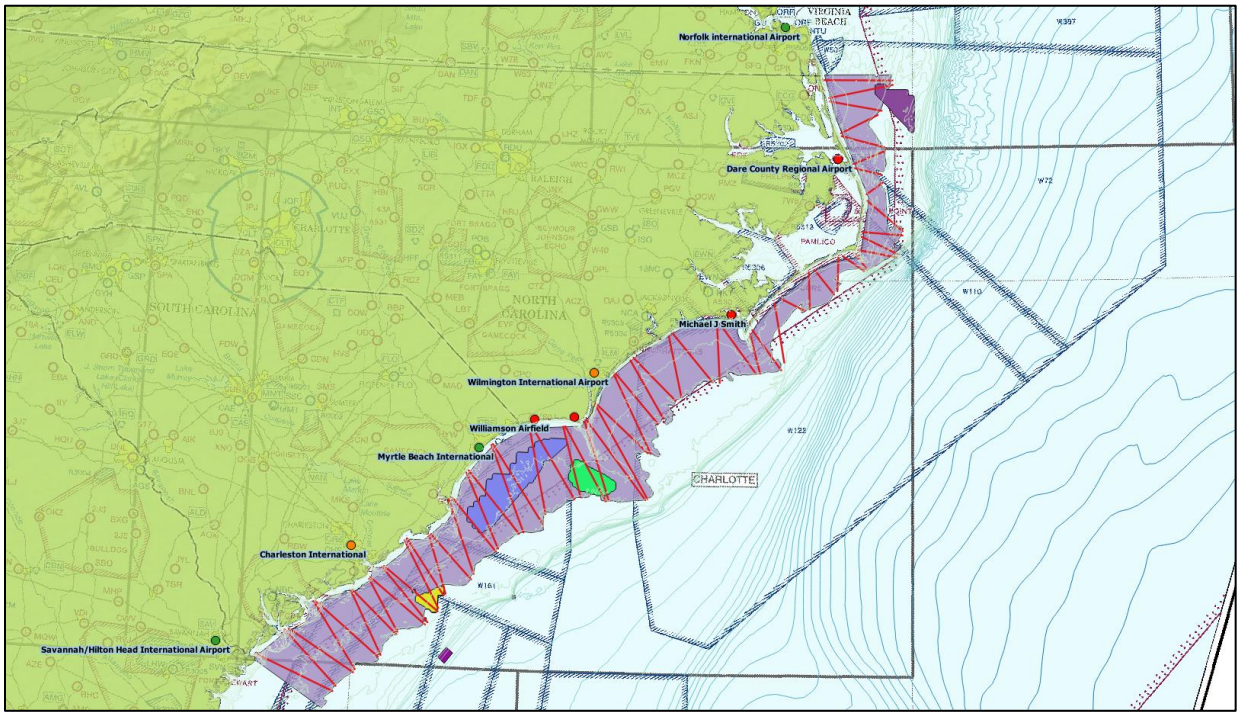

Figure 3–2. Design 1: South Atlantic Survey Area (SASA) showing transect survey protocol to achieve 5% coverage

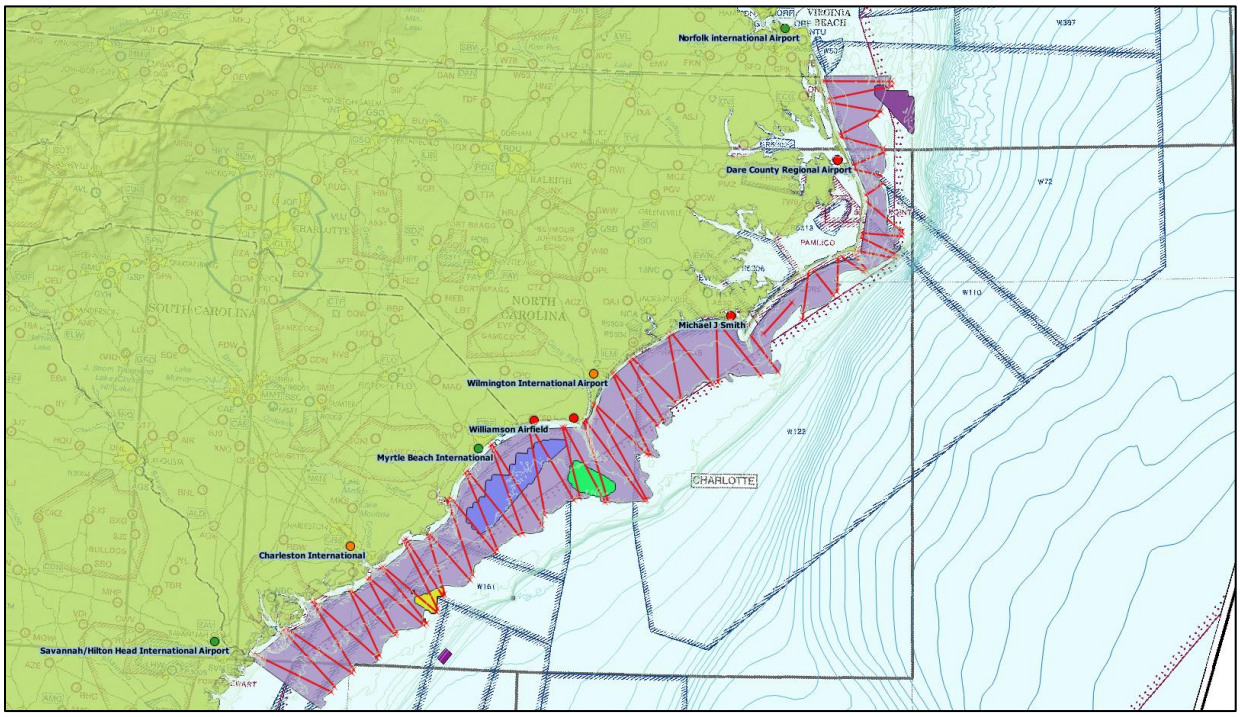

Figure 3–3. Design 2: South Atlantic Survey Area (SASA) showing transect survey protocol to achieve 5% coverage considering possible access issues into Marine Corps Air Station Cherry Point

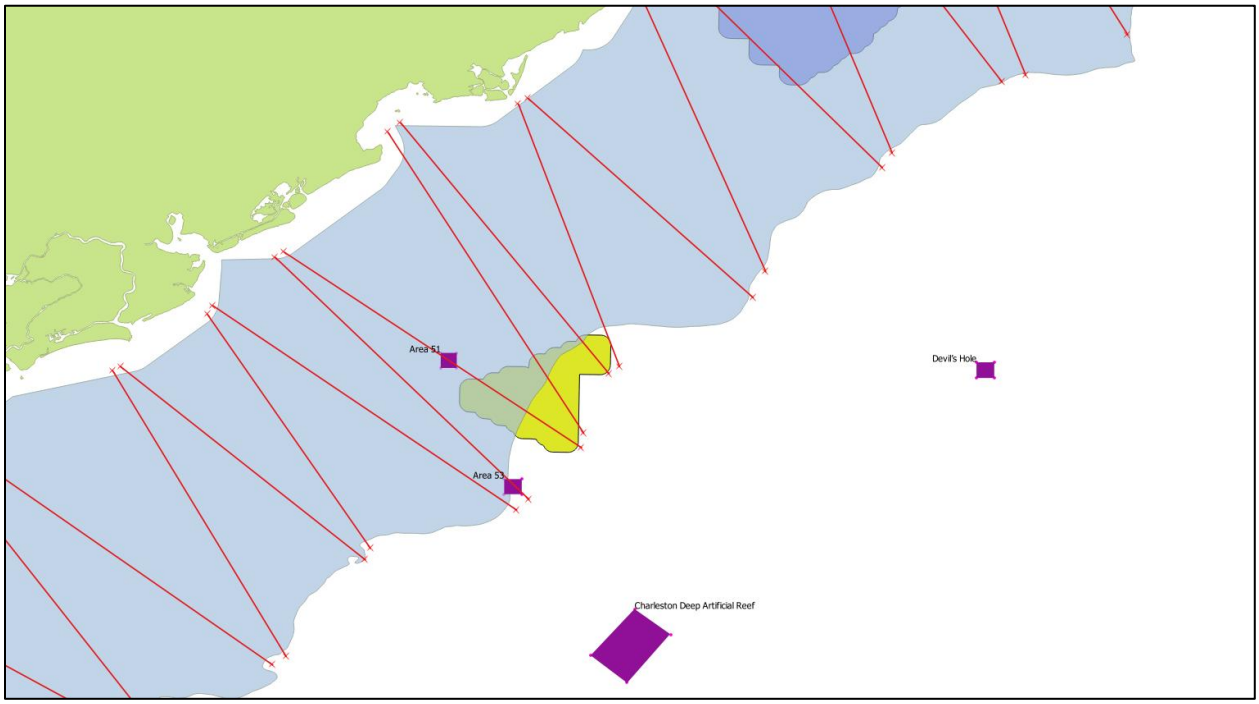

Figure 3–4. Transect lines that pass through the Charleston Call Area and Spawning SMZ Areas 51 and 53



Figure 3–5. Areas where surveys provided 10% grid coverage
Clockwise from top left: Kitty Hawk (NC) WEA, Wilmington East (NC) WEA, and Wilmington West (NC) WEA, which is attached to the Grand Strand (SC) Call Area (surveyed together).

3.2 Target Extraction and Quality Control (QC)

Target extraction is where images are reviewed, and targets of interest are identified. Targets of interest are not solely biota, but also comprise physical structures such as buoys and boats. Target extraction is accomplished using automated and manual target identification and extraction methods, and all survey data undergo QC. To continue monitoring the success of the target extraction and ensure that data are not lost, a minimum of 10% of the blank images are screened for QC (Figure 3–6). By contract, there is a minimum of 90% agreement in QC of target extraction, but self-imposed higher levels of agreement meant that any slippage in agreement below 98% triggered a review of the analysts involved, and early action was taken to maintain high confidence in the target extraction process. Once the target extraction is complete, all images found to contain organisms are transmitted to taxonomists for identification using the ReMOTe portal (https://remote.normandeau.com) for data management, identification, and reporting. Initial extraction categorizes targets into taxonomic groups and a cropped image of the animal is posted for identification. It should be noted that the size and resolution of computer monitors can have a significant effect on the clarity of some characteristics of animals. Analysts involved in the review process recommend Ultra High Definition 5K monitors with a minimum 60-cm screen.

3.3 Target Classification and Identification

Targets were categorized into ten groups representing birds, bats, turtles, marine mammals, rays, sharks, large bony fishes, fish shoals, vessels, and fixed structures (Figure 3–6). These were then accessed for identification by biologists highly experienced in their taxonomic group, and identifications of species listed as “Endangered” or “Threatened” by the state or under the Endangered Species Act (ESA) were flagged for additional review.

3.4 Identification Quality Control

A minimum of 20% of all images identified were reviewed by a second taxonomic expert, and taxonomic agreement had to meet a minimum of 90% concurrence (Figure 3–6). Failure to reach this would trigger a review of 100% of identifications made by the initial taxonomist. The 20% review included QC review of 100% of ESA and State-listed species, and for endangered species a 100% agreement had to be reached on identifications. Additional experts in the species concerned were called in to arbitrate identifications when concurrence could not be reached. Taxonomic experts were considered to have at least 7 to 10 years as career taxonomists in their species group and included research scientists from the New England Aquarium, Massachusetts Marine Fisheries, Massachusetts Shark Research Program, Marine Megafauna Foundation, National Oceanographic and Atmospheric Association, and the Sea Turtle Conservancy.

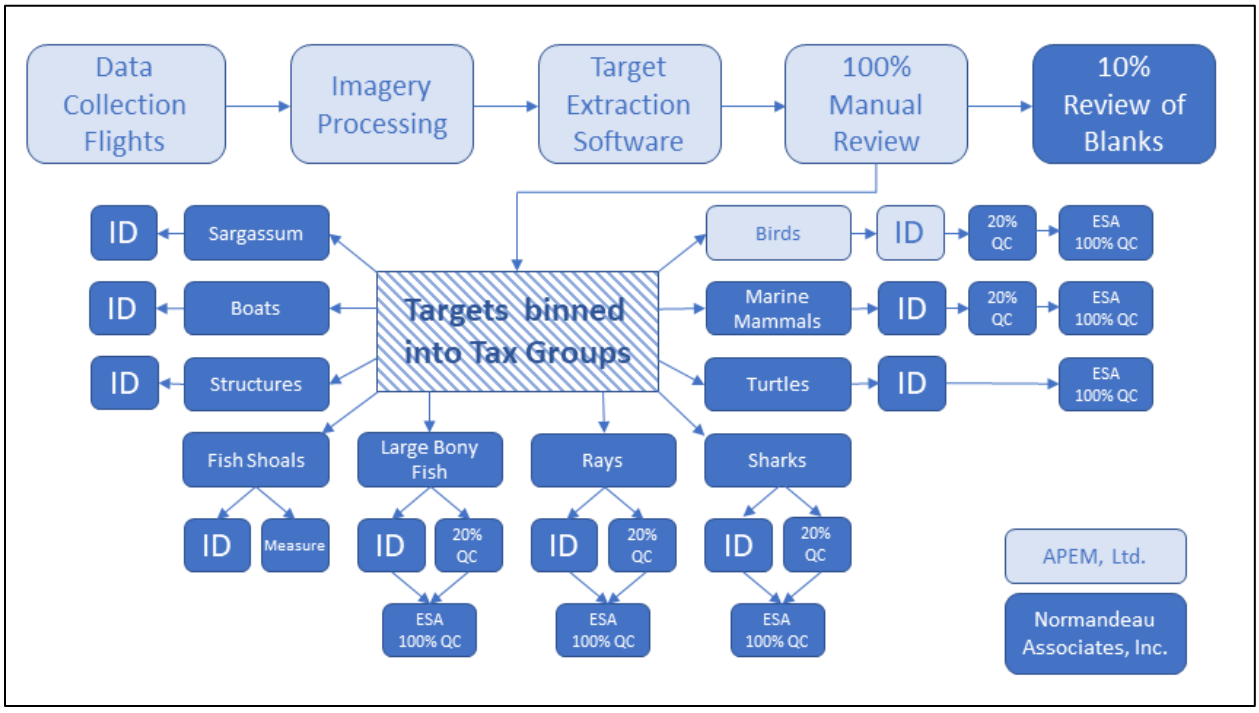

Figure 3–6. Methodological steps followed from data collection to final quality control review

Accuracy assessments were done at three taxonomic levels: (1) types (birds, marine mammals, sea turtles, sharks, and rays), (2) subtypes within each type (e.g., phalaropes, shearwaters, etc.), and (3) at the species level within each type. Subtype and species accuracy assessments were done independently for each type. For each subtype and species accuracy assessment, a confusion matrix was created with the rows representing the initially identified target and the columns representing the QC-identified target. Row totals represent the sample size for each subtype/species for the initial identifications and column totals represent the sample size for the QC identifications. The diagonal of the confusion matrix represents the individuals where the initial identification and the QC identification agree. The other cells in the confusion matrix represent disagreements between the initial identification and the QC identification. The confusion matrices were used to calculate initial identification and the QC identification accuracy (Story and Congalton 1986). The initial identification accuracy is referred to as the User's Accuracy and the QC identification accuracy is referred to as the Producer's Accuracy (Story and Congalton 1986). Accuracy was calculated for each subtype/species by dividing the number of individuals where both the initial and QC identifications agreed by the row total (for the initial identification accuracy) and the column total (for the QC identification accuracy). Finally, an overall accuracy for each type was calculated based on the species and subtype confusion matrices.

The confusion matrix is provided as supplementary material and is posted online with the final report.

3.5 Treatment of Unidentified Animals Closely Resembling Listed Species

The categorization of ESA or State-listed species was conservative, incorporating "*Sterna* tern" (possibly representing roseate tern), "hammerhead shark (unid.)" (possibly representing scalloped hammerhead), and "whale species unknown" (possibly representing blue, fin, sperm, or north Atlantic right whale). During the four survey periods, all unknown *Sterna* terns were lumped together. Inability to identify the *Sterna* tern group to individual species was usually a result of the angle of the bird and an inability to see

the bird's head or body proportions. With subsurface animals, the angle of the animal or depth of the animal in the water column often obscured characters required to differentiate animals to species; although, identifying many hammerhead sharks to species is difficult even when in proximity.

3.6 Sensitivity Mapping

Focus was expanded to bird species considered to be sensitive to collision and displacement. On behalf of BOEM, Normandeau developed a method to quantify the vulnerability of seabirds to OSW development on the Atlantic Outer Continental Shelf (Robinson Willmott et al. 2013). The method used data on bird species ecology that influences bird species sensitivity in three key areas: population, collision, and displacement. Based on species ecology and life history information, each species was assigned a population, collision, and displacement sensitivity ranking. These sensitivity rankings can be sorted from most sensitive to least sensitive to prioritize species for analysis such as what is described below.

All species observed during the two-year study period were ranked according to their sensitivity as defined in Robinson Willmott et al. (2013). Species identified as "sensitive" and included in this analysis were those in the top 20% for population, collision, and displacement sensitivity (low number = high sensitivity). To create the sensitivity maps, SASA survey transects were divided into 4-km × 4-km grid cells, and densities for the 20% most sensitive species for population, collision, and displacement were computed for each grid cell by dividing the total number of bird observations within the grid cell by the total survey effort within the grid cell for each survey timeframe. The eight surveys were grouped into four timings: December surveys included December 2018 and December 2019; February surveys included February 2018 and February 2020; May/June surveys included May/June 2018 and May 2019; and September/October surveys included October 2018 and September 2019. Collision sensitivity analysis was restricted to individual birds flying in the potential rotor swept zone (RSZ; 23–319 m).

3.7 Comparisons among Seasons

When comparing density of species and species groups among seasons, all numbers are presented as densities by km^2 of area imaged and analyzed. Because the percent survey coverage among seasons and amongst areas varied, correcting the areal coverage removes the potential nuisance effect of survey effort and allows for interseasonal and interannual comparisons moving forward.

Raw abundance for each observation was corrected for each season's survey effort. This correction estimates the total number of individuals in each area by km^2 imaged. This corrected abundance assumes that no double counting occurred by animals moving among transects as the surveys occurred.

3.8 Weather Associations

While detailed weather data were collected during the surveys, an attempt to relate species composition and abundance to weather variables was not done. This was because surveys were scheduled so weather conditions would be favorable for aerial surveys to identify marine fauna: a cloud base >426.7 m (>1,400 ft), visibility >5 km, wind speed <30 knots, and sea state 4 or less on the Douglas sea scale (wind sea). Requiring these conditions for each survey minimizes the weather variability among surveys; therefore, we lack variation in weather conditions to relate to species composition, abundance, and distribution.

3.9 Bird Flight Height Calculations

APEM created a custom avian flight height calculator (FHC) for flying targets recorded in aerial digital surveys. The FHC was developed in-house with the aid of an Imperial College mathematician to estimate bird flight heights by using trigonometry and more complex mathematics.

Using the program to calculate flight height depends on the size of the bird species and the size of the bird relative to the image. The basic premise is that the higher the bird is flying, the greater the proportion of its reference body length will be in the image. The program uses the Global Positioning System (GPS) height of the aircraft and analyst bird measurements from the imagery to estimate the flight height for each individual flying bird. It is not possible to estimate flight heights for birds diving or turning sharply, as these individuals are not fully stretched out and therefore the measured lengths are unlikely to be comparable to the reference length of the relevant species.

Besides the GPS height of the aircraft, other important variables used in the FHC include camera specifications (business confidential) and species reference lengths from literature, and these are combined to provide an estimated error for each species and each survey (see Appendix C.7). For the FHC to estimate flight heights, the minimum and maximum expected body length of each species must be known, this is referred to as the bird reference length. Previously, reference lengths from one source (Sibley 2001) were used in the FHC for US flight heights calculations. However, following a review of the comparison between reference lengths from different sources this was deemed inadequate, and a wider review of literature was undertaken to determine additional sources that would bolster the variability in body lengths that can be accounted for in the FHC (Table 3–2). Following a review of the literature, new bird reference lengths were produced by extracting the minimum and maximum body length from four sources for each avian species that could be expected in the areas we operate. The four sources used were the Collins Bird Guide (Svensson et al. 2010), The Sibley Guide to Birds (Sibley 2001), The Cornell Lab (Cornell University 2020), and the British Trust for Ornithology (BTO 2020).

The Collins Bird Guide is a well-known identification guide across Europe, and many species found in this book are comparable to species found in the US. Both the Collins and Sibley books are widely regarded as the best ornithology guides available (Dingle 2001). The Collins Bird Guide indicated that most bird lengths were collected from skins, recently killed, or living birds (Svensson et al. 2010); measurements were taken from tip of the bill to the outstretched tail, which is the same method taken by APEM when measuring birds in the imagery. Due to the highly regarded reputation and scientific approach of both the Collins and Sibley books, these sources were judged as appropriate to use as a basis for the bird reference lengths in the FHC program.

Two other sources were used in addition to the Collins and Sibley books to revise the list of reference lengths, one of these was BTO's BirdFacts (BTO 2020). The BTO's mission statement is

> We are a non-campaigning organisation and our aim is to conduct all of our work with the highest scientific rigour in order to produce robust evidence that can be used by anyone wishing to understand birds, other wildlife, their habitats and how different interventions may affect them (BTO 2020).

The BTO regularly produces peer-reviewed papers, and therefore it was concluded that the data on their website is suitable for incorporating into revision on the FHC bird reference lengths. The fourth source used was the Cornell Lab, similar to the BTO, the Cornell Lab is a highly regarded organization that studies birds and aims to conserve and educate, the Cornell Lab mission statement is "Our mission is to interpret and conserve the earth's biological diversity through research, education, and citizen science focused on birds" (Cornell University 2020). Like the BTO, the Cornell Lab supports the publication of peer-reviewed papers and was therefore accepted as a reliable source to help revise the reference lengths

(Cornell University 2020). In some cases, only three sources existed for a species. When a source gave a range for body length, the lowest and highest values in the range were used to ensure that all possible variations in bird length were accounted for. When birds only had an average length, the highest and lowest values from the sources were used. When calculating the body length of terns, the lengths of tail streamers were removed as these may not be present year-round and therefore were not included as part of the reference length.

The comparison of the body length values from one data source against four other data sources results in a positive or negative value based on the estimated difference in the mean. A negative value could suggest overestimated flight height, and a positive value could suggest underestimation of flight height.

Table 3–2. Comparison between the mean original bird body reference length from one source and revised bird body reference length from four sources used to estimate flight height

Grouping	Common Name	Mean Body Reference Lengths		Difference
		From One Source	From Four Sources	
Duck	American Black Duck	58.42	57.23	-1.19
	Redhead	48.26	48.19	-0.07
	Greater Scaup	45.72	46.43	0.71
	Lesser Scaup	41.91	41.98	0.07
	Surf Scoter	50.80	51.33	0.53
	White-winged Scoter	53.34	51.96	-1.38
	Black Scoter	48.26	47.57	-0.70
	Long-tailed Duck	41.91	43.10	1.19
	Red-breasted Merganser	58.42	56.48	-1.94
Loon	Red-throated Loon	63.50	62.38	-1.13
	Common Loon	81.28	75.93	-5.35
Grebe	Horned Grebe	35.56	34.38	-1.19
Fulmar	Northern Fulmar	45.72	46.43	0.71
Petrel	Black-capped Petrel	40.64	40.64	-0.00
Shearwater	Cory's Shearwater	48.26	48.24	-0.02
	Great Shearwater	45.72	46.57	0.85
	Sooty Shearwater	44.45	44.73	0.28
	Manx Shearwater	34.29	37.93	3.64
	Audubon's Shearwater	31.75	30.48	-1.27
Gannet	Northern Gannet	93.98	94.31	0.33
Cormorant	Double-crested Cormorant	83.82	81.94	-1.88
Pelican	Brown Pelican	129.54	124.02	-5.52
	American White Pelican	157.48	153.66	-3.82
Ardeidae	Great Blue Heron	137.16	123.61	-13.55
	Great Egret	99.06	96.14	-2.92
	Snowy Egret	60.96	60.65	-0.31
	Green Heron	45.72	44.41	-1.31

(continued)

Table 3–2. (Continued)

Grouping	Common Name	Mean Body Reference Lengths		Difference
		From One Source	From Four Sources	
Raptor	Peregrine Falcon	40.64	41.55	0.91
Shorebird	Black-bellied Plover	29.21	28.86	-0.36
	Ruddy Turnstone	24.13	21.71	-2.42
	Dunlin	21.59	19.40	-2.19
Phalarope	Red-necked Phalarope	19.69	18.55	-1.14
	Red Phalarope	21.59	21.20	-0.39
	Red/Red-necked Phalarope	21.91	19.87	-2.04
Skua	Great Skua	58.42	56.14	-2.28
	Pomarine Jaeger	46.00	41.12	-4.88
	Parasitic Jaeger	40.50	36.84	-3.66
	Long-tailed Jaeger	38.00	36.29	-1.71
Auk	Dovekie	20.96	19.99	-0.97
	Common Murre	44.45	41.74	-2.71
	Thick-billed Murre	45.72	45.36	-0.36
	Razorbill	43.18	41.17	-2.01
	Atlantic Puffin	31.75	29.56	-2.19
Gull	Black-legged Kittiwake	43.18	40.17	-3.01
	Bonaparte's Gull	34.29	33.36	-0.93
	Little Gull	27.94	27.36	-0.58
	Laughing Gull	41.91	40.23	-1.68
	Ring-billed Gull	44.45	45.74	1.29
	Herring Gull	63.50	61.00	-2.50
	Iceland Gull	55.88	55.72	-0.16
	Lesser Black-backed Gull	53.34	55.34	2.00
	Glaucous Gull	68.58	64.00	-4.58
	Great Black-backed Gull	76.20	68.25	-7.95
Tern	Sooty Tern	40.64	41.38	0.74
	Bridled Tern	38.10	36.20	-1.90
	Least Tern	22.86	22.43	-0.43
	Gull-billed Tern	35.56	36.52	0.95
	Caspian Tern	53.34	51.46	-1.88
	Black Tern	24.77	24.19	-0.57
	Royal Tern	50.80	48.08	-2.72
	Royal/Caspian Tern	52.07	49.77	-2.30
	Sandwich Tern	38.10	39.03	0.92
Sterna Tern	Common Tern	30.48	33.50	3.02
	Forster's Tern	33.02	34.13	1.11
	Commic Tern	30.48	33.62	3.14
	Commic/Forster's Tern	30.48	33.75	3.27

4 Results

4.1 Data Collection

Table 4–1 lists the data collected during the eight surveys of each area. Variations between surveys including shifts in flight altitudes or individual images selected for analyses meant there were fluctuations in areal coverage, which was always more than 5% and up to 6.19% (Table 4–1).

There were differences in duration among surveys and different survey designs used for SASA depending on constraints around MCAS Cherry Point (Figure 3–2 and Figure 3–3). Factors that affect duration of surveys include weather conditions, day length, aircraft maintenance, and survey protocol followed.

The October 2018 survey took several months to complete (Table 4–2) with weather issues causing the survey to stall in the initial month of September, stall again in October, and eventually be completed in November. Hurricanes and tropical storms went through the study area and cloud base remained low for many weeks. Decision to complete the survey despite these unavoidable delays was approved by BOEM.

The survey in December 2019 was curtailed as weather into late January prevented completion of WW and GSCA. These two sites had incomplete coverage (Table 4–2). The decision to abort completion of these surveys was approved by BOEM.

Some daily survey protocols were exceeded; survey protocol for sea state was to avoid a sea state of ≥4 on the Douglas sea scale (wind sea). This was exceeded during three of the surveys, usually at the end of runs or at the end of survey when weather changed and a sea state of 4 was reported (see highlights in Table 4–3). Survey protocol for wind speed was to avoid wind speeds of >30 knots (34.5 mph), a protocol exceeded on four occasions (see highlights in Table 4–3).

Table 4–1. Data collected during all surveys for all areas

Survey	Size (km^2)	# Images	Image Area (km^2)	% Area Imaged	# Blank	% Blank
YEAR 1						
2018 February	37,899.73	244,055	2,337.33	6.17	224,539	92.00
2018 May/June	37,899.72	242,216	2,158.84	5.70	222,757	91.97
2018 October	37,899.72	244,127	2,261.96	5.97	222,954	91.33
2018 December	37,899.72	244,110	2,347.82	6.19	230,448	94.40
YEAR 2						
2019 May	37,899.72	243,071	2,349.10	6.20	223,417	91.91
2019 September	37,899.72	244,192	2,336.68	6.17	205,541	84.17
2019 December	37,899.72	230,958	2,214.59	5.84	206,649	89.47
2020 February	37,899.72	244,245	2,326.31	6.14	215,701	88.31

Table 4–2. Collection dates for each survey and area covered

Survey	Date	Area	Action	SASA Design*
Feb 2018	01/31/18	KH	12 lines flown; area complete	
	02/01/18	GSCA, WW	14 lines flown	
	02/02/18	GSCA, WW	4 lines flown; areas complete	
	02/03/18	SASA, A51, A53, CCA	20 lines flown; A51, A52, and CCA complete	1
	02/05/18	WE	12 lines flown; area completed	
	02/06/18	SASA	6 lines flown	1
	02/09/18	SASA	22 lines flown	1
	02/13/18	SASA	10 lines flown	1
May/Jun 2018	05/25/18	KH	12 lines flown; area complete	
	05/27/18	SASA	19 lines flown	2
	06/01/18	SASA	7 lines flown	2
	06/02/18	SASA, WE	18 lines flown; WE complete	2
	06/03/18	SASA	6 lines flown	2
	06/04/18	SASA, CCA, A51, A53	18 lines flown	2
	06/16/18	GSCA, WW	13 lines flown	
	06/17/18	GSCA, WW	3 lines flown; areas complete	
Oct 2018	09/08/18	WE	12 lines flown; area complete	
	09/22/18	SASA	8 lines flown	2
	10/23/18	GSCA, WW	16 lines flown; areas complete	
	10/28/18	SASA, CCA, A51, A53	12 lines flown	2
	11/03/18	KH, SASA	12 lines of KH complete; 1 line of SASA flown	
	11/04/18	SASA	28 lines flown	2
	11/06/18	SASA	7 lines flown	2
	11/10/18	SASA	8 lines flown	2
	11/11/18	SASA	1 line flown	2
Dec 2018	12/16/18	SASA, CCA, A51, A53	16 lines flown	2
	12/18/18	SASA	25 lines flown	2
	12/19/18	SASA, KH	18 lines of SASA flown; area complete. 12 lines of KH complete	2
	12/22/18	WE, GSCA, WW	12 lines flown; 16 lines flown; areas complete	
May 2019	05/18/19	SASA	39 lines flown	2
	05/19/19	SASA, CCA, A51, A53	22 lines flown; area complete	2
	05/20/19	WE	12 lines flown; area complete	
	05/22/19	GSCA, WW	7 lines flown	
	05/23/19	GSCA, WW	10 lines flown; area complete	
	05/24/19	KH	12 lines flown; area complete	
Sep 2019	08/29/19	WE	12 lines flown; area complete	
	08/30/19	KH	12 lines flown; area complete	
	09/10/19	GSCA, WW	2 lines flown	
	09/11/19	GSCA, WW	16 lines flown; area complete	
	09/13/19	SASA	8 lines flown area	2
	09/19/19	SASA	1 line flown	2

(continued)

Table 4–2. (Continued)

Survey	Date	Area	Action	SASA Design*
Sep 2019 (cont'd)	09/22/19	SASA	20 lines flown	2
	09/24/19	SASA	9 lines flown	2
	09/26/19	SASA	13 lines flown	2
	09/27/19	SASA	9 lines flown	2
	09/29/19	SASA	2 lines flown; area complete	2
Dec 2019	12/10/19	SASA	8 lines flown	2
	12/12/19	SASA	24 lines flown	2
	12/15/19	SASA	18 lines flown	2
	12/16/19	SASA	3 lines flown	2
	12/18/19	SASA	9 lines flown; area complete	2
	12/19/19	KH	12 lines flown; area complete	
	12/21/19	WE	12 lines flown; area complete	
	12/21/19	GSCA, WW	12 lines flown	
	12/22/19	GSCA, WW	10 lines flown; area complete	
Jan 2020	02/02/20	SASA	28 lines flown	2
	02/03/20	SASA	20 lines flown	2
	02/04/20	GSCA, WW	12 lines flown	
	02/05/20	SASA	2 lines flown	2
	02/08/20	GSCA, WW	16 lines flown; area complete	
	02/09/20	SASA	10 lines flown; area complete	2
	02/12/20	KH	12 lines flown; area complete	
	02/12/20	WE	12 lines flown; area complete	

*see Figure 3–2 and Figure 3–3 for design protocol

The data collected in these surveys are available to download from the online collaborative database Ocean Biodiversity Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) at https://seamap.env.duke.edu/. The dataset names are:

- Ecological Baseline Studies of the U.S. Outer Continental Shelf Option Year 1 https://seamap.env.duke.edu/dataset/2065
- Ecological Baseline Studies of the U.S. Outer Continental Shelf Option Year 2 https://seamap.env.duke.edu/dataset/2161

Table 4–3. Minimum and maximum weather variable measurements during surveys

Yellow highlights represent exceeded protocols.

Survey	Visibility (km)		Sea State (0–4)		Glint (%)		Turbidity (0–3)		Precipitation (mins)		Cloud (%)		Outside Air Temp (°C)		Wind Speed (kts)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Year 1																
2018 February	10	10	0.5	4	0	40	1	2	0	0	0	100	-4	15	0	30
2018 May/June	10	10	1	3	0	40	1	2	0	0	0	90	21.67	29	0	23
2018 October	10	10	1	3	0	50	0	2	0	0.5	0	100	9.4	26.1	5	49
2018 December	10	10	0.5	4	0	20	1	2.5	0	0	0	90	5.56	12.22	0	15
Year 2																
2019 May	102	10	0	3	0	60	1	2	0	0	0	100	21.67	28.89	5	35
2019 September	7	10	1	3	0	50	0	2	0	0	0	95	21.11	27.78	0	35
2019 December	10	10	1	4	0	20	0	3	0	2	0	100	-2.22	22.22	5	35
2020 February	10	10	1	3	0	30	0	1	0	0	0	100	2.78	25	5	30

4.2 Target Extraction and Quality Control

Across most surveys most images collected contained no evidence of living organisms, vessels, or structures. Table 4–4 lists the data collected in each survey including number of images collected, number and percent of blank images detected, and number and percent of blank images sent for QC review.

Table 4–5 lists the data collected for each survey area during each survey including the area imaged, the percent of area without animals or objects of interest visible from the surface, and the target extraction QC rate for the area.

Variations in survey altitudes and images selected in SASA meant that areal coverage ranged between 5.12% and 5.66%. The percent of blank images where no targets were visible ranged from 83.7% in September 2019 to 94.35% in December 2018 (Table 4–5).

Areal coverage in A51 ranged between 32.85% and 34.15%, and areal coverage in A53 ranged between 33.9% and 34.17% (Table 4–5). Transects of SASA go through A51 and A53, which is why areal coverage is high for these otherwise small areas.

The CCA is surveyed as part of the transect lines extended beyond SASA boundary to provide full coverage of CCA. Areal coverage ranged from 10.82% to 10.83% and the proportion of blank images ranged from 66.46% in December 2019 up to 98.7% in December 2018 (Table 4–5).

There were slight differences in areal coverage in KH among surveys ranging from 10.25% to 10.28%. The proportion of blank images ranged from 83.49% in September 2019 up to 99.44% in November 2018 (Table 4–5).

For WW, areal coverage ranged from 4.5% (December 2019) up to 12.05%, and the proportion of blank images ranged from 41.27% in September 2019 up to 99.47% in October 2018 (Table 4–5).

Areal coverage in WE ranged from 10.39% to 10.43% (Table 4–5). The proportion of blank images ranged from 47.46% in June 2018 up to 98.55% in September 2019 (Table 4–5).

Areal coverage in GSCA ranged from 5.36% up to 11.6% and the proportion of blank images ranged from 87.22% in December 2019 up to 99.35% in May 2019 (Table 4–5).

Table 4–4. Number of images collected, number and percent of blank images detected, and number and percent sent for QC review for all surveys for all areas

Survey	Number of Images in Survey Area	Blank Images			
		Number	Percent	Number QC'd	Percent QC'd
Year 1					
2018 February	244,055	224,539	92.00	22,375	9.96
2018 May/June	242,216	222,757	91.97	22,167	9.95
2018 October	244,127	222,954	91.33	22,168	9.94
2018 December	244,110	230,448	94.40	22,865	9.92
Year 2					
2019 May	243,071	223,417	91.91	22,301	9.98
2019 September	244,192	205,541	84.17	20,473	9.96
2019 December	230,958	206,649	89.47	20,601	9.97
2020 February	244,245	215,701	88.31	21,537	9.98

Table 4–5. Survey area size, number of images collected, size and percent of area imaged, number and percent of images found to be blank, and number and percent of blanks sent for QC for each area

Area/Dates of Survey	Size (km^2)	# Images	Image Area Size (km^2)	% Area Imaged	Blank Images			
					# Blank	% Blank	# QC'd	% QC'd
SASA								
3–13 Feb 2018	33,851.10	194,896	1,916.07	5.66	177,512	91.08	17,763	10.01
27 May–4 Jun 2018	33,851.10	193,054	1,734.10	5.12	180,218	93.35	18,073	10.03
22 Sep–11 Nov 2018	33,851.10	194,949	1,808.09	5.34	179,541	92.10	17,983	10.02
16–19 Dec 2018	33,851.10	194,913	1,915.13	5.66	183,903	94.35	18,419	10.02
18–19 May 2019	33,851.10	193,893	1,906.21	5.63	177,747	91.67	17,917	10.08
13–29 Sep 2019	33,851.10	194,968	1,916.71	5.66	163,260	83.74	16,267	9.96
10–18 Dec 2019	33,851.10	195,273	1,908.17	5.64	175,694	89.97	17,639	10.04
2–9 Feb 2020	33,851.10	193,850	1,905.81	5.63	170,733	88.07	17,211	10.08
A51								
3 Feb 2018	6.94	240	2.36	34.01	236	98.33	24	10.17
4 Jun 2018	6.94	240	2.36	34.01	236	98.33	24	10.17
28 Oct 2018	6.94	232	2.28	32.85	232	100.00	24	10.34
16 Dec 2018	6.94	240	2.37	34.15	233	97.08	24	10.30
19 May 2019	6.94	240	2.36	34.01	234	97.5	24	10.26
22 Sep 2019	6.94	241	2.36	34.01	182	75.52	19	10.44
12 Dec 2019	6.94	240	2.36	34.01	235	97.92	24	10.21
3 Feb 2020	6.94	240	2.36	34.01	240	100.00	24	10.00
A53								
3 Feb 2018	7.61	264	2.60	34.17	233	88.26	24	10.30
4 Jun 2018	7.61	264	2.60	34.17	241	91.29	25	10.37
28 Oct 2018	7.61	263	2.59	34.03	225	85.55	23	10.22
16 Dec 2018	7.61	264	2.61	34.30	260	98.48	27	10.38
19 May 2019	7.61	264	2.60	34.17	260	98.48	27	10.38
22 Sep 2019	7.61	279	2.60	34.17	175	62.72	18	10.29
12 Dec 2019	7.61	262	2.58	33.90	195	74.43	21	10.77
3 Feb 2020	7.61	264	2.60	34.17	153	57.95	17	11.11
CCA								
3 Feb 2018	279.72	3,080	30.28	10.83	2,842	92.27	285	10.03
4 Jun 2018	279.72	3,080	30.28	10.83	2,859	92.82	287	10.04
28 Oct 2018	279.72	3,079	30.27	10.82	2,530	82.17	253	10.00
16 Dec 2018	279.72	3,080	30.41	10.87	3,040	98.70	305	10.03
19 May 2019	279.72	3,080	30.28	10.83	2,317	75.23	233	10.06
22 Sep 2019	279.72	3,159	30.28	10.83	2,149	68.03	215	10.00
12 Dec 2019	279.72	3,080	30.28	10.83	2,047	66.46	205	10.01
3 Feb 2020	279.72	3,080	30.28	10.83	2,742	89.03	275	10.03
KH								
31 Jan 2018	716.05	8,690	73.60	10.28	8,531	98.17	854	10.01
25 May 2018	716.05	8,690	73.60	10.28	8,608	99.06	861	10.00
3 Nov 2018	716.05	8,690	73.60	10.28	8,641	99.44	865	10.01
19 Dec 2018	716.05	8,688	73.58	10.28	7,416	85.36	742	10.01

(continued)

Table 4–5. (Continued)

Area/Dates of Survey	Size (km^2)	# Images	Image Area Size (km^2)	% Area Imaged	Blank Images			
					# Blank	% Blank	# QC'd	% QC'd
24 May 2019	716.05	8,690	73.41	10.25	8,522	98.07	853	10.01
30 Aug 2019	716.05	8,690	73.41	10.25	7,255	83.49	726	10.01
19 Dec 2019	716.05	8,694	73.45	10.26	8,592	98.83	860	10.01
12 Feb 2020	716.05	8,689	73.40	10.25	8,461	97.38	847	10.01
WW								
1–2 Feb 2018	345.30	4,170	35.32	10.23	3,770	90.41	380	10.08
16–17 Jun 2018	345.30	4,159	35.19	10.19	3,162	76.03	317	10.03
23 Oct 2018	345.30	4,165	41.60	12.05	4,143	99.47	415	10.02
22 Dec 2018	345.30	4,170	36.97	10.71	3,899	93.50	390	10.00
22–23 May 2019	345.30	4,170	35.23	10.20	4,140	99.28	415	10.02
10–11 Sep 2019	345.30	4,170	35.23	10.20	1,721	41.27	173	10.05
21–22 Dec 2019	345.30	1,840	15.54	4.50	1,575	85.60	158	10.03
2–8 Feb 2020	345.30	4,774	35.23	10.20	3,443	72.12	345	10.02
WE								
5 Feb 2018	751.45	9,250	78.35	10.43	8,559	92.53	856	10.00
2 Jun 2018	751.45	9,250	78.35	10.43	4,390	47.46	439	10.00
8 Sep 2018	751.45	9,250	78.35	10.43	4,606	49.79	461	10.01
22 Dec 2018	751.45	9,250	78.35	10.43	9,005	97.35	901	10.01
20 May 2019	751.45	9,250	78.14	10.40	6,866	74.23	687	10.01
29 Aug 2019	751.45	9,246	78.08	10.39	9,112	98.55	912	10.01
21 Dec 2019	751.45	9,249	78.13	10.40	7,566	81.8	757	10.01
12 Feb 2020	751.45	9,249	78.14	10.40	8,023	86.74	803	10.01
GSCA								
1–2 Feb 2018	1,941.55	23,465	198.75	10.24	22,856	97.40	2,386	10.44
16–17 Jun 2018	1,941.55	23,479	202.36	10.42	23,043	98.14	2,306	10.01
23 Oct 2018	1,941.55	23,499	225.18	11.60	23,036	98.03	2,356	10.23
22 Dec 2018	1,941.55	23,505	208.40	10.73	22,692	96.54	2,270	10.00
22–23 May 2019	1,941.55	23,484	220.87	11.38	23,331	99.35	2,334	10.00
10–11 Sep 2019	1,941.55	23,439	198.01	10.20	21,687	92.53	2,279	10.51
21–22 Dec 2019	1,941.55	12,320	104.08	5.36	10,745	87.22	1,075	10.00
2–8 Feb 2020	1,941.55	24,099	198.49	10.22	21,906	90.9	2,191	10.00

During blank review of the February 2018 survey, 109 of the 22,375 images that underwent QC were determined to contain targets missed in the initial target extraction (Table 4–6). The overall quality rate of the initial extraction was 99.51%, well within the QC criteria established for the project (Table 4–6).

During February 2020 blank review, 78 of the 51,537 images that underwent QC were determined to contain targets missed in the initial target extraction (Table 4–6). The overall quality rate of the initial extraction was 99.64%, well within the QC criteria established for the project (Table 4–6).

For the May/June 2018 blank review, 60 of the 22,167 images that underwent QC were determined to contain targets missed in the initial target extraction (Table 4–6). The overall quality rate of the initial extraction was 99.73%, well within the QC criteria established for the project (Table 4–6).

During blank review of the May 2019 survey, 74 of the 22,301 images that underwent QC were determined to contain targets missed in the initial target extraction (Table 4–6). The overall quality rate of the initial extraction was 99.67%, well within the QC criteria established for the project (Table 4–6).

In October 2018, 72 of the 22,168 images that underwent QC were determined to contain targets missed in the initial target extraction (Table 4–6). The overall quality rate of the initial extraction was 99.68%, well within the QC criteria established for the project (Table 4–6).

For the September 2019 blank review, 108 of the 20,473 images that underwent QC were determined to contain targets missed in the initial target extraction (Table 4–6). The overall quality rate of the initial extraction was 99.47%, well within the QC criteria established for the project (Table 4–6).

During December 2018 blank review, 196 of the 22,865 images that underwent QC were determined to contain targets missed in the initial target extraction (Table 4–6). The overall quality rate of the initial extraction was 99.14%, well within the QC criteria established for the project (Table 4–6).

In December 2019, 106 of the 20,601 images that underwent QC were determined to contain targets missed in the initial target extraction (Table 4–6). The overall quality rate of the initial extraction was 99.49%, well within the QC criteria established for the project (Table 4–6).

Table 4–6. Quality control results: blank images for each survey for all areas

Survey	# Images for QC	# Images QC'd as Blank	# Images QC'd Not Blank	% Agreement Reached
2018 February	22,375	22,266	109	99.51
2020 February	21,537	21,459	78	99.64
2018 May/June	22,167	22,107	60	99.73
2019 May	22,301	22,227	74	99.67
2018 October	22,168	22,097	72	99.68
2019 September	20,473	20,365	108	99.47
2018 December	22,865	22,669	196	99.14
2019 December	20,601	20,495	106	99.49

4.2.1 Animals Found during the Quality Control Process by Taxonomic Group

The number of individuals found during the QC process across all areas and for each survey are listed by taxonomic group in Table 4–7.

Of the 109 images from the February 2018 review, most images contained birds (n=92) followed by sharks (n=8), marine mammals (n=4), turtles (n=3), and large bony fishes (n=2) (Table 4–7). No rays were found during this period.

Of the 73 images from the February 2020 review, most images contained birds (n=61) followed by turtles (n=4), rays, turtles, and large bony fishes (n=3), and marine mammals (n=1) (Table 4–7).

Of the 60 images from the May/June 2018 review, most images contained sharks (n=17) followed by turtles (n=15), rays (n=13), birds (n=8), large bony fishes (n=5), and marine mammals (n=1) (Table 4–7).

Of the 68 images from the May 2019 review, most images contained large bony fishes (n=29) followed by sharks (n=17), birds (n=8), rays (n=6), marine mammals (n=4), and turtles (n=4) (Table 4–7).

During the October 2018 review, there were 72 images with most containing large bony fishes (n=27) followed by birds (n=17), rays (n=13), turtles (n=11), and sharks (n=3) (Table 4–7). There were no marine mammals found during this period.

During the September 2019 review, there were 93 images with most containing large bony fishes (n=59) followed by birds (n=20), sharks (n=9), turtles (n=3), rays (n=1), and marine mammals (n=1) (Table 4–7).

Of the 196 images from the December 2018 review, most images contained birds (n=157) followed by turtles (n=21), marine mammals (n=7), large bony fishes (n=7), and rays (n=3) (Table 4–7). There were no sharks found during this period.

Of the 103 images from the December 2019 review, most images contained birds (n=75) followed by turtles (n=13), large bony fishes (n=8), rays (n=3), marine mammals (n=3), and sharks (n=1) (Table 4–7).

Over all surveys, 771 images contained targets with most containing birds (n=438; 57%) followed by large bony fishes (n=140; 18%), turtles (n=74; 10%), sharks (n=56; 7%), rays (n=42; 5%), and marine mammals (n=21; 3%) (Table 4–7).

Table 4–7. Number of individuals within reported taxonomic groups found during the target extraction QC process for all surveys for all areas

Survey	Taxonomic Group						Total
	Avian	Marine Mammals	Turtles	Sharks	Rays	Large Bony Fish	
Feb 2018	92	4	3	8	–	2	**109**
Feb 2020	61	1	4	1	3	3	**73**
May/Jun 2018	8	1	15	17	13	5	**60**
May 2019	8	4	4	17	6	29	**68**
Oct 2018	17	–	11	3	13	27	**72**
Sep 2019	20	1	3	9	1	59	**93**
Dec 2018	157	7	21	–	3	7	**196**
Dec 2019	75	3	13	1	3	8	**103**
Totals	**438**	**21**	**74**	**56**	**42**	**140**	**771**

The number of individuals found during QC review for each survey are presented by area surveyed and taxonomic group in Appendix B.1, Table B–1. When counted by area, SASA counts include all of A51, part of A53, and part of CCA with 1-NM buffer; GSCA with 1-NM buffer counts include part of WW with 1-NM buffer. This causes multiple counts of some targets when added together, but these have been eliminated in Table 4–7. Values in Table B–1 will allow assessment of individual survey areas for each survey period.

4.2.2 Animals Found During Image Review by Taxonomic Group

The number of individuals found during target extraction are presented by taxonomic group for each survey (Table 4–8). Across all eight surveys, 185,983 animals were sent to taxonomic experts for identification, including 148,074 birds, 4,191 marine mammals, 3,049 turtles, 3,034 sharks, 23,380 rays, and 4,255 large bony fishes (Table 4–8). A list of all species found during the surveys is provided in Appendix A.

Table 4–8. Number of individuals within taxonomic groups found during the target extraction process and sent for identification during each survey for all areas

Survey	Taxonomic Group							Vessels and Fixed Structures
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	Total	
2018 February	61,566	501	379	278	3	526	**63,253**	9
2020 February	49,005	1,064	353	101	8	395	**50,926**	10
2018 May/June	257	104	241	608	3,795	192	**5,197**	12
2019 May	755	386	421	1,115	14,486	1,227	**18,390**	24
2018 October	2,181	358	394	269	813	988	**5,003**	10
2019 September	2,352	564	236	351	3,532	682	**7,717**	21
2018 December	17,639	667	345	41	603	88	**19,383**	12
2019 December	14,319	547	680	271	141	156	**16,114**	15
Totals	**148,074**	**4,191**	**3,049**	**3,034**	**23,380**	**4,255**	**185,983**	

The number of individuals found during target extraction for each area are presented by survey and taxonomic group in Appendix B.1 (Table B–2). When counted by area, SASA counts include all of A51, part of A53, and part of CCA with a 1-NM buffer; GSCA with 1-NM buffer counts include part of WW and 1-NM buffer. This means that some images and targets represent overlap of multiple areas and causes repeat counting of some targets when added together, but these duplicate counts have been eliminated in Table 4–8. Values in Table B–2 and Figure B–1 will allow assessment of individual survey areas for each survey period and include shared values.

During February 2018 across all areas, 63,262 targets were identified including vessels and fixed structures with 63,253 animals sent to taxonomic experts for identification including 61,566 birds, 501 marine mammals, 379 turtles, 278 sharks, 3 rays, and 526 large bony fishes (Table 4–8, Table B–2, Figure B–1).

During February 2020 across all areas, 50,936 targets were identified including vessels and fixed structures with 50,926 animals sent to taxonomic experts for identification including 49,005 birds, 1,064 marine mammals, 353 turtles, 101 sharks, 8 rays, and 395 large bony fishes (Table 4–8, Table B–2, Figure B–1).

Across all areas during May/June 2018, 5,209 targets were identified including vessels and fixed structures; 5,197 animals were sent to taxonomic experts for identification including 257 birds, 104 marine mammals, 243 turtles, 611 sharks, 3,795 rays, and 192 large bony fishes (Table 4–8, Table B–2, Figure B–1).

Across all areas during May 2019, 18,414 targets were identified including vessels and fixed structures; 18,390 animals were sent to taxonomic experts for identification including 755 birds, 386 marine mammals, 421 turtles, 1,115 sharks, 14,486 rays, and 1,227 large bony fishes (Table 4–8, Table B–2, Figure B–1).

For October 2018 across all areas, 5,013 targets were identified including vessels and fixed structures and 5,003 animals sent to taxonomic experts for identification including 2,181 birds, 358 marine mammals, 394 turtles, 269 sharks, 813 rays, and 988 large bony fishes (Table 4–8, Table B–2, Figure B–1).

For September 2019 across all areas, 7,738 targets were identified including vessels and fixed structures and 7,717 animals sent to taxonomic experts for identification including 2,352 birds, 564 marine mammals, 236 turtles, 351 sharks, 3,532 rays, and 682 large bony fishes (Table 4–8, Table B–2, Figure B–1).

Across all areas during December 2018, 19,395 targets were identified including vessels and fixed structures, and 19,383 animals were sent to taxonomic experts for identification including 17,639 birds, 667 marine mammals, 345 turtles, 41 sharks, 603 rays, and 88 large bony fishes (Table 4–8, Table B–2, Figure B–1).

Across all areas during December 2019, 16,124 targets were identified including vessels and fixed structures, and 16,114 animals were sent to taxonomic experts for identification including 14,319 birds, 547 marine mammals, 680 turtles, 271 sharks, 141 rays, and 156 large bony fishes (Table 4–8, Table B–2, Figure B–1).

4.3 Identification Success

Table 4–9 shows the total number of individuals (by taxonomic group), the number of images sent for QC, and the percent agreement reached. There were 181,728 animals sent for identification with 39,683 going through QC review (Table 4–9). All identifications reached and exceeded their targeted percent agreement with an overall 99% agreement (Table 4–9).

Table 4–9. Total number of images by taxonomic group, number of images QC'd, and percent agreement reached for all surveys for all areas

Taxonomic Group	2018 February–2020 February		
	Total Individuals	Number of Images for QC	% Agreement (rounded)
Avian	148,074	30,225	99
Marine Mammals	4,191	843	100
Turtles	3,049	3,049	100
Sharks	3,034	870	100
Rays	23,380	4,696	100
Total	**181,728**	**39,683**	**99**

The number of individuals within each taxonomic group, number of individuals QC'd, and percent agreement among QC'd individuals for each survey, survey design, and survey area are shown in Appendix B.3, Table B–3 through Table B–10. When counted by area, SASA counts include all of A51, part of A53, and part of CCA with 1-NM buffer; GSCA with 1-NM buffer counts include part of WW with 1-NM buffer. This causes multiple counts of some targets when added together, but these have been eliminated in Table 4–9. Values in Table B–3 through Table B–10 will allow assessment of individual survey areas for each survey period.

In February 2018, there were 63,632 targets identified from all areas and sent to taxonomic experts for identification (Table B–3). QC review was performed on 12,906 individuals (20%). All identifications reached and exceeded their targeted percent agreement (Table B–3) (see Appendix A for a list of species in taxonomic groups).

In February 2020, there were 51,264 targets identified from all areas and sent to taxonomic experts for identification (Table B–4). QC review was performed on 10,436 individuals (20%). All identifications reached and exceeded their targeted percent agreement (Table B–4) (Appendix A).

For May/June 2018, there were 5,202 targets identified from all areas and sent to taxonomic experts for identification with 1,242 (24%) undergoing QC review (Table B–5). All identifications reached and exceeded their targeted percent agreement (Table B–5) (Appendix A).

For May 2019, there were 18,449 targets identified from all areas and sent to taxonomic experts for identification with 3,912 (21%) undergoing QC review (Table B–6). All identifications reached and exceeded their targeted percent agreement (Table B–6) (Appendix A).

In October 2018, there were 5,008 targets identified from all areas and sent to taxonomic experts for identification with 1,968 (39%) undergoing QC review (Table B–7). All identifications reached and exceeded their targeted percent agreement (Table B–7) (Appendix A).

In September 2019, there were 7,743 targets identified from all areas and sent to taxonomic experts for identification with 1,627 (21%) undergoing QC review (Table B–8). All identifications reached and exceeded their targeted percent agreement (Table B–8) (Appendix A).

During December 2018, there were 19,445 targets identified from all areas and sent to taxonomic experts for identification with 4,170 (21%) undergoing QC review (Table B–9). All identifications reached and exceeded their targeted percent agreement (Table B–9) (Appendix A).

During December 2019, there were 16,354 targets identified from all areas and sent to taxonomic experts for identification with 3,816 (23%) undergoing QC review (Table B–10). All identifications reached and exceeded their targeted percent agreement (Table B–10) (Appendix A).

The number of individuals of threatened and endangered species identified by taxonomic group that were reviewed, and the percent identification reached for each survey across all areas are listed in Table 4–10. For the February 2018 survey, 576 (<1%) of the 63,632 (Table B–3) individuals recorded were considered endangered species, either identified as a listed species or in the same genus as a listed species where species-level identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 4–10). Within the endangered species, turtles (n=379; 65.8%) and sharks (n=187; 32.5%) were the most abundant taxonomic groups for February 2018 (Table 4–10).

For the February 2020 survey, 373 (<1%) of the 51,264 (Table B–4) individuals recorded were considered endangered species, either identified as a listed species or in the same genus as a listed species where species-level identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 4–10). Within the endangered species, turtles (n=353; 95%) and large bony fishes (n=13; 3.5%) were the most abundant taxonomic groups for February 2020 (Table 4–10).

Of the 5,202 targets imaged during the May/June 2018 survey (Table B–5), 338 (6.5%) were considered endangered species, either identified as a listed species or in the same genus as a listed species where species-level identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 4–10). Turtles comprised 71% (n=241) of the total for this survey followed by sharks (n=51; 15%) (Table 4–10).

Of the 18,449 targets imaged during the May 2019 survey (Table B–6), 584 (3.2%) were considered endangered species, either identified as a listed species or in the same genus as a listed species where species-level identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 4–10). Turtles comprised 72% (n=421) of the total for this survey followed by sharks (n=155; 26.5%) (Table 4–10).

Of the 5,008 images during October 2018 (Table B–7), 684 (13.7%) were considered endangered species, either identified as a listed species or in the same genus as a listed species where species-level

identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 4–10). The dominant taxonomic groups were turtles (n=394; 57.6%) and large bony fishes (n=210; 30.7%) (Table 4–10).

Of the 7,743 images during September 2019 (Table B–8), 282 (3.6%) were considered endangered species, either identified as a listed species or in the same genus as a listed species where species-level identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 4–10). The dominant taxonomic groups were turtles (n=236; 83.7%) and sharks (n=28; 10%) (Table 4–10).

During December 2018, 19,445 images were collected (Table B–9). Of these, 370 (1.9%) were considered endangered species, either as a listed species or in the same genus as a listed species where species-level identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 4–10). The dominant group during this survey was turtles (n=345; 93.2%) (Table 4–10).

During December 2019, 16,345 images were collected (Table B–10). Of these, 766 (4.7%) were considered endangered species, either as a listed species or in the same genus as a listed species where species-level identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 4–10). The dominant group during this survey was turtles (n=680; 88.8%) followed by sharks (n=68; 8.9% (Table 4–10).

Overall, turtles (n=3,049; 77%) made up the bulk of threatened and endangered species found during all surveys (Table 4–10). Following turtles, sharks (n=540; 14%) and large bony fishes (n=246; 6.2%) were the most abundant taxonomic groups (Table 4–10).

Table 4–10. Number of individuals of threatened and endangered species by taxonomic group reviewed and percent identification agreement reached for all areas for all surveys

Survey	Taxonomic Group						Total
	Avian	Marine Mammals	Turtles	Sharks	Rays	Large Bony Fish	
Feb 2018	–	2	379	187	1	7	**576**
Feb 2020	2	2	353	3	–	13	**373**
May/Jun 2018	41	–	241	51	5	–	**338**
May 2019	–	–	421	155	6	2	**584**
Oct 2018	40	1	394	37	2	210	**684**
Sep 2019	7	–	236	28	10	1	**282**
Dec 2018	–	1	345	11	–	13	**370**
Dec 2019	16	2	680	68	–	–	**766**
% Agreement	**100**	**100**	**100**	**100**	**100**	**100**	**100**

The number of threatened and endangered individuals within each taxonomic group, number of individuals QC'd, and percent identification agreement for each survey, survey design, and survey area are shown in Table B–11 through Table B–18. When counted by area, SASA counts include all of A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–10. Values in Table B–11 through Table B–18 will allow assessment of individual survey areas for each survey period.

Accuracy assessments show 100% agreement when comparing the initial identification and the QC identification by type (e.g., all targets initially identified as birds were QC'd as birds). At the species-

group level, there was a high level of agreement between the initial identifications and the QC identifications with all animal types showing >99% accuracy. Accuracy was lower when identifying targets to the species level with birds having the lowest species-level identification accuracy at 79.1% and rays having the highest at 98.9% (Table 4–11).

Further assessments looking at accuracy at the subtype and species levels are presented in their respective report sections.

Table 4–11. Overall accuracy assessments by animal type among all seasons

Percentages reflect the agreement between the initial identification the identification made during QC. Species-group comparisons compare the ability to identify a target in the appropriate species group (e.g., shearwaters, phalaropes, etc.) while species-level comparisons assess the accuracy of species-level identifications.

Animal Type	Species-Group Level	Species-Level	n
Birds	99.7%	79.1%	30,225
Marine Mammals	100.0%	94.9%	843
Sea Turtles	99.9%	94.9%	3,049
Sharks	99.9%	94.7%	870
Rays	99.9%	98.9%	4,696

4.4 Density and Relative Abundance

The density and relative abundance of each taxonomic group differed among surveys. We have corrected for survey coverage bias by presenting densities per km^2 of area imaged and analyzed per survey as described in Methods (Section 3.7). Density of individuals in each taxonomic group by survey across all areas is shown in Table 4–12, Figure 4–1.

Density was greatest during February 2018 with 27.1 individuals/km^2 (34% of the total for all surveys combined). Birds were the most frequent with 26.3 birds/km^2 (97%) followed by large bony fishes (0.23; 0.83%), marine mammals (0.21; 0.79%), turtles (0.16; 0.60%), and sharks (0.12; 0.44%). Ray encounters (0.001) represented <0.01% (Table 4–12).

Density during February 2020 was the second highest of all surveys with 21.9 individuals/km^2 (27.3%). Birds were the most frequent with 21.1 birds/km^2 (96%) followed by marine mammals (0.46; 2%), large bony fishes (0.17; 0.78%), turtles (0.15; 0.69%), and sharks (0.04; 0.20%). Ray encounters (0.003) represented 0.02% (Table 4–12).

Of the 2.4 individuals/km^2 (3% of all surveys combined) encountered during May/June 2018, rays (1.76 rays/km^2; 73%) were the most frequently encountered group followed by sharks (0.28; 11.7%), birds (0.12; 4.95%), turtles (0.11; 4.6%), large bony fishes (0.09; 3.69%), and marine mammals (0.05; 2.0%) (Table 4–12).

Of the 7.8 individuals/km^2 (9.8%) encountered during May 2019, rays (6.17 rays/km^2; 78.8%) were the most frequently encountered group followed by large bony fishes (0.52; 6.7%), sharks (0.48; 6%), birds (0.32; 4.11%), turtles (0.18; 2.3%), and marine mammals (0.16; 2.1%) (Table 4–12).

October 2018 had the lowest total abundance of all surveys (2.8%). Of the 2.2 individuals/km^2, birds (0.96; 43.6%) were the most frequently encountered group. Large bony fishes (19.8%) and rays (16.3%) were followed by turtles (7.9%), marine mammals (7.2%), and sharks (5.4%) (Table 4–12).

September 2019 also had a low total abundance (4.1%). Of the 3.3 individuals/km^2, rays (1.5; 45.8%) were the most frequently encountered group. Birds (30.4%), large bony fishes (8.8%), and marine mammals (7.3%) were followed by sharks (4.6%) and turtles (3.1%) (Table 4–12).

December 2018 accounted for the third most abundant period with 10.3% of the total for all surveys combined. Birds accounted for 91% of the total. Marine mammals, rays, and turtles combined represented 8.3% of the total observations with large bony fishes and sharks being <1% (Table 4–12).

December 2019 accounted for 10.3% of the total for all surveys combined. Birds accounted for 89% of the total for this survey. Marine mammals, rays, and turtles combined represented 9.3% of the total observations with large bony fishes and sharks being <1% (Table 4–12).

Overall, birds represented the greatest number of occurrences with 80% of the combined total (Table 4–12). Rays were encountered 12.6% of the time followed by large bony fishes (2.3%), marine mammals (2.3%), turtles (1.5%), and sharks (1.6%) (Table 4–12).

The density/km^2 of individuals in each taxonomic group by survey for each area is shown in Appendix B.4, Table B–19 through Table B–26, Figure B–1. When counted by area, SASA counts include all of A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–12 and Figure 4–1. Values in Table B–19 through Table B–26 and Figure B–1 will allow assessment of individual survey areas for each survey period.

Table 4–12. Density per km^2 and percent of total of individuals in taxonomic group by survey

Survey	Taxonomic Group and Density per km^2												Total Density (km^2)
	Avian		Mammal		Turtle		Shark		Ray		Large Bony Fish		
	Density (km^2)	%	Density (km^2)	%	Density (km^2)	%	Density (km^2)	%	Density (km^2)	%	Density (km^2)	%	
Feb 2018	26.3403	97.33	0.2143	0.79	0.1622	0.60	0.1189	0.44	0.0013	0.00	0.2250	0.83	27.0620
Feb 2020	21.0655	96.23	0.4574	2.09	0.1517	0.69	0.0434	0.20	0.0034	0.02	0.1698	0.78	21.8912
May/Jun 2018	0.1190	4.95	0.0482	2.00	0.1116	4.64	0.2816	11.70	1.7579	73.02	0.0889	3.69	2.4072
May 2019	0.3214	4.11	0.1643	2.10	0.1792	2.29	0.4746	6.06	6.1666	78.77	0.5223	6.67	7.8284
Oct 2018	0.9642	43.59	0.1583	7.16	0.1742	7.88	0.1189	5.38	0.3594	16.25	0.4368	19.75	2.2118
Sep 2019	1.0066	30.48	0.2414	7.31	0.1010	3.06	0.1502	4.55	1.5115	45.77	0.2919	8.84	3.3026
Dec 2018	7.5129	91.00	0.2841	3.44	0.1469	1.78	0.0175	0.21	0.2568	3.11	0.0375	0.45	8.2557
Dec 2019	6.4658	88.86	0.2470	3.39	0.3071	4.22	0.1224	1.68	0.0637	0.88	0.0704	0.97	7.2764
Total	**63.7957**	**79.62**	**1.8150**	**2.25**	**1.3339**	**1.64**	**1.3275**	**1.63**	**10.1202**	**12.57**	**1.8430**	**2.29**	**80.2353**

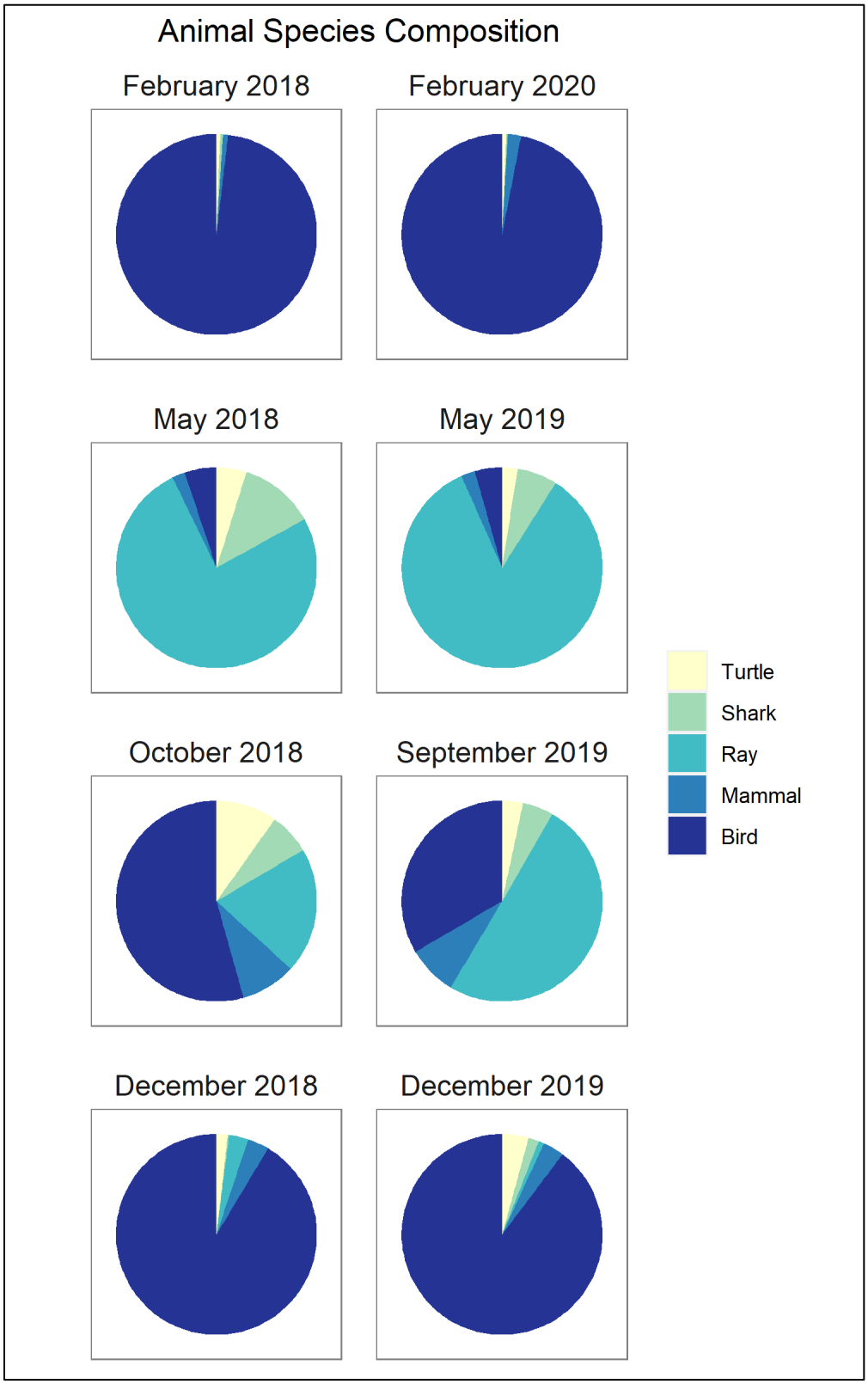

Figure 4–1. Percent composition of taxonomic groups found during target extraction for each survey

4.5 Birds

4.5.1 Species Identification

Over the eight surveys, 148,074 birds were identified in imagery comprising 64 species (see Appendix A). All birds were classified to species group at a minimum (Appendix A). Avian species-level identifications varied by group depending on size and coloration. The largest and most distinct bird species found naturally had higher identification rates, and this included northern gannet with 100% of these identified to species (n=20,760), pelicans (n=126), fulmars (n=51), Ardeidae (n=18), grebes (n=2), and raptors (n=1) (Table 4–13). Of the remaining species, ducks (scoters) and loons had a 99% identification success rate (n=901 and n=25,074, respectively), auks 97% (n=20,009), cormorants 96% (n=1,195), gulls 93% (n=35,556), shearwaters 89% (n=809), ducks (excluding scoters) 72% (n=94), terns 71% (n=1,746), *Sterna* terns 67% (n=4,910), and skuas 65% (n=17) (Table 4–13).

Other species groups with multiple morphologically similar species expected in the project area had lower identification rates. Two species of morphologically similar species of phalaropes are found in the project area. These are red and red-necked phalaropes, and 88% of these small birds were ascribed to species (n=36,410). The *Sterna* tern group also contains difficult-to-distinguish species with 67% ascribed to species (n=4,910). Storm-petrels achieved a 0% identification success; however, only 8 individuals were observed. Shorebird identification is always challenging with multiple small species having similar morphological traits; 7% of shorebirds were ascribed to species (n=346). Although a large-species group, the cormorant group has two morphologically similar species present in the area at certain times of the year (double-crested cormorant and great cormorant), and 96% of cormorants were identified to species (n=1,195) (Table 4–13; Appendix A).

The number of individuals identified in avian groups, the percent identification success rate, and the percent of individuals sitting are presented in Appendix C.1, Table C–1 through Table C–8 for each area for each survey. When counted by area, SASA counts include all of A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–13. Values in Table C–1 through Table C–8 will allow assessment of individual survey areas for each survey period. Raw counts of avian species identified in all surveys in all areas combined are presented in Appendix C.2, Table C–9. Raw counts of avian species are presented in Table C–10 through Table C–16 for each area for each survey.

Table 4–13. Species identification success rates for birds for all surveys and all areas

Name	Number in Species Group	Number Identified to Species	Number of Species Unknown or Species Group	Percent ID Success
Duck (excluding Scoters)	94	68	26	72
Duck (Scoters)	901	895	6	99
Loon	25,074	24,735	339	99
Grebe	2	2	–	100
Fulmar	51	51	–	100
Petrel	14	9	5	64
Shearwater	809	720	89	89
Storm-petrel	8	–	8	–
Gannet	20,760	20,760	–	100

(continued)

Table 4–13. (Continued)

Name	Number in Species Group	Number Identified to Species	Number of Species Unknown or Species Group	Percent ID Success
Cormorant	1,195	1,153	42	96
Pelican	126	126	–	100
Ardeidae	18	18	–	100
Raptor	1	1	–	100
Shorebird	346	23	323	7
Phalarope	36,410	32,168	4,242	88
Skua	17	11	6	65
Auk	20,009	19,467	542	97
Gull	35,556	33,066	2,490	93
Tern	1,746	1,238	508	71
Sterna Tern	4,910	3,308	1,602	67
Passerine	27	–	27	–

Accuracy assessments for birds showed an overall 99.7% accuracy at the subtype level and a 79.1% accuracy at the species level. Individual species groups accuracy was also high with most species groups having >95% agreement between initial identification and QC identification (Table 4–14). The notable exception was shearwaters where the initial identification had only 77% agreement with the QC identification (n=96), and this was due to 22 targets initially identified as shearwaters being QC'd as unknown small shearwater.

At the species level, identification accuracy was much more variable due to the increasing difficulty of identifying targets at lower taxonomic levels. Species with distinctive field marks and/or large body size (e.g., northern gannet) had high identification success. In contrast species that appear similar or occur as part of a species blend (e.g., phalaropes and terns) had lower identification accuracy (Table 4–15). For example, of the 6,021 red phalaropes initially identified, only 2,930 of those (48.7%) were identified as such by the QC identification. The remaining 3,091 birds were identified as a similar species or species blend: red-necked phalarope (23), red/red-necked phalarope (3,063), and phalarope-species unknown (5). A similar finding occurred with common tern: of the 237 targets initially identified as a common tern, 175 were also identified the same by the QC identification. The remaining 62 targets were identified by the QC observer as commic tern (8), commic/Forster's tern (24), sandwich tern (1), *Sterna* tern unknown (28), and tern-species unknown (1).

Table 4–14. Initial identification accuracy and QC ID accuracy for bird species groups

Species Group	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Duck	99.7%	100.0%	365	364
Loon	99.9%	100.0%	4,576	4,572
Fulmar	100.0%	100.0%	10	10
Shearwater	100.0%	98.0%	96	98
Storm-petrel	100.0%	100.0%	1	1
Gannet	100.0%	100.0%	4,226	4,227
Cormorant	100.0%	100.0%	287	287
Pelican	100.0%	100.0%	25	25
Ardeidae	100.0%	100.0%	1	1
Shorebird	98.2%	100.0%	55	54
Phalarope	100.0%	99.9%	7,232	7,236
Skua	100.0%	100.0%	2	2
Auk	99.9%	100.0%	3,444	3,443
Gull	99.9%	99.9%	7,472	7,473
Tern	95.8%	98.0%	518	506
Sterna Tern	99.4%	98.9%	1,913	1,924
Passerine	100.0%	100.0%	2	2

Table 4–15. Initial identification accuracy and QC ID accuracy for bird species

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Greater Scaup	100.0%	100.0%	7	7
White-winged Scoter	100.0%	100.0%	2	2
Black Scoter	99.4%	99.7%	342	341
Scoter unid.	0.0%	0.0%	1	1
Red-breasted Merganser	87.5%	100.0%	8	7
Duck-species unknown	80.0%	66.7%	5	6
Red-throated Loon	94.0%	98.7%	1,958	1,865
Common Loon	97.0%	99.5%	2,530	2,467
Loon-species unknown	73.9%	27.1%	88	240
Northern Fulmar	100.0%	100.0%	10	10
Cory's Shearwater	100.0%	100.0%	8	8
Great Shearwater	100.0%	100.0%	1	1
Manx Shearwater	66.2%	100.0%	77	51
Audubon's Shearwater	100.0%	66.7%	4	6
Shearwater-species unknown-Large	100.0%	100.0%	3	3
Shearwater-species unknown-Small	100.0%	11.1%	3	27
Shearwater-species unknown	NA*	0.0%	0	2
Storm-petrel-species unknown	100.0%	100.0%	1	1

(continued)

Table 4–15. (Continued)

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Northern Gannet	100.0%	100.0%	4,226	4,227
Double-crested Cormorant	100.0%	100.0%	281	281
Cormorant-species unknown	100.0%	100.0%	6	6
Brown Pelican	100.0%	100.0%	25	25
Snowy Egret	100.0%	100.0%	1	1
Black-bellied Plover	100.0%	100.0%	3	3
Ruddy Turnstone	100.0%	66.7%	2	3
Dunlin	100.0%	100.0%	1	1
Shorebird-species unknown	95.9%	100.0%	49	47
Red-necked Phalarope	16.7%	1.8%	6	57
Red Phalarope	48.7%	99.8%	6,021	2,936
Red/Red-necked Phalarope	96.8%	27.5%	1,205	4,236
Skua-species unknown	100.0%	100.0%	2	2
Dovekie	NA*	0.0%	0	1
Common/Thick-billed Murre	100.0%	66.7%	4	6
Razorbill	28.6%	100.0%	3,345	956
Murre/Razorbill	91.5%	2.8%	71	2,310
Atlantic Puffin	83.3%	100.0%	6	5
Auk-species unknown	77.8%	8.5%	18	165
Black-legged Kittiwake	96.9%	78.8%	65	80
Bonaparte's Gull	99.4%	98.6%	5,900	5,949
Little Gull	NA*	0.0%	0	1
Laughing Gull	97.2%	97.7%	217	216
Ring-billed Gull	88.0%	95.7%	25	23
Herring Gull	99.3%	98.6%	842	848
Iceland Gull	100.0%	100.0%	1	1
Lesser Black-backed Gull	95.5%	84.0%	22	25
Glaucous Gull	100.0%	100.0%	1	1
Great Black-backed Gull	100.0%	93.4%	71	76
Gull-species unknown - Large	26.1%	42.9%	23	14
Gull-species unknown - Small	64.7%	84.0%	300	231
Gull-species unknown	40.0%	25.0%	5	8
Bridled Tern	100.0%	100.0%	5	5
Least Tern	100.0%	85.7%	6	7
Gull-billed Tern	100.0%	50.0%	4	8
Caspian Tern	100.0%	100.0%	1	1
Black Tern	100.0%	100.0%	130	130
Royal Tern	95.3%	85.3%	85	95

(continued)

Table 4–15. (Continued)

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Royal/Caspian Tern	100.0%	50.0%	4	8
Sandwich Tern	86.8%	91.7%	38	36
Thalasseus Tern unid.	100.0%	83.3%	5	6
Tern-species unknown	83.8%	95.7%	240	210
Common Tern	73.8%	84.1%	237	208
Commic Tern	100.0%	7.1%	1	14
Forster's Tern	93.8%	91.5%	792	812
Commic/Forster's Tern	81.5%	87.7%	777	722
Sterna Tern-species unknown	70.8%	44.9%	106	167
Passerine-species unknown	100.0%	100.0%	2	2
Phalarope-species unknown	NA*	0.0%	0	7
Roseate Tern	NA*	0.0%	0	1

*An NA value means that no individuals of that species were identified by the respective observer.

4.5.2 Species Composition and Density

Species composition and abundance was varied throughout the year, highlighting the seasonal nature of avian activity. The February 2018 survey was dominated by loons (26%), gulls (22%), phalaropes (22%), and auks (19%) (Table 4–16, Figure 4–2). The February 2020 survey was dominated by phalaropes (33%), gulls (27%), and auks (16%), with loons comprising only 9%. Abundance for gannets during both February surveys was similar (10%) (Table 4–16). During the May/June 2018 survey, terns accounted for 58% of the sample with *Sterna* terns and gulls comprising 16% and 15% of the sample, respectively (Table 4–16, Figure 4–2). During the May 2019 survey, shorebirds (43%) were most dominant with terns and *Sterna* terns at 16% and 12%, respectively (Table 4–16). During the October 2018 survey *Sterna* terns (36%), terns (27%), and gulls (22%) were dominant (Table 4–16, Figure 4–2). Similarly, the September 2019 survey was dominated by *Sterna* terns (50%) and terns (36%), but low numbers of gulls were observed (2%) with shearwaters (10%) observed the most during any survey (Table 4–16). The December 2018 survey was dominated by gulls (38%) and gannets (21%) with 14% of the survey sampling containing loons (Table 4–16, Figure 4–2). The December 2019 survey was dominated by phalaropes (41%), gannets (24%), and loons (17%) (Table 4–16). Overall, the dominant species across all surveys and all areas were phalaropes (25%), gulls (24%), loons (17%), and gannets (14%) and auks (both at 14%) (Table 4–16, Figure 4–2).

Relative abundance by each species group varied among surveys. The shift in species seasonal representation was marked, with avian species-group richness the lowest in the May/June 2018 survey (n=9), followed by February 2018 (n=10), September 2019 and December 2019 (n=12), December 2018 (n=13), and October 2018 (n=18) with an overall species-group richness of 20 for the eight surveys (see Table 4–16, Appendix A and Appendix C.1 for a list of species in taxonomic groups and numbers by season). We do not include phalaropes in the group “shorebird,” nor do we include *Sterna* terns with the overall group of terns (Table 4–16, Figure 4–2).

Table 4–16. Percent relative abundance of each avian species group by survey for all areas

Species	Relative Abundance (%)								Species Total
	2018 Feb	2020 Feb	2018 May/Jun	2019 May	2018 Oct	2019 Sep	2018 Dec	2019 Dec	
Duck	0.15	0.08	—	—	—	0.34	3.46	1.70	0.67
Loon	25.71	8.72	3.89	7.42	5.09	—	13.75	16.58	16.93
Grebe	>0.01	—	—	—	—	—	—	—	<0.01
Fulmar	0.08	—	—	—	0.05	—	0.01	—	0.03
Petrel	—	0.01	0.78	0.13	0.23	0.13	—	—	0.01
Shearwater	0.05	0.16	4.28	0.40	2.66	10.25	1.69	0.64	0.55
Storm-petrel	—	—	—	0.66	0.09	—	—	—	0.01
Gannet	10.36	10.80	1.17	0.79	2.98	—	31.44	24.21	14.02
Cormorant	0.03	2.36	—	0.26	0.37	—	0.02	0.03	0.81
Pelican	—	0.10	—	1.46	0.96	0.04	0.25	—	0.09
Ardeidae	—	—	0.39	0.13	0.69	0.04	—	—	0.01
Raptor	—	—	—	—	0.05	—	—	—	—
Shorebird	—	—	—	42.91	0.73	0.09	—	0.03	0.23
Phalarope	21.77	32.98	0.78	4.24	1.56	1.32	4.73	41.32	24.59
Skua	—	—	—	0.13	0.09	0.09	0.03	0.02	0.01
Auk	18.70	16.28	—	1.32	0.09	—	2.75	0.17	13.51
Gull	22.20	27.16	14.79	8.34	21.82	2.00	38.31	8.36	24.01
Tern	—	0.01	57.98	16.29	26.55	35.93	0.19	0.07	1.18
Sterna Tern	0.95	1.35	15.95	12.32	35.95	49.70	3.36	6.88	3.32
Passerine	—	—	—	3.18	0.05	0.09	—	—	0.02
Totals	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

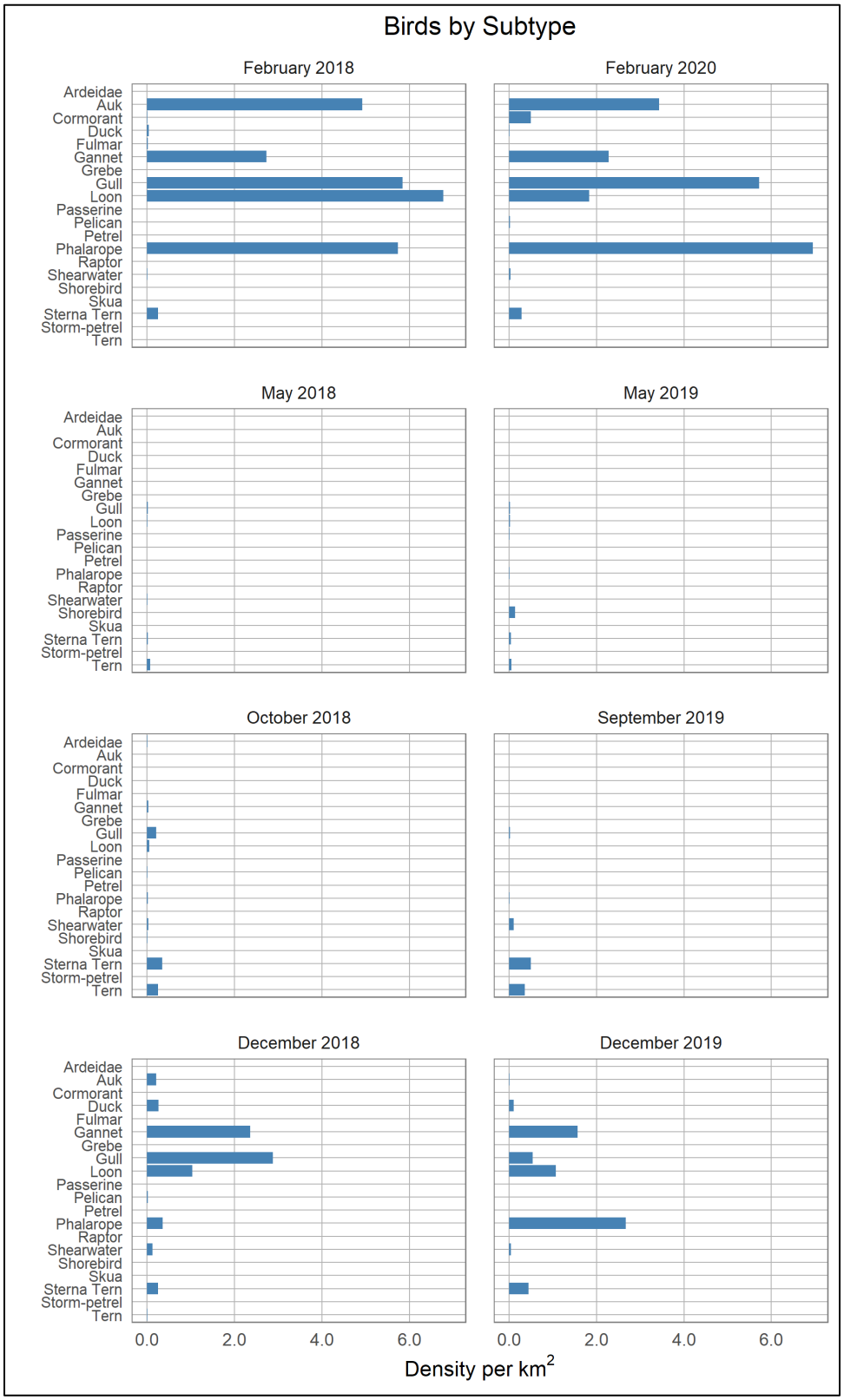

Figure 4–2. Density (per km^2) of avian species groups by survey for all areas

The percent relative abundance of each avian species group for each area for each survey is presented in Appendix C.3, Table C–17 through Table C–24 and Figure C–1. When counted by area, SASA counts include all of A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–17 and Table 4–18. Values in Table C–17 through Table C–24 and Figure C–1 will allow assessment of individual survey areas for each survey period.

Across all surveys, phalaropes (15.8 birds/km^2; 24.7%) was the most frequently encountered group closely followed by gulls (15.3 birds/km^2; 23.9%). However, gulls and ducks were the most diverse groups with 10 species identified (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4 while there were only 2 phalarope species identified (Table 4–17, Table 4–18). Numbers of gulls were highest during February 2018 and February 2020 with a near equal density of 5.9 and 5.7 birds/km^2. During December 2018 and 2019, numbers were 2.9 and 0.5 birds/km^2, respectively (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). For the remaining surveys, there were ≥0.2 birds/km^2. Despite this difference in densities, diversity remained similar for five of the eight surveys with 10 gull species identified in February 2018 and December 2018, 8 gulls species identified in February 2020, 7 gull species in October 2018 and December 2019, and 5 gull species identified in September 2019. There was only one gull species recorded during the May/June 2018 survey (laughing gull), which was the only species observed during all eight surveys (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4).

The next most abundant species group across all surveys and all areas was loons (10.8 birds/km^2) (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4) with 63% (6.8 per km^2) found during the February 2018 survey. Red-throated loons were dominant (5.1 per km^2; 87%) during the February 2018 survey while common loons were dominant in February 2020 (1.4 per km^2; 29%) and in both December surveys (17.4%) (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4).

After loons, gannets was the next most frequently encountered species group (8.9 per km^2) with only one species recorded (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). For gannets, the numbers were highest during the February and December surveys with February 2018 having the highest number (2.7 per km^2; 30.7%) closely followed by December 2018 (2.4 per km^2; 26.7%) and February 2020 (2.3 per km^2; 25.5%). The December 2019 survey had 1.6 birds/km^2 (16.7%), and all other surveys were >1% except during September 2019 when no gannets were observed (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4).

The auks species group (8.6 per km^2) was the next most frequently encountered group following loons (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). Three species of auks were identified in images and there were two species blends. This species group showed variable density fluctuations among surveys. When looking at numbers and accounting for effort (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4), the numbers of auks in the February 2018 survey represented 57.5% (4.9 per km^2) of those recorded in all surveys combined followed by February 2020 (3.4 per km^2; 39.8%). The auks recorded in December 2018 represented 19% (2.9 per km^2) and during December 2019 3.4% (0.54 per km^2) of the total. Razorbill was the most dominant species in this group with 8.3 birds/km^2 (97%) observed across all surveys and areas (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). There were two species observed during the May/June 2018 and May 2019 surveys (dovekie and 'species unknown'), one species during October 2018 ('species unknown'), and no observations during September 2019.

Sterna terns (overall 2.1 per km^2) were most abundant during the September 2019 survey (0.5 per km^2; 23.8%) and December 2019 survey (0.44 per km^2; 20%), followed by the October 2018 survey (0.35 per km^2; 16%) with similar density in both February surveys (0.25 [11.8%] and 0.29 [13.5%] per km^2) and December 2018 (0.25 per km^2; 12%) (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). Abundance of

Sterna terns was low for the May/June 2018 survey (0.02 per km^2) and consisted 100% of 'species unknown.' Forster's tern was the dominant species in December 2019 (0.38 per km^2; 86% of the survey), February 2018 (0.25 per km^2; 100%), and February 2020 and December 2018 (0.20 per km^2; 71% and 80.1%, respectively); it was the overall dominant species across all surveys (51%) (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). A large group of individuals in the Commic/Forster's tern species group (0.24 per km^2; 68% of the survey) was encountered in the October 2018 survey (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4).

Terns were present in seven of the eight surveys; they were not recorded in February 2018 (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). The most terns were recorded during the September 2019 survey (0.36 per km^2; 48%) and October 2018 survey (0.26 per km^2; 33.2%). The dominant species over all surveys for all areas was royal tern (0.23 per km^2; 30.6%) followed by black tern (0.18 per km^2; 14%). Royal terns were observed in five of the seven surveys where terns were recorded, representing 48% of the total (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). There was also a large group of 'species unknown' recorded in the October survey 2018 (0.12 per km^2), with this species group being the third most dominant over all surveys for all areas (0.16 per km^2; 21.4%). This group had a large diversity with 9 species identified over all surveys, most of which were observed during the May/June 2018, May 2019, October 2018, and September 2019 surveys.

Ducks were observed during December 2018 (0.26 per km^2; 61.4%), December 2019 (0.12 per km^2; 24.4%), February 2018 (0.04 per km^2; 9.6%), February 2020 (0.02 per km^2; 3.8%), and September 2019 (0.003 per km^2; 0.8%) (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4). The dominant species for these surveys was black scoter (0.38 per km^2) representing 89% of the total. The group had the largest diversity of all surveys with 10 species identified (same as gulls); most being found during December 2018 (n=8) (Table 4–17, Table 4–18; Figure 4–3, Figure 4–4).

Table 4–17. Density per km^2 and percent of total avian species identified in the February 2018 through February 2020 surveys for all areas

Species Group	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		Species Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Duck	**0.0406**	**9.55**	**0.0163**	**3.82**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0034**	**0.80**	**0.2602**	**61.41**	**0.1097**	**24.42**	**0.4304**
Gadwall	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0023	100.00	0.0023
American Black Duck	–	–	–	–	–	–	–	–	–	–	–	–	0.0004	100.00	–	–	0.0004
Redhead	–	–	–	–	–	–	–	–	–	–	0.0004	100.00	–	–	–	–	0.0004
Greater Scaup	–	–	0.0103	64.86	–	–	–	–	–	–	–	–	0.0043	27.03	0.0014	8.11	0.0159
Lesser Scaup	–	–	–	–	–	–	–	–	–	–	–	–	0.0017	100.00	–	–	0.0017
Surf Scoter	–	–	0.0004	25.00	–	–	–	–	–	–	–	–	0.0013	75.00	–	–	0.0017
White-winged Scoter	–	–	–	–	–	–	–	–	–	–	–	–	0.0034	88.89	0.0005	11.11	0.0039
Black Scoter	0.0381	10.09	0.0034	0.91	–	–	–	–	–	–	–	–	0.2381	63.38	0.1021	25.62	0.3817
Scoter unid.	–	–	0.0017	66.67	–	–	–	–	–	–	–	–	0.0009	33.33	–	–	0.0026
Long-tailed Duck	0.0004	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0004
Red-breasted Merganser	0.0013	15.79	–	–	–	–	–	–	–	–	–	–	0.0047	57.89	0.0023	26.32	0.0082
species unknown	0.0009	7.69	0.0004	3.85	–	–	–	–	–	–	0.0030	26.92	0.0055	50.00	0.0014	11.54	0.0112
Loon	**6.7710**	**63.12**	**1.8360**	**17.03**	**0.0046**	**0.04**	**0.0238**	**0.22**	**0.0491**	**0.44**	**–**	**–**	**1.0333**	**9.68**	**1.0720**	**9.47**	**10.7898**
Red-throated Loon	5.1247	86.91	0.3912	6.60	–	–	0.0009	0.01	0.0013	0.02	–	–	0.2083	3.55	0.1806	2.90	5.9069
Common Loon	1.6048	34.25	1.3816	29.34	0.0046	0.09	0.0217	0.47	0.0477	0.99	–	–	0.8135	17.44	0.8620	17.43	4.7360
species unknown	0.0415	28.61	0.0632	43.36	–	–	0.0013	0.88	–	–	–	–	0.0115	7.96	0.0294	19.17	0.1468
Grebe	**0.0009**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0009**
Horned Grebe	0.0009	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0009
Fulmar	**0.0205**	**94.12**	**0.0004**	**1.96**	**–**	**–**	**–**	**–**	**0.0004**	**1.96**	**–**	**–**	**0.0004**	**1.96**	**–**	**–**	**0.0218**
Northern Fulmar	0.0205	94.12	0.0004	1.96	–	–	–	–	0.0004	1.96	–	–	0.0004	1.96	–	–	0.0218
Petrel	**–**	**–**	**0.0013**	**21.43**	**0.0009**	**14.29**	**0.0004**	**7.14**	**0.0022**	**35.71**	**0.0013**	**21.43**	**–**	**–**	**–**	**–**	**0.0061**
Trindade Petrel	–	–	–	–	–	–	0.0004	100.00	–	–	–	–	–	–	–	–	0.0004
Black-capped Petrel	–	–	0.0009	25.00	0.0005	12.50	–	–	0.0009	25.00	0.0013	37.50	–	–	–	–	0.0035
species unknown	–	–	0.0004	20.00	0.0005	20.00	–	–	0.0013	60.00	–	–	–	–	–	–	0.0022
Shearwater	**0.0128**	**3.71**	**0.0331**	**9.52**	**0.0051**	**1.36**	**0.0013**	**0.37**	**0.0256**	**7.17**	**0.1031**	**29.79**	**0.1269**	**36.84**	**0.0411**	**11.25**	**0.3491**
Cory's Shearwater	–	–	–	–	0.0028	3.70	0.0009	1.23	0.0172	24.07	0.0488	70.37	0.0004	0.62	–	–	0.0701
Great Shearwater	0.0004	4.00	–	–	0.0014	12.00	0.0004	4.00	0.0018	16.00	0.0068	64.00	–	–	–	–	0.0109
Sooty Shearwater	–	–	–	–	–	–	–	–	–	–	0.0004	20.00	0.0017	80.00	–	–	0.0021

(continued)

Table 4–17. (Continued)

Species Group	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		Species Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Manx Shearwater	0.0120	5.77	0.0327	15.67	–	–	–	–	–	–	–	–	0.1235	59.79	0.0411	18.76	0.2093
Audubon's Shearwater	–	–	–	–	–	–	–	–	–	–	0.0184	100.00	–	–	–	–	0.0184
species unknown-Large	0.0004	3.45	–	–	0.0005	3.45	–	–	0.0057	44.83	0.0047	37.93	0.0013	10.34	–	–	0.0126
species unknown-Small	–	–	0.0004	1.92	0.0005	1.92	–	–	0.0009	3.85	0.0205	92.31	–	–	–	–	0.0223
species unknown	–	–	–	–	–	–	–	–	–	–	0.0034	100.00	–	–	–	–	0.0034
Storm-petrel	**0.0004**	**12.50**	**–**	**–**	**–**	**–**	**0.0021**	**62.50**	**0.0009**	**25.00**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0034**
species unknown	0.0004	12.50	–	–	–	–	0.0021	62.50	0.0009	25.00	–	–	–	–	–	–	0.0034
Gannet	**2.7296**	**30.73**	**2.2753**	**25.50**	**0.0014**	**0.01**	**0.0026**	**0.03**	**0.0287**	**0.31**	**–**	**–**	**2.3622**	**26.71**	**1.5655**	**16.70**	**8.9653**
Northern Gannet	2.7296	30.73	2.2753	25.50	0.0014	0.01	0.0026	0.03	0.0287	0.31	–	–	2.3622	26.71	1.5655	16.70	8.9653
Cormorant	**0.0081**	**1.59**	**0.4978**	**96.90**	**–**	**–**	**0.0009**	**0.17**	**0.0035**	**0.67**	**–**	**–**	**0.0017**	**0.33**	**0.0018**	**0.33**	**0.5138**
Double-crested Cormorant	–	–	0.4913	99.13	–	–	–	–	0.0035	0.69	–	–	0.0009	0.17	–	–	0.4957
species unknown	0.0081	45.24	0.0064	35.71	–	–	0.0009	4.76	–	–	–	–	0.0009	4.76	0.0018	9.52	0.0181
Pelican	**–**	**–**	**0.0211**	**38.89**	**–**	**–**	**0.0047**	**8.73**	**0.0093**	**16.67**	**0.0004**	**0.79**	**0.0187**	**34.92**	**–**	**–**	**0.0542**
Brown Pelican	–	–	0.0211	39.52	–	–	0.0047	8.87	0.0084	15.32	0.0004	0.81	0.0187	35.48	–	–	0.0533
American White Pelican	–	–	–	–	–	–	–	–	0.0009	100.00	–	–	–	–	–	–	0.0009
Ardeidae	**–**	**–**	**–**	**–**	**0.0005**	**5.56**	**0.0004**	**5.56**	**0.0066**	**83.33**	**0.0004**	**5.56**	**–**	**–**	**–**	**–**	**0.0079**
Great Blue Heron	–	–	–	–	–	–	–	–	0.0057	92.86	0.0004	7.14	–	–	–	–	0.0062
Great Egret	–	–	–	–	–	–	–	–	0.0004	100.00	–	–	–	–	–	–	0.0004
Snowy Egret	–	–	–	–	0.0005	50.00	0.0004	50.00	–	–	–	–	–	–	–	–	0.0009
Green Heron	–	–	–	–	–	–	–	–	0.0004	100.00	–	–	–	–	–	–	0.0004
Raptor	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0004**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0004**
Peregrine Falcon	–	–	–	–	–	–	–	–	0.0004	100.00	–	–	–	–	–	–	0.0004
Shorebird	**–**	**–**	**–**	**–**	**–**	**–**	**0.1379**	**93.64**	**0.0071**	**4.62**	**0.0009**	**0.58**	**–**	**–**	**0.0018**	**1.16**	**0.1477**
Black-bellied Plover	–	–	–	–	–	–	0.0072	100.00	–	–	–	–	–	–	–	–	0.0072
Ruddy Turnstone	–	–	–	–	–	–	0.0009	100.00	–	–	–	–	–	–	–	–	0.0009
Dunlin	–	–	–	–	–	–	–	–	0.0018	100.00	–	–	–	–	–	–	0.0018
species unknown	–	–	–	–	–	–	0.1298	94.43	0.0053	3.72	0.0009	0.62	–	–	0.0018	1.24	0.1378
Phalarope	**5.7335**	**36.81**	**6.9466**	**44.38**	**0.0009**	**0.01**	**0.0136**	**0.09**	**0.0150**	**0.09**	**0.0133**	**0.09**	**0.3552**	**2.29**	**2.6714**	**16.25**	**15.7495**
Red-necked Phalarope	0.0047	34.38	–	–	–	–	–	–	–	–	0.0021	15.63	0.0043	31.25	0.0027	18.75	0.0138
Red Phalarope	4.4405	32.30	6.9466	50.29	–	–	–	–	0.0124	0.09	0.0043	0.03	0.3165	2.31	2.1747	14.99	13.8950
Red/Red-necked Phalarope	1.2882	70.98	–	–	0.0009	0.05	0.0136	0.75	0.0027	0.14	0.0068	0.38	0.0345	1.91	0.4940	25.79	1.8408

(continued)

Table 4–17. (Continued)

Species Group	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		Species Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Skua	**0.0009**	**11.76**	**0.0004**	**5.88**	**–**	**–**	**0.0004**	**5.88**	**0.0009**	**11.76**	**0.0009**	**11.76**	**0.0026**	**35.29**	**0.0014**	**17.65**	**0.0074**
Great Skua	0.0004	50.00	–	–	–	–	–	–	–	–	–	–	–	–	0.0005	50.00	0.0009
Pomarine Jaeger	–	–	–	–	–	–	–	–	0.0004	33.33	–	–	0.0004	33.33	0.0005	33.33	0.0013
Parasitic Jaeger	0.0004	20.00	0.0004	20.00	–	–	–	–	0.0004	20.00	–	–	0.0009	40.00	–	–	0.0022
Long-tailed Jaeger	–	–	–	–	–	–	0.0004	100.00	–	–	–	–	–	–	–	–	0.0004
species unknown	–	–	–	–	–	–	–	–	–	–	0.0009	33.33	0.0013	50.00	0.0005	16.67	0.0026
Auk	**4.9244**	**57.52**	**3.4290**	**39.87**	**–**	**–**	**0.0043**	**0.05**	**0.0009**	**0.01**	**–**	**–**	**0.2066**	**2.42**	**0.0113**	**0.12**	**8.5765**
Dovekie	0.0013	27.27	–	–	–	–	0.0034	72.73	–	–	–	–	–	–	–	–	0.0047
Common/Thick-billed Murre	–	–	0.0017	44.44	–	–	–	–	–	–	–	–	0.0017	44.44	0.0005	11.11	0.0039
Razorbill	4.8547	58.47	3.2953	39.50	–	–	–	–	–	–	–	–	0.1661	2.01	0.0014	0.02	8.3175
Murre/Razorbill	0.0359	18.58	0.1131	58.19	–	–	–	–	–	–	–	–	0.0366	19.03	0.0086	4.20	0.1942
Atlantic Puffin	0.0090	42.00	0.0099	46.00	–	–	–	–	–	–	–	–	0.0021	10.00	0.0005	2.00	0.0215
species unknown	0.0235	67.90	0.0090	25.93	–	–	0.0009	2.47	0.0009	2.47	–	–	–	–	0.0005	1.23	0.0347
Gull	**5.8486**	**38.45**	**5.7206**	**37.43**	**0.0176**	**0.11**	**0.0268**	**0.18**	**0.2104**	**1.34**	**0.0201**	**0.13**	**2.8780**	**19.00**	**0.5405**	**3.37**	**15.2627**
Black-legged Kittiwake	0.0051	1.89	0.0228	8.36	–	–	–	–	0.0009	0.32	0.0004	0.16	0.2398	88.80	0.0014	0.47	0.2704
Bonaparte's Gull	5.5136	50.08	4.7698	43.12	–	–	–	–	0.0027	0.02	–	–	0.6708	6.12	0.0763	0.66	11.0331
Little Gull	0.0009	40.00	0.0004	20.00	–	–	–	–	–	–	0.0004	20.00	0.0004	20.00	–	–	0.0021
Laughing Gull	0.0150	3.11	0.0017	0.36	0.0176	3.37	0.0226	4.71	0.0933	18.74	0.0167	3.46	0.1435	29.93	0.1847	36.32	0.4951
Ring-billed Gull	0.0047	9.17	0.0017	3.33	–	–	–	–	0.0013	2.50	–	–	0.0405	79.17	0.0032	5.83	0.0514
Herring Gull	0.2084	10.33	0.5747	28.36	–	–	0.0013	0.06	0.0729	3.50	0.0004	0.02	0.9835	48.97	0.1865	8.76	2.0277
Iceland Gull	–	–	–	–	–	–	–	–	–	–	–	–	0.0013	100.00	–	–	0.0013
Lesser Black-backed Gull	0.0081	10.98	0.0284	38.15	–	–	–	–	0.0155	20.23	–	–	0.0217	29.48	0.0009	1.16	0.0746
Glaucous Gull	0.0009	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0009
Great Black-backed Gull	0.0308	12.97	0.0391	16.40	–	–	0.0009	0.36	0.0119	4.86	0.0004	0.18	0.1256	53.15	0.0303	12.07	0.2390
species unknown - Large	0.0043	5.08	0.0172	20.30	–	–	–	–	0.0013	1.52	0.0004	0.51	0.0605	72.08	0.0005	0.51	0.0842
species unknown - Small	0.0552	5.71	0.2605	26.80	–	–	0.0013	0.13	0.0102	1.02	0.0013	0.13	0.5882	61.08	0.0524	5.13	0.9690
species unknown	0.0017	12.50	0.0043	31.25	–	–	0.0009	6.25	0.0004	3.13	–	–	0.0021	15.63	0.0045	31.25	0.0139
Tern	**–**	**–**	**0.0026**	**0.34**	**0.0690**	**8.53**	**0.0524**	**7.04**	**0.2560**	**33.16**	**0.3616**	**48.40**	**0.0145**	**1.95**	**0.0045**	**0.57**	**0.7606**
Sooty Tern	–	–	–	–	–	–	–	–	–	–	0.0030	100.00	–	–	–	–	0.0030
Bridled Tern	–	–	–	–	–	–	–	–	0.0013	11.11	0.0103	88.89	–	–	–	–	0.0116
Sooty/Bridled Tern	–	–	–	–	–	–	–	–	–	–	0.0034	100.00	–	–	–	–	0.0034

(continued)

Table 4–17. (Continued)

Species Group	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		Species Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Least Tern	–	–	–	–	–	–	–	–	–	–	0.0060	100.00	–	–	–	–	0.0060
Gull-billed Tern	–	–	–	–	–	–	0.0017	21.05	0.0062	73.68	0.0004	5.26	–	–	–	–	0.0083
Caspian Tern	–	–	–	–	0.0060	50.00	0.0017	15.38	0.0035	30.77	0.0004	3.85	–	–	–	–	0.0117
Black Tern	–	–	–	–	0.0134	6.79	0.0009	0.47	–	–	0.1695	92.74	–	–	–	–	0.1838
Royal Tern	–	–	–	–	0.0338	13.64	0.0387	17.01	0.0539	22.80	0.1061	46.36	0.0004	0.19	–	–	0.2330
Royal/Caspian Tern	–	–	–	–	–	–	0.0047	10.28	0.0385	81.31	0.0039	8.41	–	–	–	–	0.0470
Sandwich Tern	–	–	–	–	0.0144	16.94	0.0017	2.19	0.0292	36.07	0.0351	44.81	–	–	–	–	0.0803
Thalasseus Tern unid.	–	–	–	–	–	–	–	–	–	–	0.0098	100.00	–	–	–	–	0.0098
species unknown	–	–	0.0026	1.62	0.0014	0.81	0.0030	1.89	0.1233	75.41	0.0137	8.65	0.0141	8.92	0.0045	2.70	0.1626
***Sterna* Tern**	**0.2490**	**11.85**	**0.2850**	**13.50**	**0.0190**	**0.84**	**0.0396**	**1.89**	**0.3466**	**15.97**	**0.5003**	**23.81**	**0.2526**	**12.08**	**0.4448**	**20.06**	**2.1368**
Common Tern	–	–	–	–	–	–	0.0175	5.00	0.0522	14.39	0.2825	80.49	0.0004	0.12	–	–	0.3525
Commic Tern	–	–	–	–	–	–	–	–	0.0004	100.00	–	–	–	–	–	–	0.0004
Forster's Tern	0.2490	23.39	0.2025	18.93	–	–	0.0004	0.04	0.0407	3.70	0.0047	0.44	0.2040	19.25	0.3847	34.24	1.0860
Commic/Forster's Tern	–	–	0.0817	12.71	–	–	0.0217	3.41	0.2356	35.65	0.2101	32.84	0.0481	7.56	0.0528	7.83	0.6501
species unknown	–	–	0.0009	1.89	0.0190	38.68	–	–	0.0177	37.74	0.0030	6.60	–	–	0.0072	15.09	0.0478
Passerine	**–**	**–**	**–**	**–**	**–**	**–**	**0.0102**	**88.89**	**0.0004**	**3.70**	**0.0009**	**7.41**	**–**	**–**	**–**	**–**	**0.0115**
species unknown	–	–	–	–	–	–	0.0102	88.89	0.0004	3.70	0.0009	7.41	–	–	–	–	0.0115
Total	**26.3403**	**41.86**	**21.0655**	**33.32**	**0.1190**	**0.17**	**0.3214**	**0.51**	**0.9642**	**1.48**	**1.0066**	**1.60**	**7.5129**	**11.99**	**6.4658**	**9.74**	**63.7958**

Table 4–18. Percent of overall total in species group represented by each taxon
The pale blue rows represent the number of birds/km^2 and the white rows represent the percent of the total within that species group

Species	Density (per km^2)								Total
	Feb 2018	Feb 2020	May/Jun 2018	May 2019	Oct 2018	Sep 2019	Dec 2018	Dec 2019	
Duck	**0.0406**	**0.0163**	**–**	**–**	**–**	**0.0034**	**0.2602**	**0.1097**	**0.4304**
Gadwall								2.1	0.5
American Black Duck							0.2		0.1
Redhead						12.5			0.1
Greater Scaup		63.2					1.6	1.2	3.7
Lesser Scaup							0.7		0.4
Surf Scoter		2.6					0.5		0.4
White-winged Scoter							1.3	0.4	0.9
Black Scoter	93.7	21.1					91.5	93.0	88.6
Scoter unid.		10.5					0.3		0.6
Long-tailed Duck	1.1								0.1
Red-breasted Merganser	3.2						1.8	2.1	1.9
species unknown	2.1	2.6				87.5	2.1	1.2	2.6
Loon	**6.7710**	**1.8360**	**0.0046**	**0.0238**	**0.0491**	**–**	**1.0333**	**1.0720**	**10.7898**
Red-throated Loon	75.7	21.3		3.6	2.7		20.2	16.8	55.0
Common Loon	23.7	75.3	100.0	91.1	97.3		78.7	80.4	43.7
species unknown	0.6	3.4		5.4			1.1	2.7	1.4
Grebe	**0.0009**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0009**
Horned Grebe	100.0								100.0
Fulmar	**0.0205**	**0.0004**	**–**	**–**	**0.0004**	**–**	**0.0004**	**–**	**0.0218**
Northern Fulmar	100.0	100.0			100.0		100.0		100.0
Petrel	**–**	**0.0013**	**0.0009**	**0.0004**	**0.0022**	**0.0013**	**–**	**–**	**0.0061**
Trindade Petrel				100.0					7.1
Black-capped Petrel		66.7	50.0		40.0	100.0			57.1
species unknown		33.3	50.0		60.0				35.7
Shearwater	**0.0128**	**0.0331**	**0.0051**	**0.0013**	**0.0256**	**0.1031**	**0.1269**	**0.0411**	**0.3491**
Cory's Shearwater			54.5	66.7	67.2	47.3	0.3		20.0
Great Shearwater	3.3		27.3	33.3	6.9	6.6			3.1
Sooty Shearwater						0.4	1.3		0.6
Manx Shearwater	93.3	98.7					97.3	100.0	60.0
Audubon's Shearwater						17.8			5.3
species unknown-Large	3.3		9.1		22.4	4.6	1.0		3.6
species unknown-Small		1.3	9.1		3.4	19.9			6.4
species unknown						3.3			1.0

(continued)

Table 4–18. (Continued)

Species	Density (per km^2)								Total
	Feb 2018	Feb 2020	May/Jun 2018	May 2019	Oct 2018	Sep 2019	Dec 2018	Dec 2019	
Storm-petrel	**0.0004**	**–**	**–**	**0.0021**	**0.0009**	**–**	**–**	**–**	**0.0034**
species unknown	100.0			100.0	100.0				100.0
Gannet	**2.7296**	**2.2753**	**0.0014**	**0.0026**	**0.0287**	**–**	**2.3622**	**1.5655**	**8.9653**
Northern Gannet	100.0	100.0	100.0	100.0	100.0		100.0	100.0	100.0
Cormorant	**0.0081**	**0.4978**	**–**	**0.0009**	**0.0035**	**–**	**0.0017**	**0.0018**	**0.5138**
Double-crested Cormorant		98.7			100.0		50.0		96.5
species unknown	100.0	1.3		100.0			50.0	100.0	3.5
Pelican	**–**	**0.0211**	**–**	**0.0047**	**0.0093**	**0.0004**	**0.0187**	**–**	**0.0542**
Brown Pelican		100.0		100.0	90.5	100.0	100.0		98.4
American White Pelican					9.5				1.6
Ardeidae	**–**	**–**	**0.0005**	**0.0004**	**0.0066**	**0.0004**	**–**	**–**	**0.0079**
Great Blue Heron					86.7	100.0			77.8
Great Egret					6.7				5.6
Snowy Egret			100.0	100.0					11.1
Green Heron					6.7				5.6
Raptor	**–**	**–**	**–**	**–**	**0.0004**	**–**	**–**	**–**	**0.0004**
Peregrine Falcon					100.0				100.0
Shorebird	**–**	**–**	**–**	**0.1379**	**0.0071**	**0.0009**	**–**	**0.0018**	**0.1477**
Black-bellied Plover				5.2					4.9
Ruddy Turnstone				0.6					0.6
Dunlin					25.0				1.2
species unknown				94.1	75.0	100.0		100.0	93.4
Phalarope	**5.7335**	**6.9466**	**0.0009**	**0.0136**	**0.0150**	**0.0133**	**0.3552**	**2.6714**	**15.7495**
Red-necked Phalarope	0.1					16.1	1.2	0.1	0.1
Red Phalarope	77.4	100.0			82.4	32.3	89.1	81.4	88.3
Red/Red-necked Phalarope	22.5		100.0	100.0	17.6	51.6	9.7	18.5	11.7
Skua	**0.0009**	**0.0004**	**–**	**0.0004**	**0.0009**	**0.0009**	**0.0026**	**0.0014**	**0.0074**
Great Skua	50.0							33.3	11.8
Pomarine Jaeger					50.0		16.7	33.3	17.6
Parasitic Jaeger	50.0	100.0			50.0		33.3		29.4
Long-tailed Jaeger				100.0					5.9
species unknown						100.0	50.0	33.3	35.3
Auk	**4.9244**	**3.4290**	**–**	**0.0043**	**0.0009**	**–**	**0.2066**	**0.0113**	**8.5765**
Dovekie				80.0					0.1
Common/Thick-billed Murre		0.1					0.8	4.0	
Razorbill	98.6	96.1					80.4	12.0	97.0
Murre/Razorbill	0.7	3.3					17.7	76.0	2.3
Atlantic Puffin	0.2	0.3					1.0	4.0	0.2

(continued)

Table 4–18. (Continued)

Species	Density (per km^2)								Total
	Feb 2018	Feb 2020	May/Jun 2018	May 2019	Oct 2018	Sep 2019	Dec 2018	Dec 2019	
species unknown	0.5	0.3		20.0	100.0			4.0	0.4
Gull	**5.8486**	**5.7206**	**0.0176**	**0.0268**	**0.2104**	**0.0201**	**2.8780**	**0.5405**	**15.2627**
Black-legged Kittiwake	0.1	0.4			0.4	2.1	8.3	0.3	1.8
Bonaparte's Gull	94.3	83.4			1.3		23.3	14.1	72.4
Little Gull						2.1			
Laughing Gull	0.3		100.0	84.1	44.3	83.0	5.0	34.2	3.2
Ring-billed Gull	0.1				0.6		1.4	0.6	0.3
Herring Gull	3.6	10.0		4.8	34.7	2.1	34.2	34.5	13.3
Iceland Gull									
Lesser Black-backed Gull	0.1	0.5			7.4		0.8	0.2	0.5
Glaucous Gull									
Great Black-backed Gull	0.5	0.7		3.2	5.7	2.1	4.4	5.6	1.6
species unknown - Large	0.1	0.3			0.6	2.1	2.1	0.1	0.6
species unknown - Small	0.9	4.6		4.8	4.8	6.4	20.4	9.7	6.4
species unknown		0.1		3.2	0.2		0.1	0.8	0.1
Tern	**–**	**0.0026**	**0.0690**	**0.0524**	**0.2560**	**0.3616**	**0.0145**	**0.0045**	**0.7606**
Sooty Tern						0.8			0.4
Bridled Tern					0.5	2.8			1.5
Sooty/Bridled Tern						0.9			0.5
Least Tern						1.7			0.8
Gull-billed Tern				3.3	2.4	0.1			1.1
Caspian Tern			8.7	3.3	1.4	0.1			1.5
Black Tern			19.5	1.6		46.9			24.5
Royal Tern			49.0	74.0	21.1	29.3	2.9		30.6
Royal/Caspian Tern				8.9	15.0	1.1			6.1
Sandwich Tern			20.8	3.3	11.4	9.7			10.5
Thalasseus Tern unid.						2.7			1.3
species unknown		100.0	2.0	5.7	48.2	3.8	97.1	100.0	21.2
***Sterna* Tern**	**0.2490**	**0.2850**	**0.0190**	**0.0396**	**0.3466**	**0.5003**	**0.2526**	**0.4448**	**2.1368**
Common Tern				44.1	15.1	56.5	0.2		16.7
Commic Tern					0.1				
Forster's Tern	100.0	71.0		1.1	11.7	0.9	80.8	86.5	50.7
Commic/Forster's Tern		28.7		54.8	68.0	42.0	19.1	11.9	30.4
species unknown		0.3	100.0		5.1	0.6		1.6	2.2
Passerine	**–**	**–**	**–**	**0.0102**	**0.0004**	**0.0009**	**–**	**–**	**0.0115**
species unknown				100.0	100.0	100.0			100.0
Total	**26.3403**	**21.0655**	**0.1190**	**0.3214**	**0.9642**	**1.0066**	**7.5129**	**6.4658**	**63.7958**

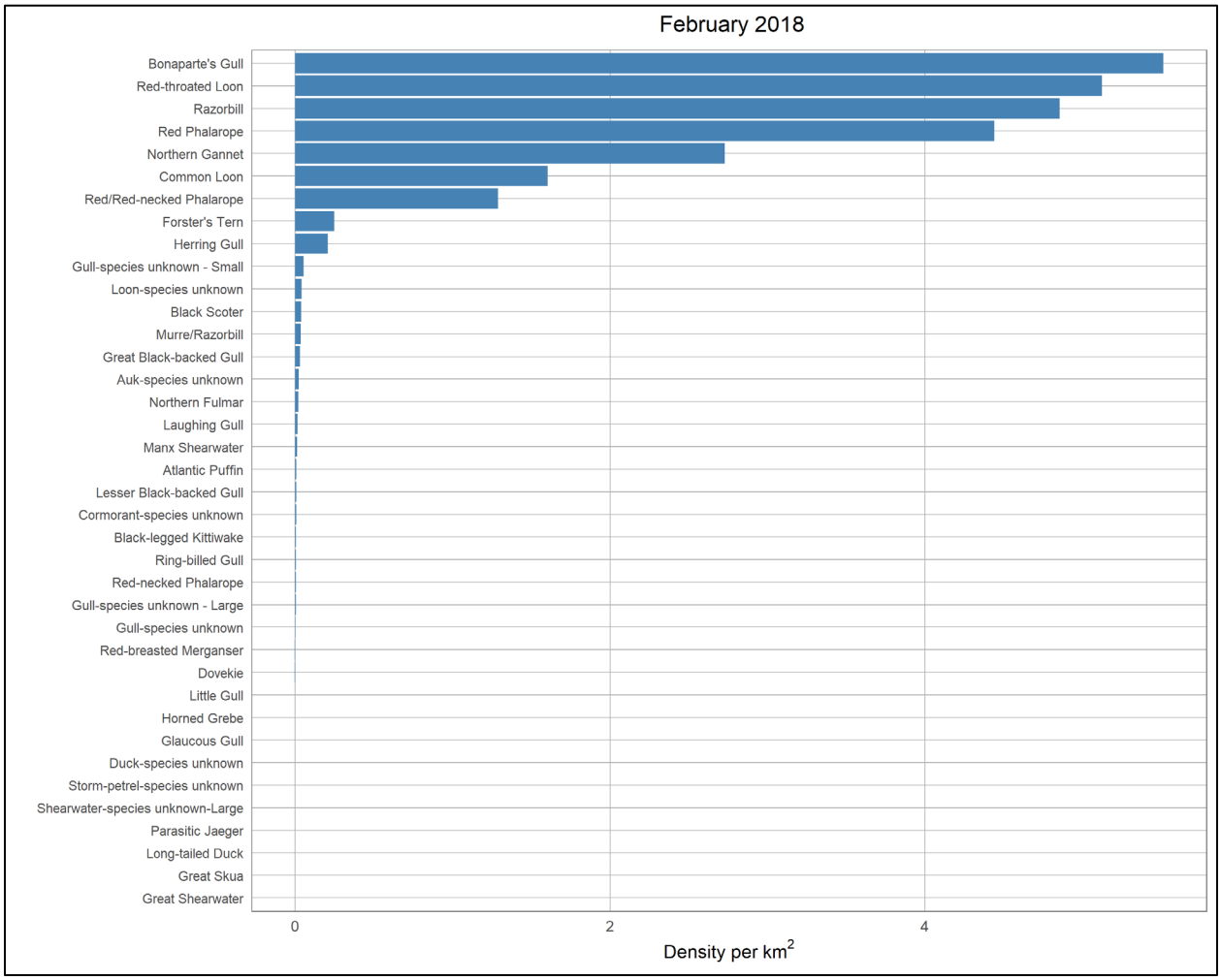

Figure 4–3. Density (per km^2) of avian species identified in the February 2018 through February 2020 surveys in all areas, ordered by density for each survey (figure continued below)

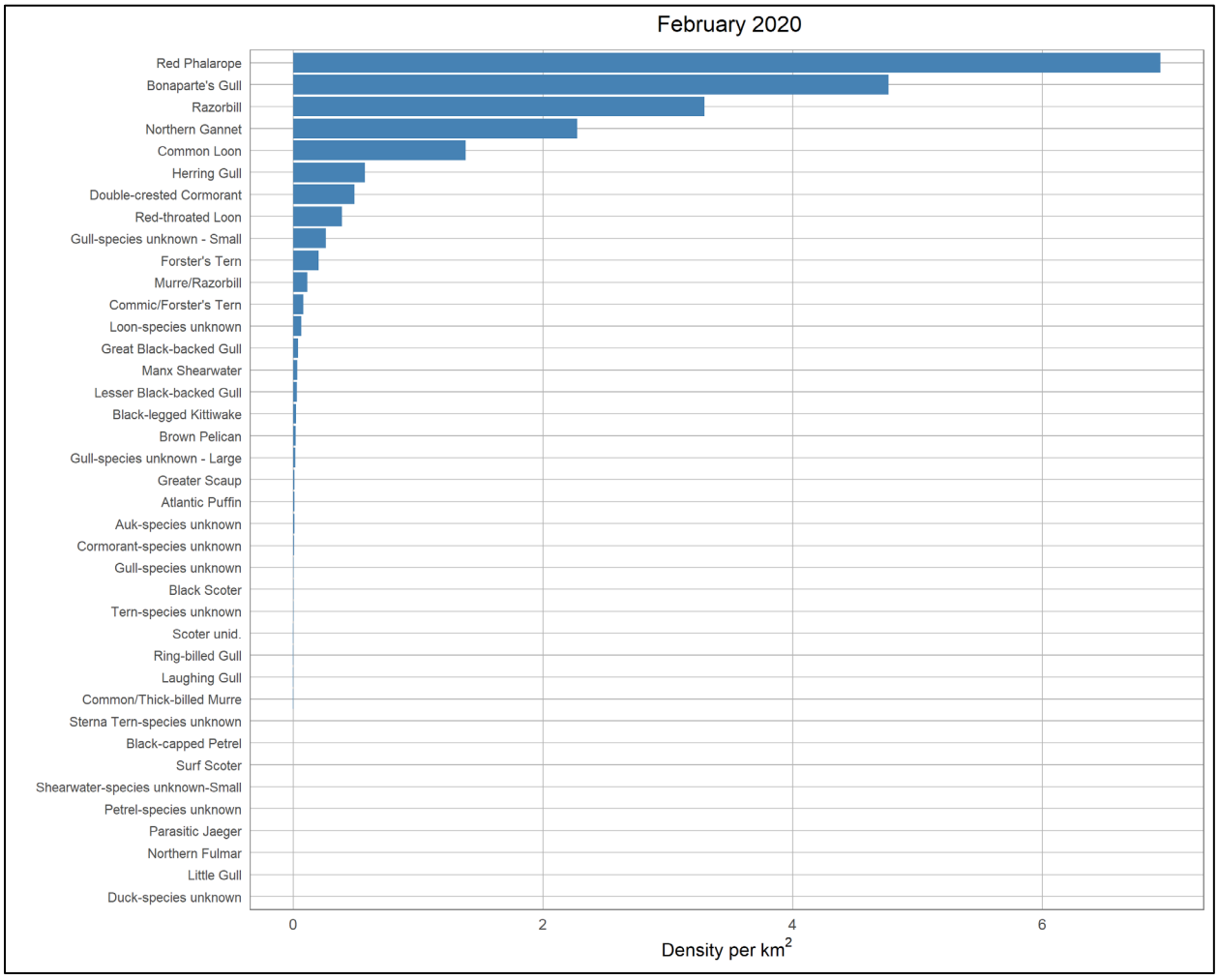

Figure 4–3. (Continued)

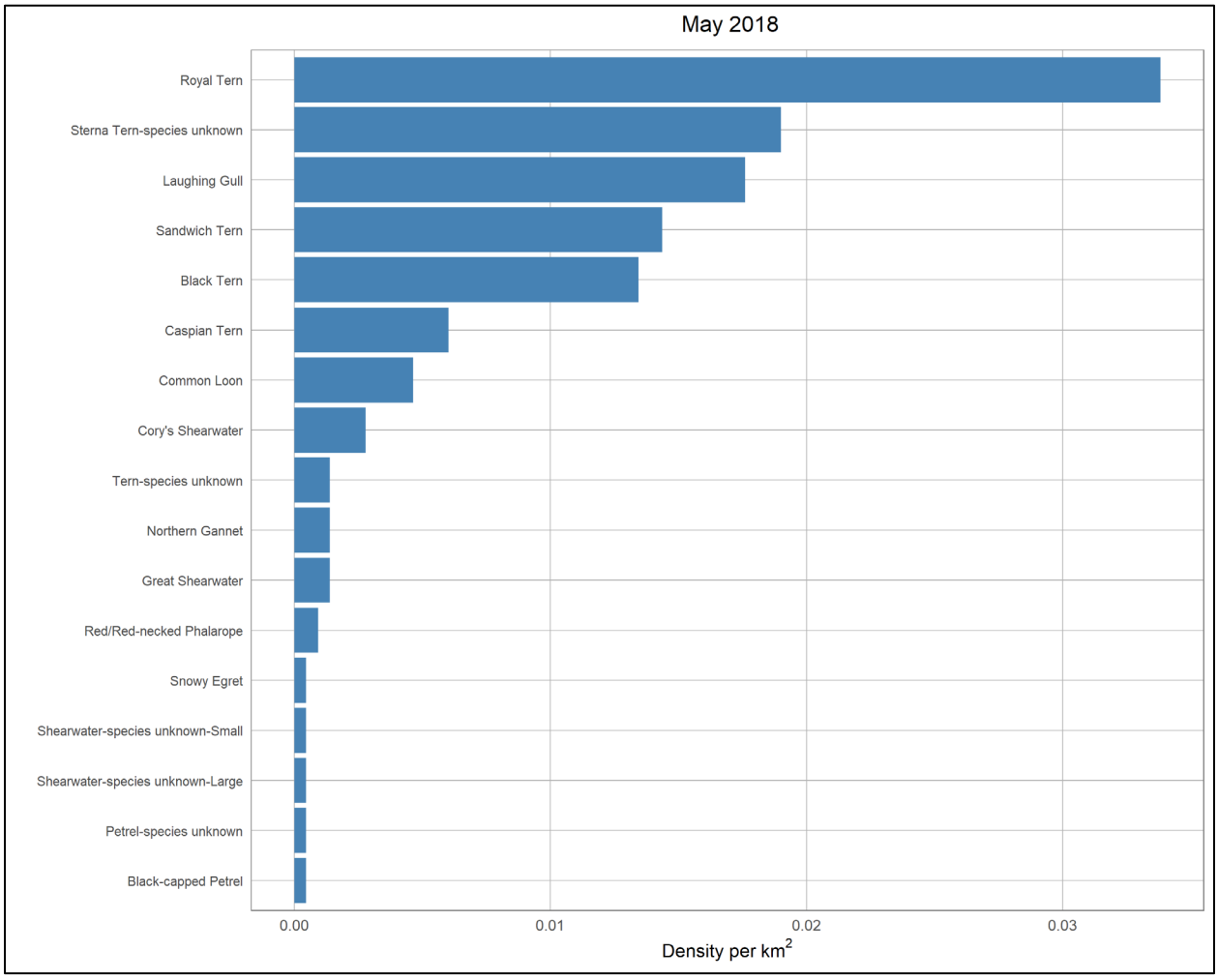

Figure 4–3. (Continued)

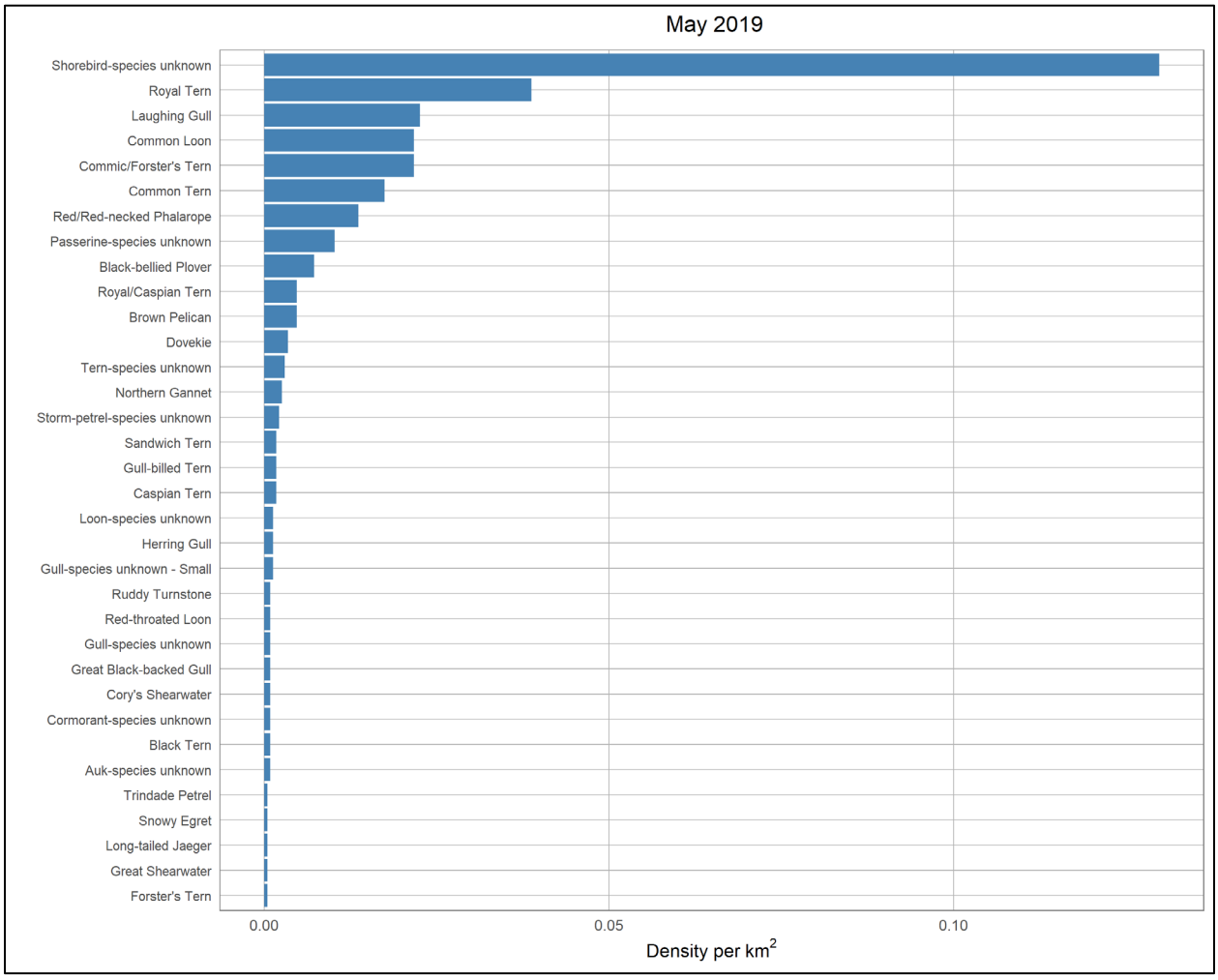

Figure 4–3. (Continued)

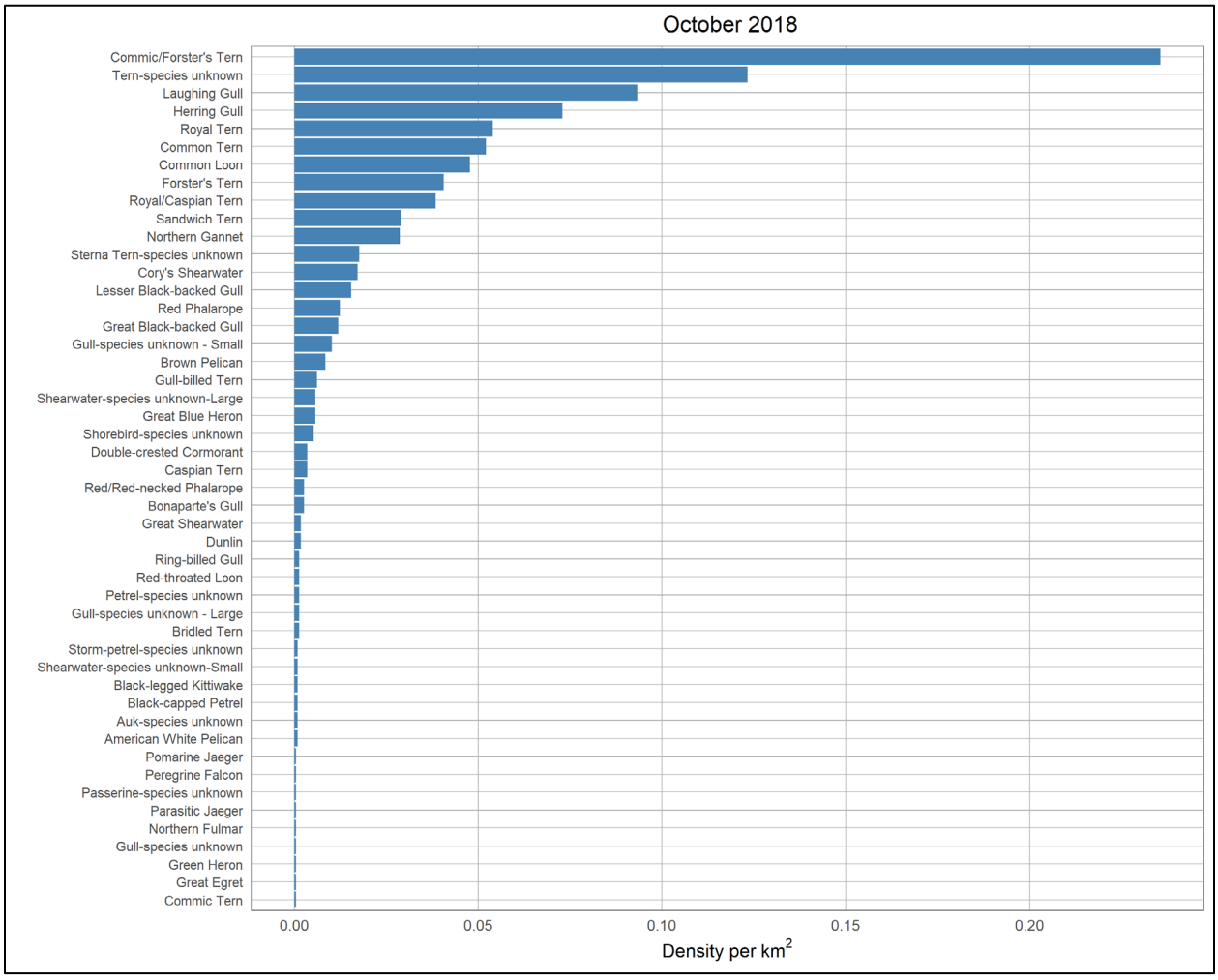

Figure 4–3. (Continued)

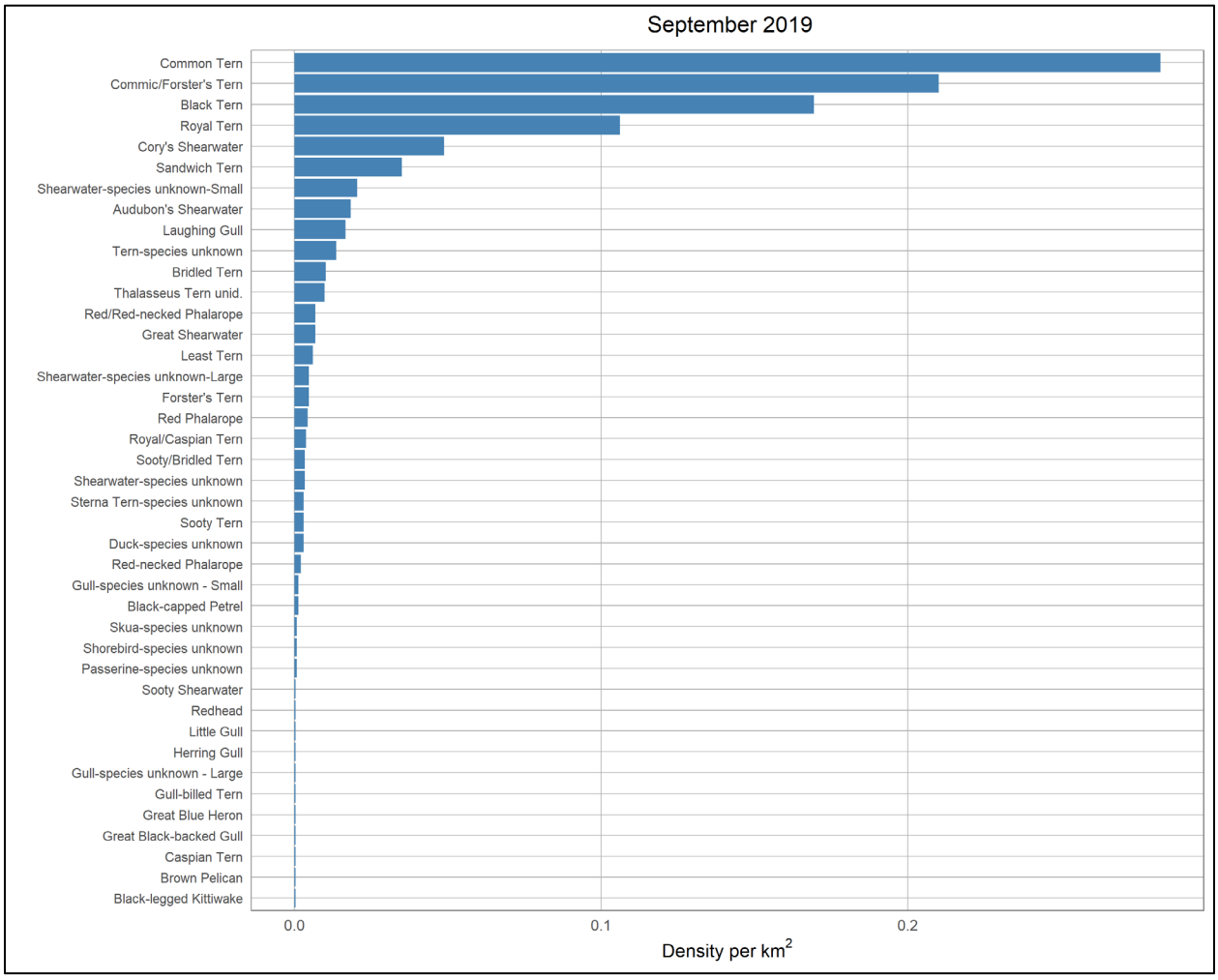

Figure 4–3. (Continued)

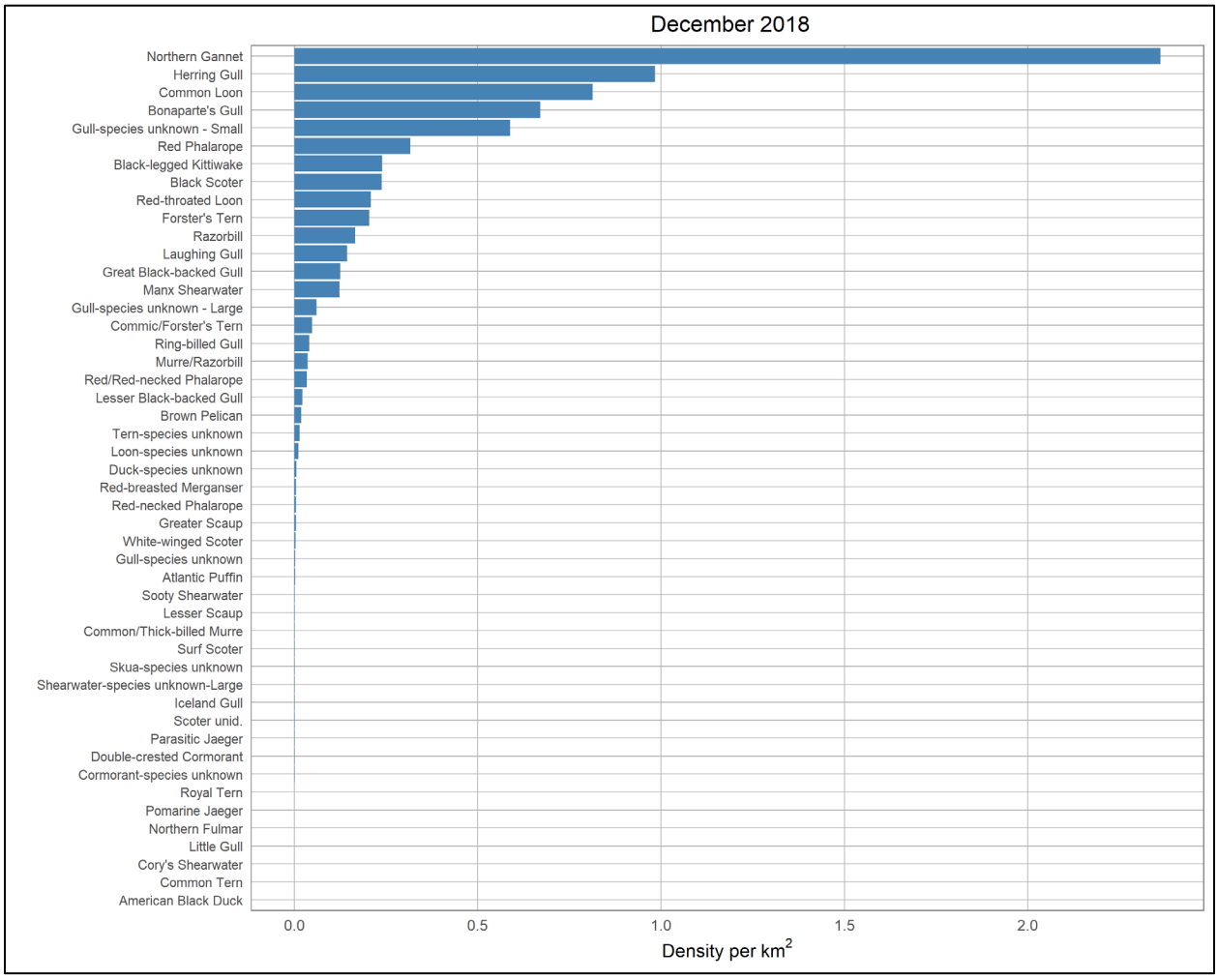

Figure 4–3. (Continued)

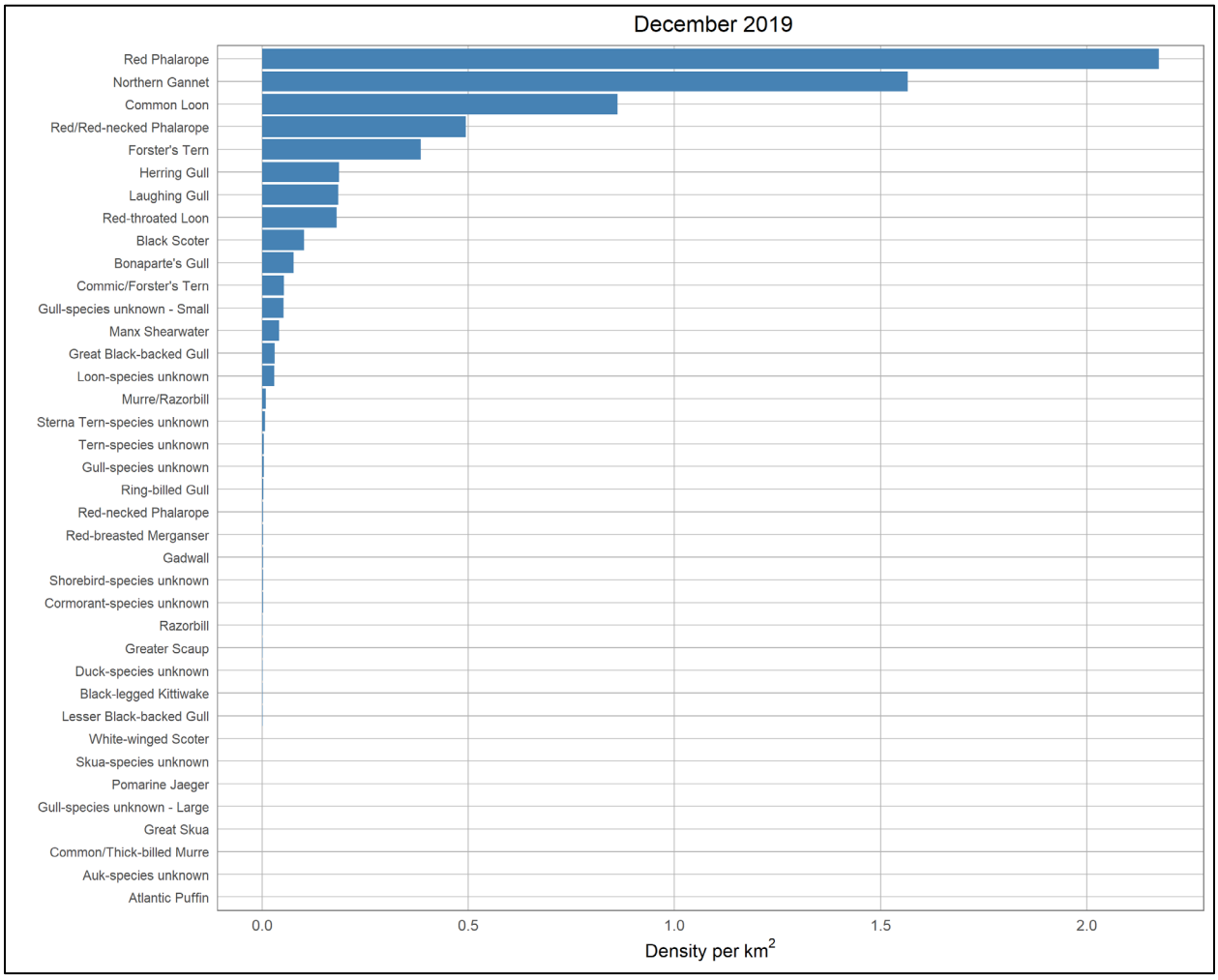

Figure 4–3. (Continued)

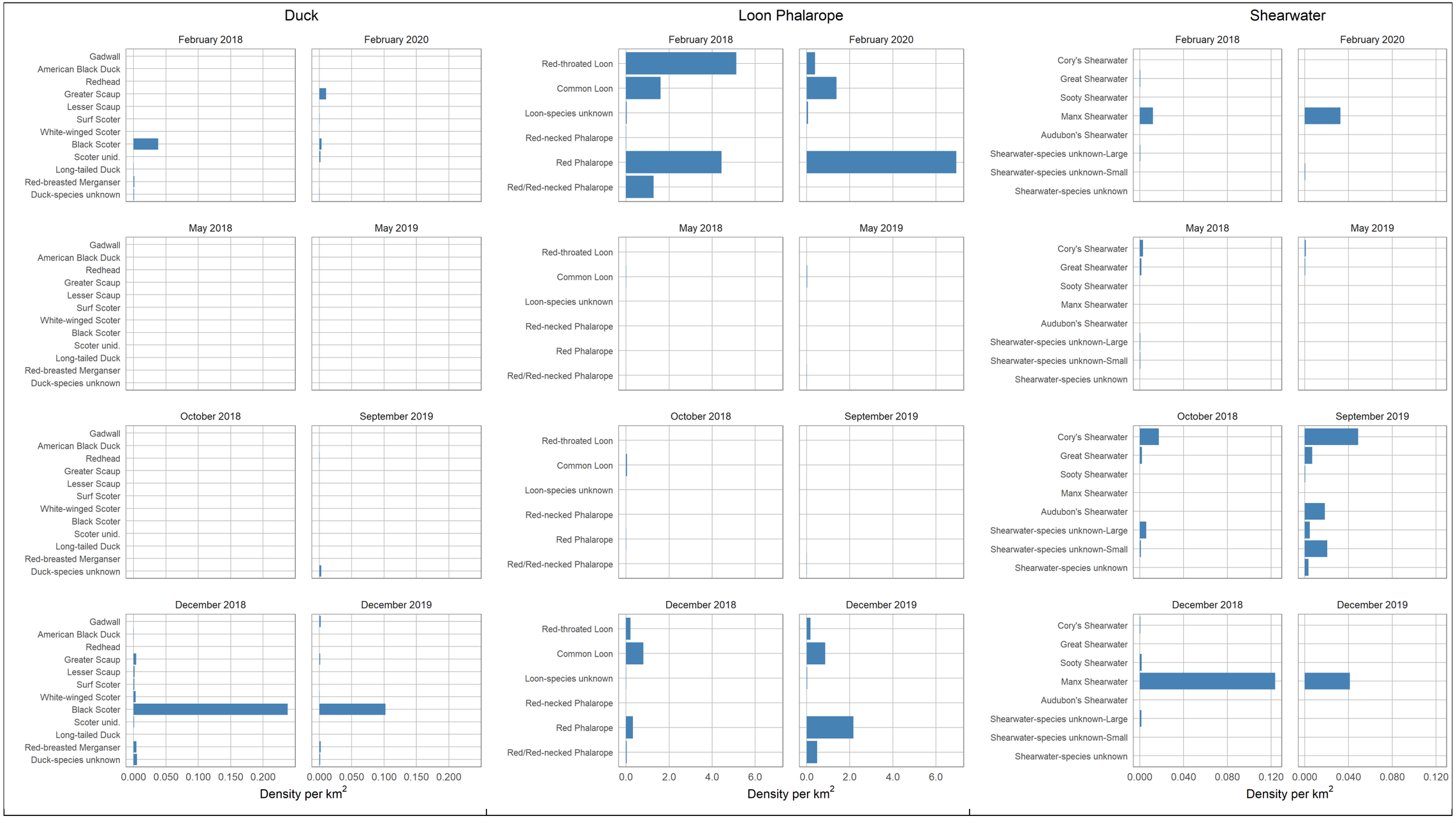

Figure 4–4. Density (per km^2) of species (by species group) for each survey across all areas (figure continued below)

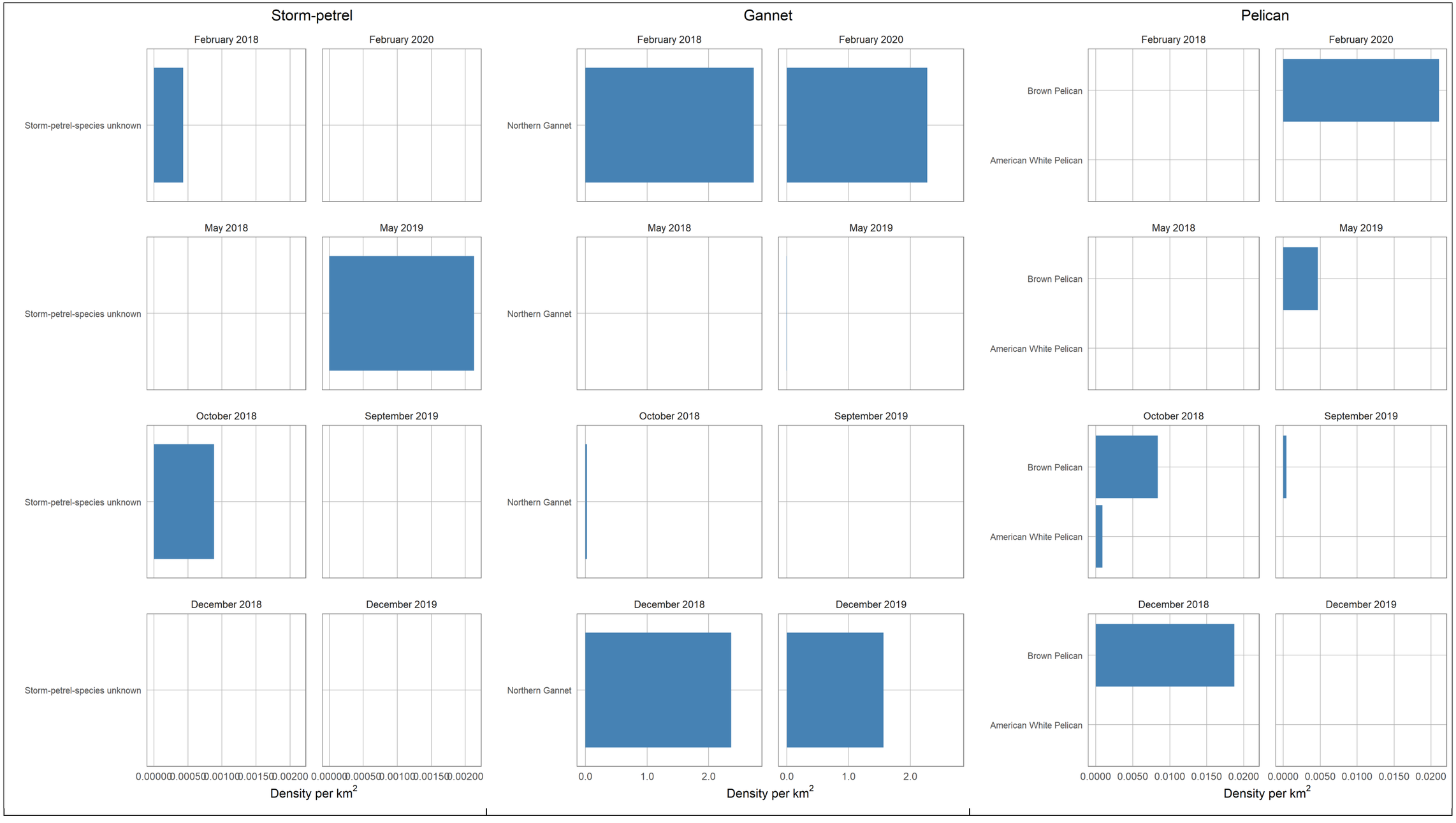

Figure 4–4. (Continued)

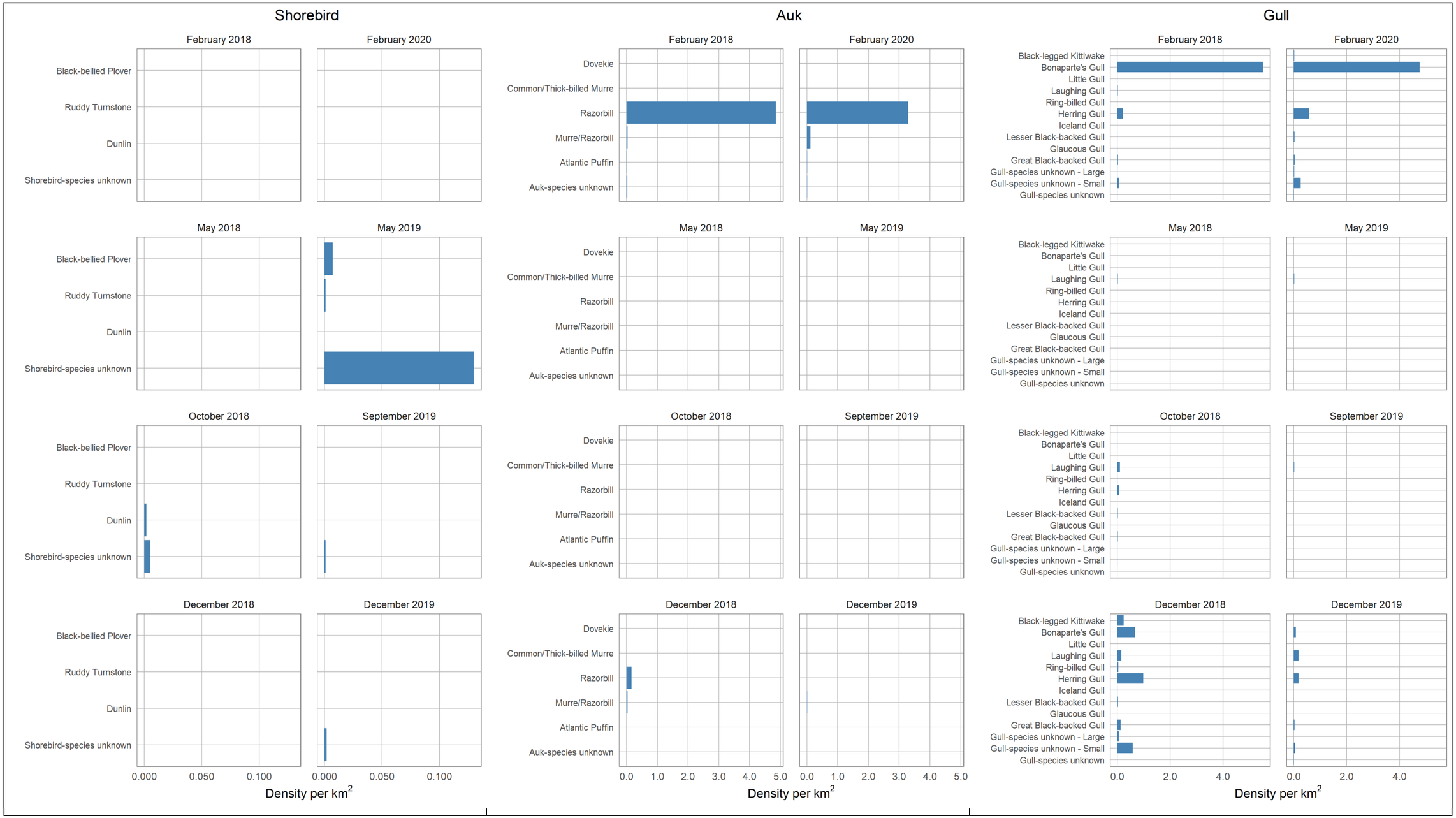

Figure 4–4. (Continued)

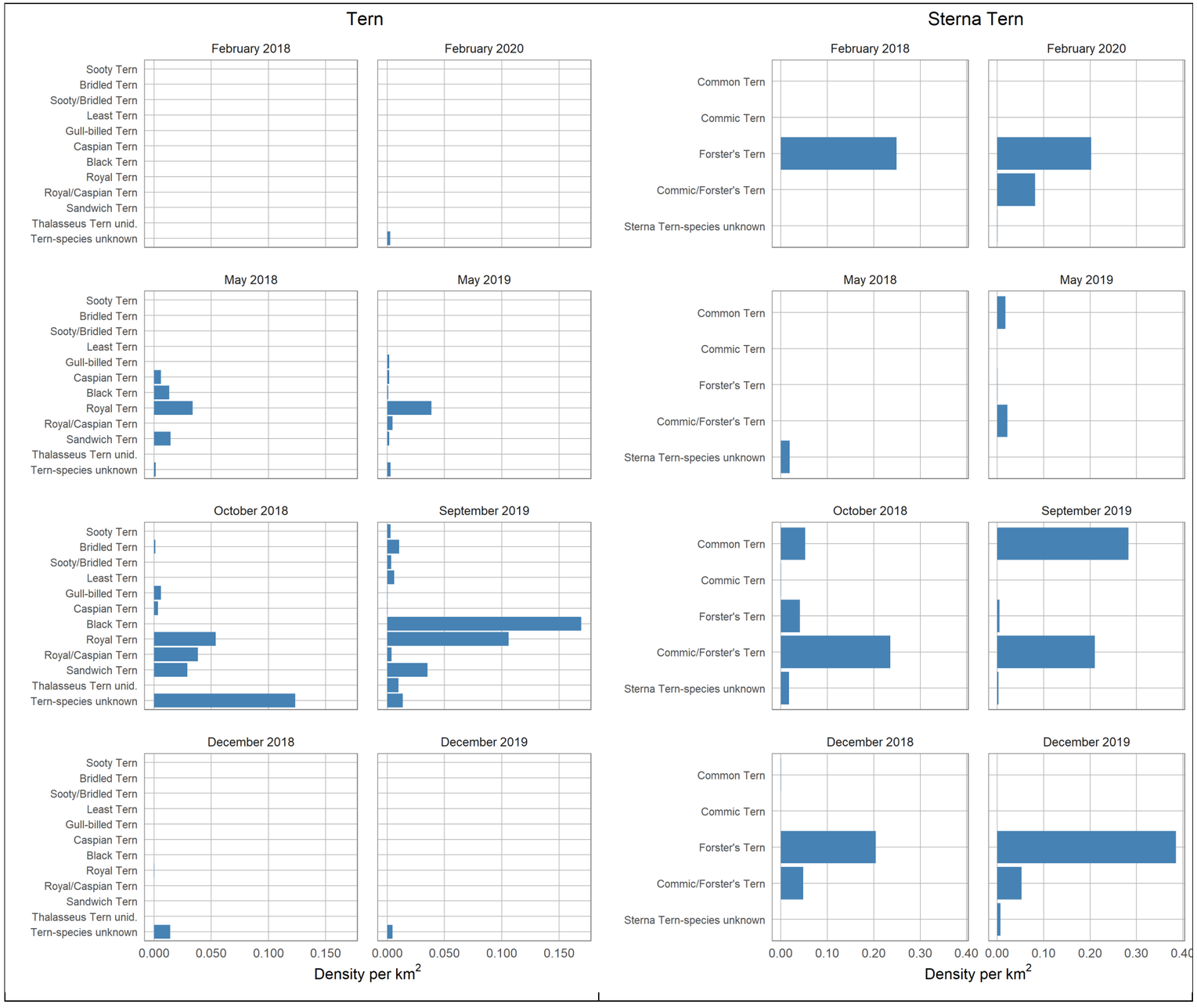

Figure 4–4. (Continued)

Avian species identified within each species group and the relative abundance of individuals for each area for each survey are shown in Appendix C.3, Table C–25 through Table C–32 and Figure C–2 through Figure C–9. When counted by area, SASA counts include all of A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–17. Values in Table C–25 through Table C–32 and Figure C–2 through Figure C–9 will allow assessment of individual survey areas for each survey period. Avian species identified within each species group and the corrected number of individuals by survey area for each survey period are graphically presented in Figure C–10 through Figure C–17 and by species group for each survey period by area in Figure C–18 through Figure C–25.

4.5.3 Spatial Distribution

The spatial distribution of all bird species encountered in the February 2018 through February 2020 surveys for all areas is shown in Figure 4–5 through Figure 4–8. In February bird density was higher in SASA north than SASA south with the highest densities occurring east of Pamlico Sound and east of the North Carolina/South Carolina border. Among the call areas, the highest bird densities occurred in WE and WW (Figure 4–5). In May/June, bird densities were lower with slightly higher densities occurring in SASA north. There were no obvious spatial trends in bird density among the call areas during May/June (Figure 4–6). During September/October, bird densities were homogeneously distributed across SASA with few clear spatial trends observed (Figure 4–7). During December, bird densities were higher in SASA north than in SASA south. Spatial trends among the call areas were similar with patches of higher densities occurring in KH, GSCA, WE, and WW (Figure 4–8).

Spatial distribution of individual bird species during the February 2018 through February 2020 surveys is shown in Appendix C.4, Figure C–26 through Figure C–258.

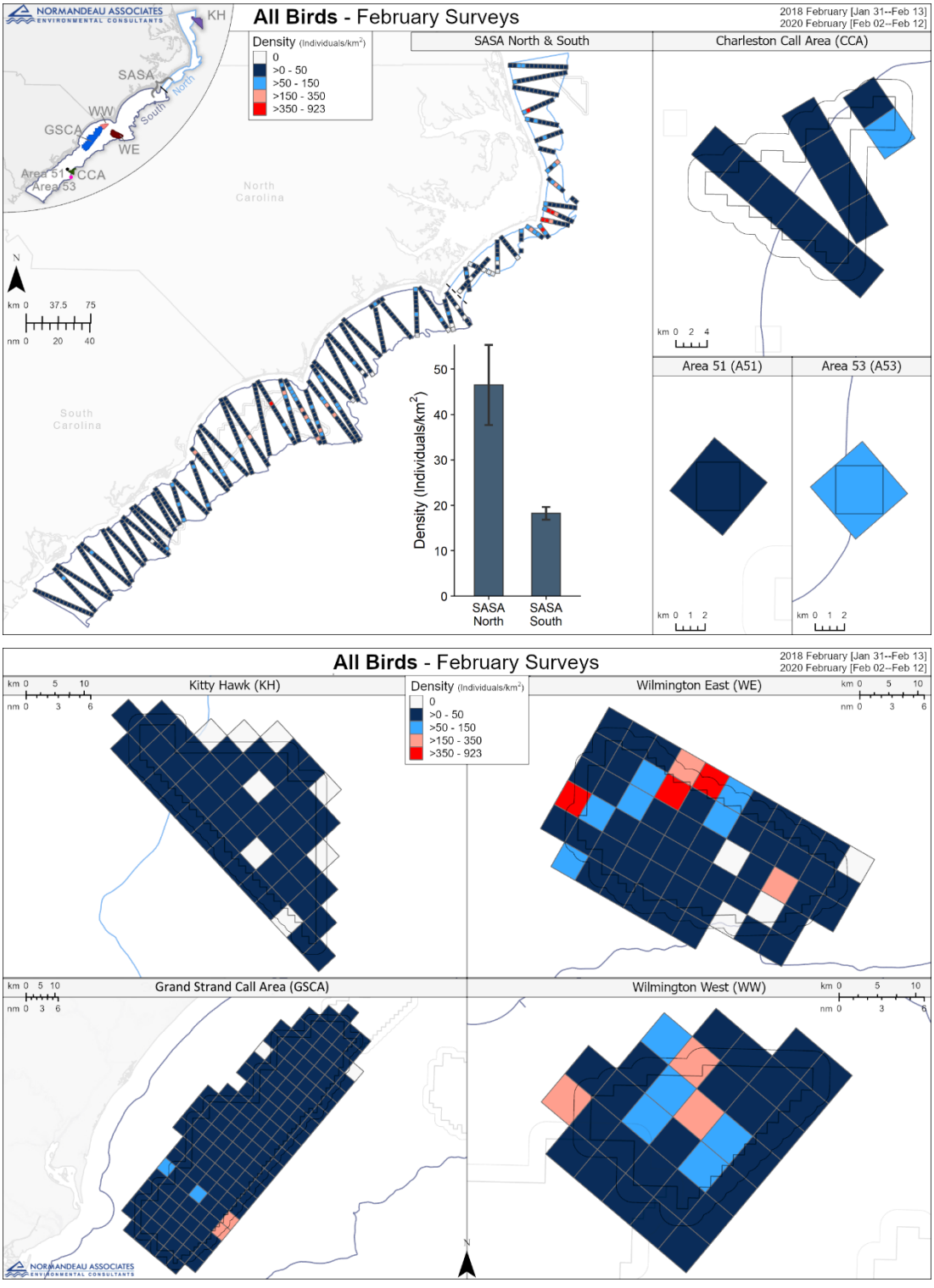

Figure 4–5. Spatial distribution of all bird species during the February surveys across all areas

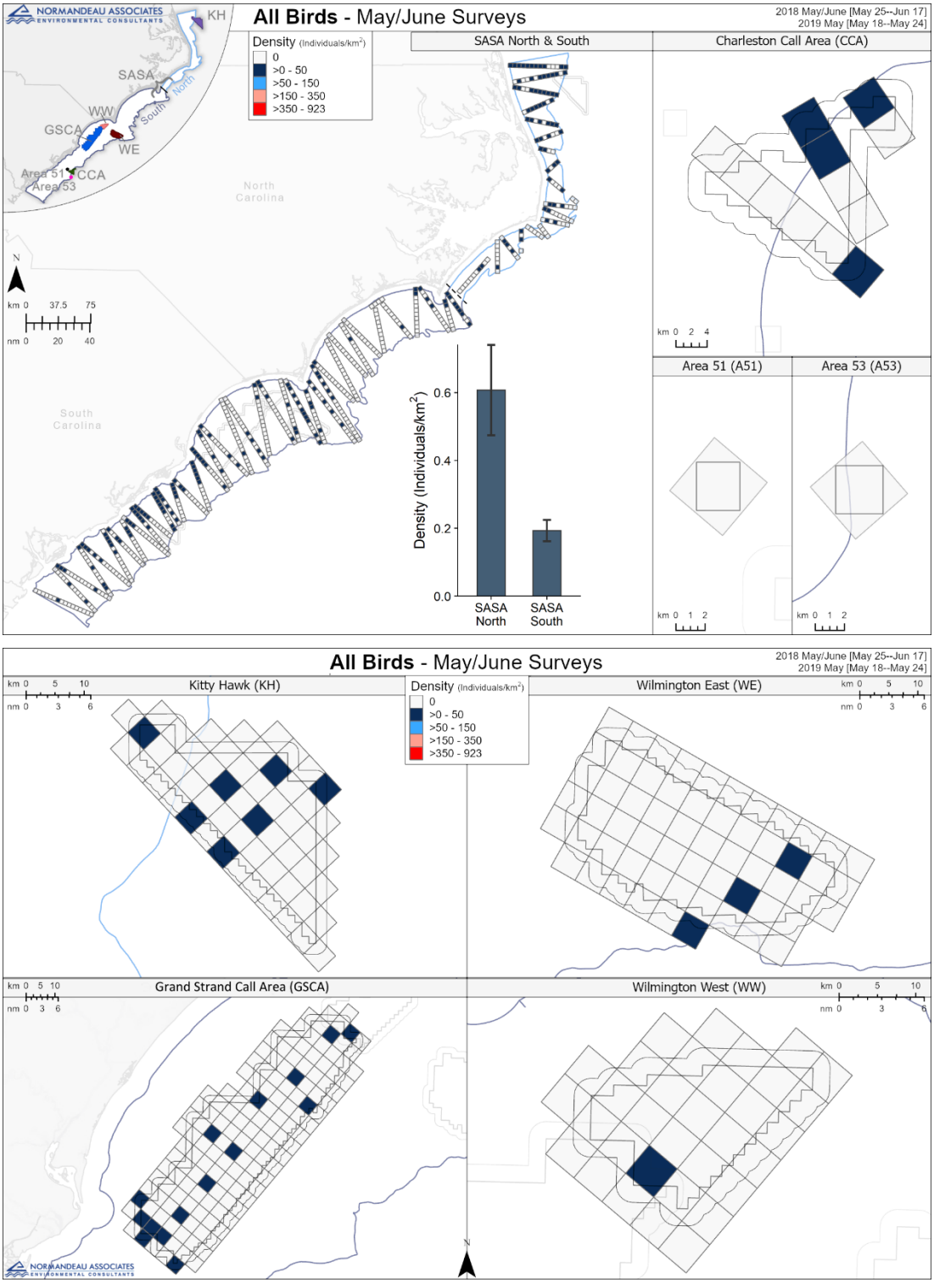

Figure 4–6. Spatial distribution of all bird species during the May/June surveys across all areas

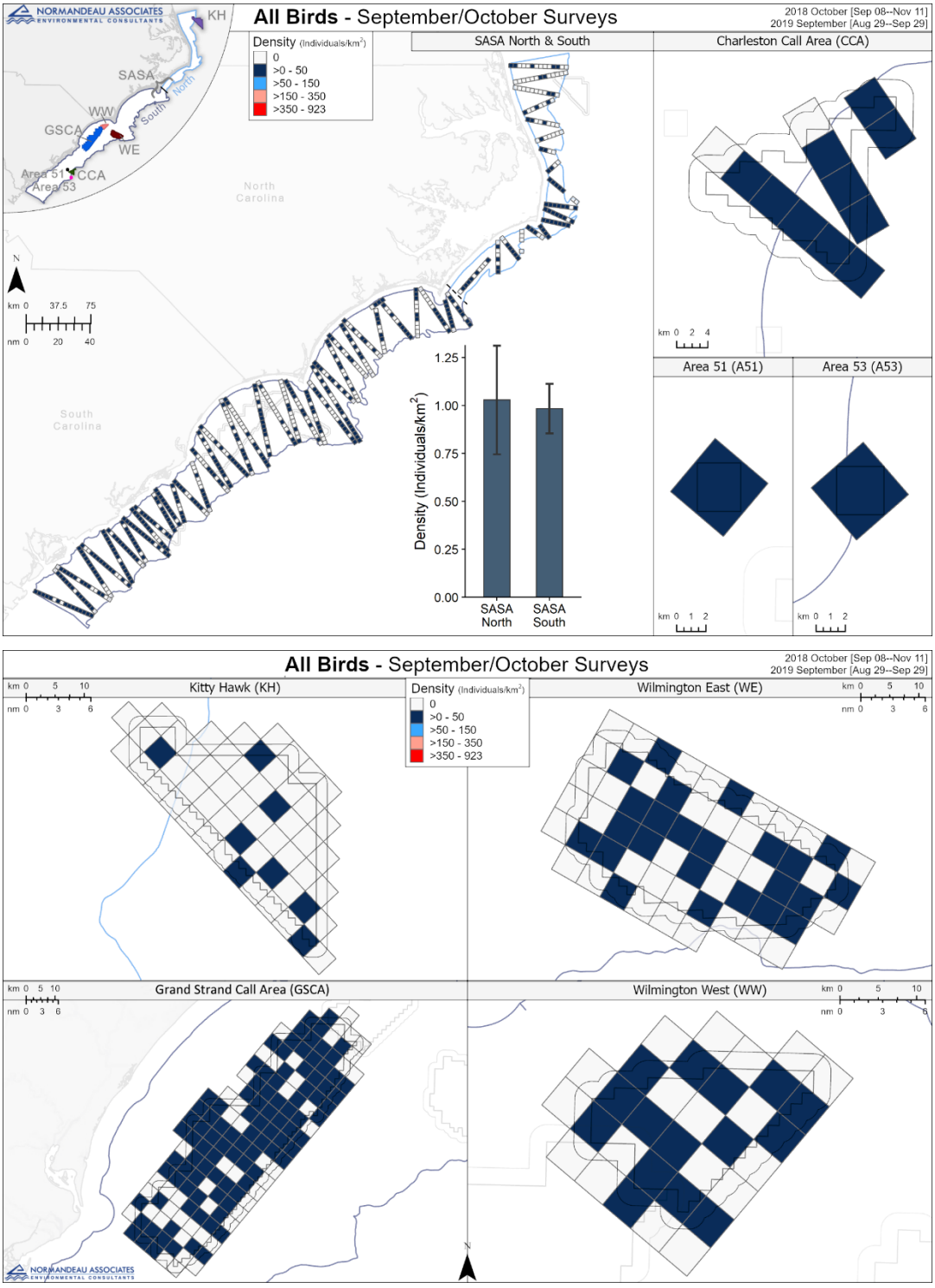

Figure 4–7. Spatial distribution of all bird species during the September/October surveys across all areas

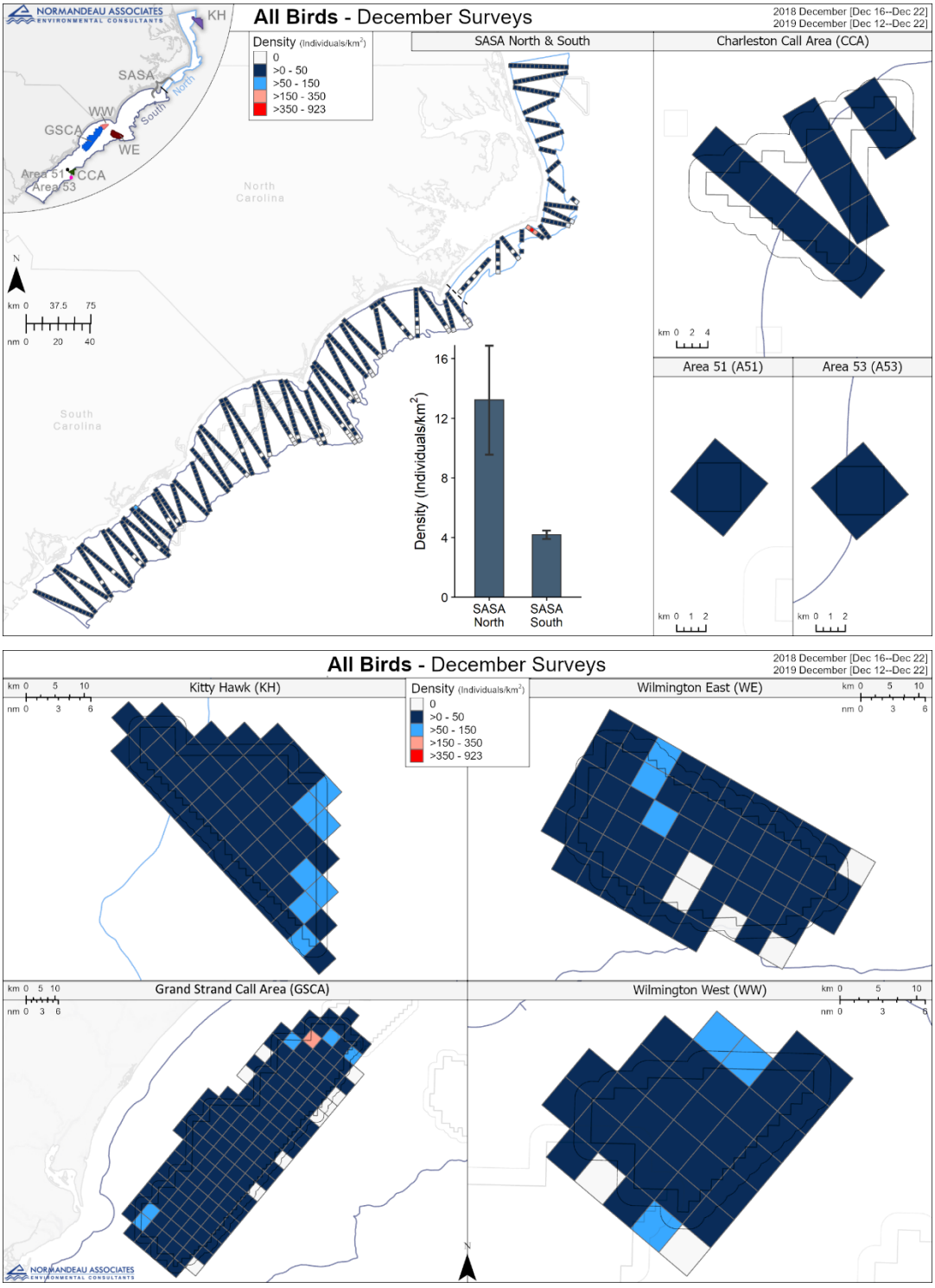

Figure 4–8. Spatial distribution of all bird species during the December surveys across all areas

Duck density was highest in SASA south across February, September/October, and December periods while being absent during the May/June period (Figure C–26 through Figure C–28). Most species were sparsely distributed across SASA with only isolated observations or small groups occurring in one location. Black scoter only occurred during the February and December surveys; February observations were limited to SASA south while December observations occurred across SASA with the highest densities occurring off the coast of South Carolina (Figure C–37 through Figure C–38).

Loons were observed across all survey periods. During February across SASA, the highest densities occurred in SASA north east of Pamlico Sound (Figure C–45). Loon observations were sparse during May/June and September/October (Figure C–46 and Figure C–47), with densities increasing during December (Figure C–48). During February, red-throated loons had higher abundance east of Pamlico Sound and east of the North Carolina/South Carolina border compared to other areas (Figure C–49); however, this trend was not observed during other survey periods. During February, common loon abundance was highest in the northern portion of SASA north; additional areas of higher abundance also occurred in GSCA and WW (Figure C–53); this trend was less evident during December (Figure C–56).

There were too few grebe observations to ascertain any spatial trends for this species group (Figure C–60).

Northern fulmar was only observed during the February surveys and occurred in much higher densities in SASA north (Figure C–61).

During February and May/June, black-capped petrel was only observed in SASA north (Figure C–65 through Figure C–66), while during September/October they were observed in both SASA north and SASA south. There were too few observations of Trindade petrel or unidentified petrels to draw any conclusions about spatial trends (Figure C–64, Figure C–68 through Figure C–70).

During September/October, Cory's shearwater was more abundant in SASA north than SASA south, though pockets of higher densities were also observed in WE. Too few Cory's shearwater observations occurred during other time periods to make any definitive statements about spatial trends of this species (Figure C–71 through Figure C–73). Great shearwater was observed across SASA in low densities during February, May/June, and September/October with higher densities occurring in WE during September/October (Figure C–74 through Figure C–76). Sooty shearwater had higher densities at KH during December compared to September/October (Figure C–77 and Figure C–78). Manx shearwater had the highest densities in SASA north in both February and December. During December there was a patch of higher densities of Manx shearwater in KH (Figure C–79 and Figure C–80). Audubon's shearwater was only observed during September/October and occurred sporadically across SASA (Figure C–81).

There are too few storm-petrel observations for any conclusive findings regarding spatial distribution (Figure C–90 through Figure C–92).

Northern gannet was observed uniformly throughout SASA during February and December. During May/June and September/October densities were much lower and primarily observed in SASA north (Figure C–93 through Figure C–96).

Cormorants were observed throughout all survey periods and sporadically across SASA. Higher densities were observed in SASA south during all survey periods except May/June, though densities were low in all periods (Figure C–97 through Figure C–106).

Brown pelican was observed throughout the year in low densities with no obvious spatial trends (Figure C–107 through Figure C–110). The American white pelican was only observed during the September/October surveys (Figure C–111).

There were too few individuals observed for species in the Ardeidae or raptor family for any conclusive findings regarding spatial distribution (Figure C–112 through Figure C–116).

Shorebirds were observed during the May/June, September/October, and December periods with the highest densities occurring in May/June. During May/June, shorebirds were observed almost exclusively in SASA north. Densities during September/October and December were higher in SASA south (Figure C–117 through Figure C–125).

Phalaropes were observed most often during February and December, and during this time phalaropes had the highest densities in SASA south, WE, WW, and GSCA Figure C–126 through Figure C–139).

There were too few observations of skua to draw any conclusions about spatial trends (Figure C–140 through Figure C–149).

Auk species were observed throughout the year and were observed in higher densities in SASA north compared to SASA south during all survey periods (Figure C–150 through Figure C–167). This trend was largely driven by razorbill, which makes up most of the auk observations (Figure C–158 and Figure C–159). Atlantic puffin was observed in February and December with higher numbers in SASA north than SASA south; higher densities were also observed in KH compared to the other call areas (Figure C–162 and Figure C–163).

Gulls were observed throughout the year with higher numbers observed during February and December and in SASA north (Figure C–168 through Figure C–171). During February, higher densities were observed in GSCA, WE, and WW compared to the other call areas (Figure C–168). During December higher gull densities were observed at KH compared to other call areas (Figure C–171). Black-legged kittiwakes were more abundant in SASA north compared to SASA south in February and December. Among the call areas, black-legged kittiwakes were observed almost exclusively in KH (Figure C–172 through Figure C–174). Bonaparte's gulls were observed throughout SASA and all call areas during February (Figure C–175); however, during December, most observations were concentrated at KH (Figure C–177). There were too few observations of Bonaparte's gull during May/June and September/October to make any definitive conclusions about spatial trends (Figure C–176). Laughing gull densities were low during February and May/June but became more abundant in September/October and December with observations primarily occurring east of Pamlico Sound in September/October. laughing gull was distributed throughout SASA during December with higher numbers in SASA north and found in KH, GSCA, WE, and WW (Figure C–181 through Figure C–184). Ring-billed gulls were found throughout SASA in February and December with higher densities found in SASA north (Figure C–185 through Figure C–187). Herring gulls are located throughout SASA in February and December, with higher numbers seen in SASA north. During May/June and September/October, most herring gull were observed off the coast of North Carolina (Figure C–188 through Figure C–191). Lesser black-backed gulls were observed almost exclusively east of and just south of Pamlico Sound (Figure C–193 through Figure C–195). Great black-backed gull occurred most frequently in February and December and was found mostly east of and just south of Pamlico Sound; during December this species was also found in higher densities in KH compared to other call areas. There are no obvious spatial trends for great black-backed gull in May/June and September/October (Figure C–197 through Figure C–200). Rare gull species including little gull, Iceland gull, and glaucous gull occurred too infrequently to draw any conclusions about spatial trends (Figure C–178 through Figure C–180, Figure C–192, Figure C–196).

Terns occurred most often in May/June and September/October with few observations in February and December. During May/June terns were most abundant in SASA south; during September/October, terns were most abundant in SASA south, GSCA, WE, and WW (Figure C–212 through Figure C–215). No obvious spatial trends were seen for sooty tern, bridled tern, least tern, gull-billed tern, or Caspian tern

(Figure C–216 through Figure C–222). During September/October, black terns were observed east of Pamlico Sound and off the South Carolina coast in SASA. Smaller numbers of black tern were seen in KH and WE during September/October (Figure C–223 through Figure C–224). Royal tern was almost exclusively observed during May/June and September/October with greater densities in SASA south (mostly off the South Carolina coast) than SASA north during both periods. Royal tern was also observed in GSCA in May/June and WE, GSCA, and WW during September/October (Figure C–225 through Figure C–227). Sandwich tern was observed more frequently in SASA south compared to SASA north during May/June and September/October; they were also observed in GSCA and WW in September/October (Figure C–230 and Figure C–231). *Sterna* terns were observed throughout SASA, with higher abundance in SASA south during all periods except December. *Sterna* terns were observed in CCA during May/June and September/October and in GSCA and WE during all survey periods. *Sterna* terns were only observed in KH during December (Figure C–237 through Figure C–240). Common terns were most abundant during September/October and had the highest densities in SASA south, CCA, A53, GSCA, and WE (Figure C–241 through Figure C–243). Forester's terns were observed throughout SASA with the highest densities occurring in February and December. Forester's tern densities were highest in SASA south, WE, GSCA, and WW in February and SASA north, GSCA, WE, and WW during December (Figure C–245 through Figure C–248).

There are too few data to make definitive conclusions about passerine spatial trends (Figure C–257 through Figure C–258).

4.5.4 Direction of Travel

Avian direction of travel for each species group is graphically presented for SASA in Appendix C.5, Figure C–259 through Figure C–277. The discussion of species groups that follows is limited to those with sufficient sample sizes ($n \geq 10$ in one or more seasons) observed in flight.

Duck travel direction was toward the WNW in February surveys and variable during December surveys (Figure C–259). Loon travel direction was variable with no clear patterns of travel direction for survey periods with large sample sizes (Figure C–260). Fulmar travel direction in February surveys was primarily to the N and NE (Figure C–261). There were too few petrel observations to conclude anything about flight direction (Figure C–262). Shearwaters were primarily observed traveling to the NE and SW during October/September surveys and to the NNE during December surveys, but there were too few observations to conclude any trends for the other surveys (Figure C–263). There were too few storm-petrel observations to make any conclusions about travel direction (Figure C–264). Northern gannets were recorded flying primarily to the NNE and NE during December and February surveys (Figure C–265). There were too few observations of cormorants, pelicans, wading birds, and raptors in flight to conclude anything about flight direction (Figure C–266 through Figure C–270). Shorebirds exhibited a strong preference for a northerly travel direction during the May/June surveys (Figure C–270). Phalarope flight direction was largely to the NE during the December and May/June surveys and predominantly to the SW during the February surveys (Figure C–271). There were too few skua observations to determine anything conclusive about flight direction (Figure C–272). Auk flight direction primarily occurred to the NNW during the February surveys and mixed travel directions during the December surveys (Figure C–273). Gulls primarily flew to the NE (Figure C–274). Terns mainly flew to the E and ENE during the October/September surveys and to the SE during the May/June surveys (Figure C–275). *Sterna* tern mainly flew NE during February surveys, and most individuals flew either NE or SE during October/September surveys (Figure C–276). There were insufficient passerine observations in flight to make any definitive conclusions about flight direction; however, all 24 individuals observed in flight during the May/June surveys flew northerly (Figure C–277).

4.5.5 Flight Height

All bird observations in the February 2018 through February 2020 surveys were classified as sitting or flying, and species with known flight heights were classified as outside or within the RSZ (23–319 m) for all areas combined by survey (Table 4–19, Figure 4–9, Appendix C.6). Flight height errors calculated by APEM as described in Section 3.9 for each species and each survey can be found in Appendix C.7. Avian flight activity during all surveys for each species in all areas combined is presented in Appendix C.6 (Table C–33). Flight activity during the surveys for each species by survey area is shown in Appendix C.6 (Table C–33 through Table C–41). Density per km^2 of all flying and sitting birds during each survey by area is shown in Appendix C.6 (Table C–42 through Table C–49).

Median flight height data for flying birds (with known flight heights) by species group for each survey across all areas is shown in Table 4–20 and Figure 4–10 through Figure 4–26, for each species in all areas by survey in Appendix C.7 (Table C–50), and for each species in each area by survey in Appendix C.7 (Table C–51 through Table C–58). All raw flight heights with associated error margins for each species group are presented by area for each survey in Appendix C.7 (Table C–59 through Table C–66, Figure C–278 through Figure C–294).

Of all birds observed (n=148,074), 72% were observed sitting (n=106,640) and 28% were observed flying (n=41,434): 7.8% were flying within the RSZ (n=11,521), 4.4% were flying above or below the RSZ (n=64,39), and 15.9% had unknown flight heights (n=23,474) (Table 4–19, Figure 4–9). Unknown flight heights can occur when bird species' identification, size, or wingspan cannot be determined; a lack of these data limits the ability to estimate flight height.

Within species groups, median flight height by survey was similar for *Sterna* terns and gulls (Table 4–20) when the species group was recorded during each survey. Species recorded in fewer surveys but had similar flight heights across the surveys they were observed in include loons and cormorants (Table 4–20). Both shearwater and gannet median flight heights differed among surveys with shearwater median flight height ranging from 34.0 m in December 2018 to 0.7 m in December 2019, although large median altitude errors (Table C–59 through Table C–66) makes these differences uncertain; shearwaters were not observed during February 2018 (Table 4–20; Figure 4–14). Gannett median flight height was highest in October 2018 (81.8 m) compared to other surveys where gannets were recorded (34.4 m in February 2018, 26.8 m in February 2020, 23.6 m in December 2019, and 25.1 m in December 2018); gannets were not observed during May/June 2018 or September 2019 (Table 4–20; Figure 4–15).

In the February 2018 survey, 79% of birds were observed sitting, 7% were flying within the RSZ, 3% were flying above or below the RSZ, and 10% had an unknown flight height (Table 4–19, Figure 4–9, Appendix C.7). Unknown flight heights largely comprised of select Bonaparte's gull (Appendix C.6 Table C–33). Of the individuals where flight height was calculable, skuas, ducks, gulls, and cormorants as a species group were observed flying the highest with a median flight height of 50.6 m, 42.7 m, 41.5 m, and 40.8 m, respectively (Table 4–20). Loons, gannets, and phalaropes had similar median flight heights (35.4 m, 34.4 m, and 37.4 m, respectively) during February 2018 (Table 4–20, Appendix C.7).

In the February 2020 survey, 72% of birds were observed sitting, 9% were flying within the RSZ, 5% were flying above or below the RSZ, and 14% had an unknown flight height (Table 4–19, Figure 4–9, Appendix C.7). Unknown flight heights largely comprised of select Bonaparte's gull and red phalaropes (Appendix C.6 Table C–33). Of the individuals where flight height was calculable, gulls, loons, phalaropes, and *Sterna* terns as a species group were observed flying the highest with a median flight height of 35.8 m, 33.7 m, 31.9 m, and 31.0 m, respectively (Table 4–20). Skua, gannets, and ducks had similar median flight heights (29.2 m, 26.8 m, and 25.3 m, respectively) during February 2020 (Table 4–20, Appendix C.7).

In the May/June 2018 survey, 8% of birds were observed sitting, 23% were flying within the RSZ, 9% were flying above or below the RSZ, and 60% had an unknown flight height (Table 4–19, Figure 4–9, Appendix C.7). Unknown flight heights largely comprised of royal terns and *Sterna* tern-species unknown (Appendix C.6 Table C–33). Of the individuals where flight height was calculable, gulls, *Sterna* terns, and terns were observed flying the highest with a median flight height of 34.1 m, 34.4 m, and 25.7 m, respectively (Table 4–20). The only other species group recorded during May/June 2018 was shearwaters with a median flight height of 6.2 m (Table 4–20, Appendix C.7). This survey recorded the least diverse species groups (n=4) with flight heights (Table 4–20).

In the May 2019 survey, 15% of birds were observed sitting, 15% were flying within the RSZ, 5% were flying above or below the RSZ, and 65% had an unknown flight height (Table 4–19, Figure 4–9, Appendix C.7). Unknown flight heights largely comprised of shorebird-species unknown (Appendix C.6 Table C–33). Of the individuals where flight height was calculable, terns, gulls, shorebirds, and *Sterna* terns were observed flying the highest with a median flight height of 39.1 m, 63.3 m, 30.2 m, and 30.2 m, respectively (Table 4–20). The only other species groups recorded during May 2019 was shearwaters and phalaropes with median flight heights of 13.7 m and 2.1 m (Table 4–20, Appendix C.7).

In the October 2018 survey, 26% of birds were observed sitting, 12% were flying within the RSZ, 8% were flying above or below the RSZ, and 54% had an unknown flight height (Table 4–19, Figure 4–9, Appendix C.7). Unknown flight heights largely comprised of common terns and Commic/Forster's terns (Appendix C.6 Table C–33). Of the individuals where flight height was calculable, Ardeidae were observed flying the highest with a median flight height of 123.3 m followed by skua, gannets, and petrels (73.7 m, 81.8 m, and 73.9 m, respectively) (Table 4–20, Appendix C.7). This survey recorded the most diverse species groups (n=14) with flight heights (Table 4–20).

In the September 2019 survey, 8% of birds were observed sitting, 19% were flying within the RSZ, 9% were flying above or below the RSZ, and 64% had an unknown flight height (Figure 4–9, Table 4–19, Appendix C.7). Unknown flight heights largely comprised of Commic/Forster's terns (Appendix C.6 Table C–33). Of the individuals where flight height was calculable, Ardeidae were observed flying the highest with a median flight height of 188.4 m followed by petrels, gulls, terns, and *Sterna* terns (37.0 m, 54.7 m, 34.6 m, and 38.6 m, respectively) (Table 4–20, Appendix C.7).

In the December 2018 survey, 71% of birds observed were sitting, 5% were flying within the RSZ, 4% were flying above or below the RSZ, and 20% had an unknown flight height (Figure 4–9, Table 4–19, Appendix C.7). Unknown flight heights largely comprised of northern gannet and Bonaparte's gull observed in flight (Appendix C.6 Table C–33). Of the individuals where flight height was calculable, median flight height was fairly even across the 10 species groups, with a range of 18.6 m (auks), 19.1 m (phalaropes), 22.1 m (*Sterna* terns), and 23.5 m (cormorants) to 25.1 m (gannets), 25.5 m (loons and gulls), 33.4 m (terns), 33.6 m (ducks), and 34.0 m (shearwaters) (Table 4–20).

In the December 2019 survey, 66% of birds observed were sitting, 6% were flying within the RSZ, 5% were flying above or below the RSZ, and 24% had an unknown flight height (Figure 4–9, Table 4–19, Appendix C.7). Unknown flight heights largely comprised of red phalarope and northern gannet observed in flight (Appendix C.6 Table C–33). Of the individuals where flight height was calculable, median flight height ranged from 0.4 m (skua) to 66.3 m (cormorants). Shearwater was recorded with a median flight height of 0.7 m with all other species groups being fairly even: 36.2 m (ducks), 32.8 m (gulls), 30.3 m (terns), 23.6 m (gannets and *Sterna* terns), 24.8 m (loons), and 22.3 m (phalaropes) (Table 4–20).

Gulls were observed flying higher in May 2019 (63.3 m) and September 2019 (54.7 m) than during February 2018 (41.5 m), February 2020 (35.8 m), May/June 2018 (25.7 m), October 2018 (43.7), December 2018 (25.5 m), and December 2019 (32.8 m) (Table 4–20; Figure 4–24). Median flight heights

for *Sterna* terns were fairly even across all surveys ranging from 38.6 m (September 2019) to 21.7 m (October 2018) (Table 4–20; Figure 4–26).

In Figure 4–10 through Figure 4–26 the boxplots show the distribution of data among the seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines above and below the box represent the data points that are within 1.5 times the length of the box above or below the box. Data beyond this range are shown as individual points.

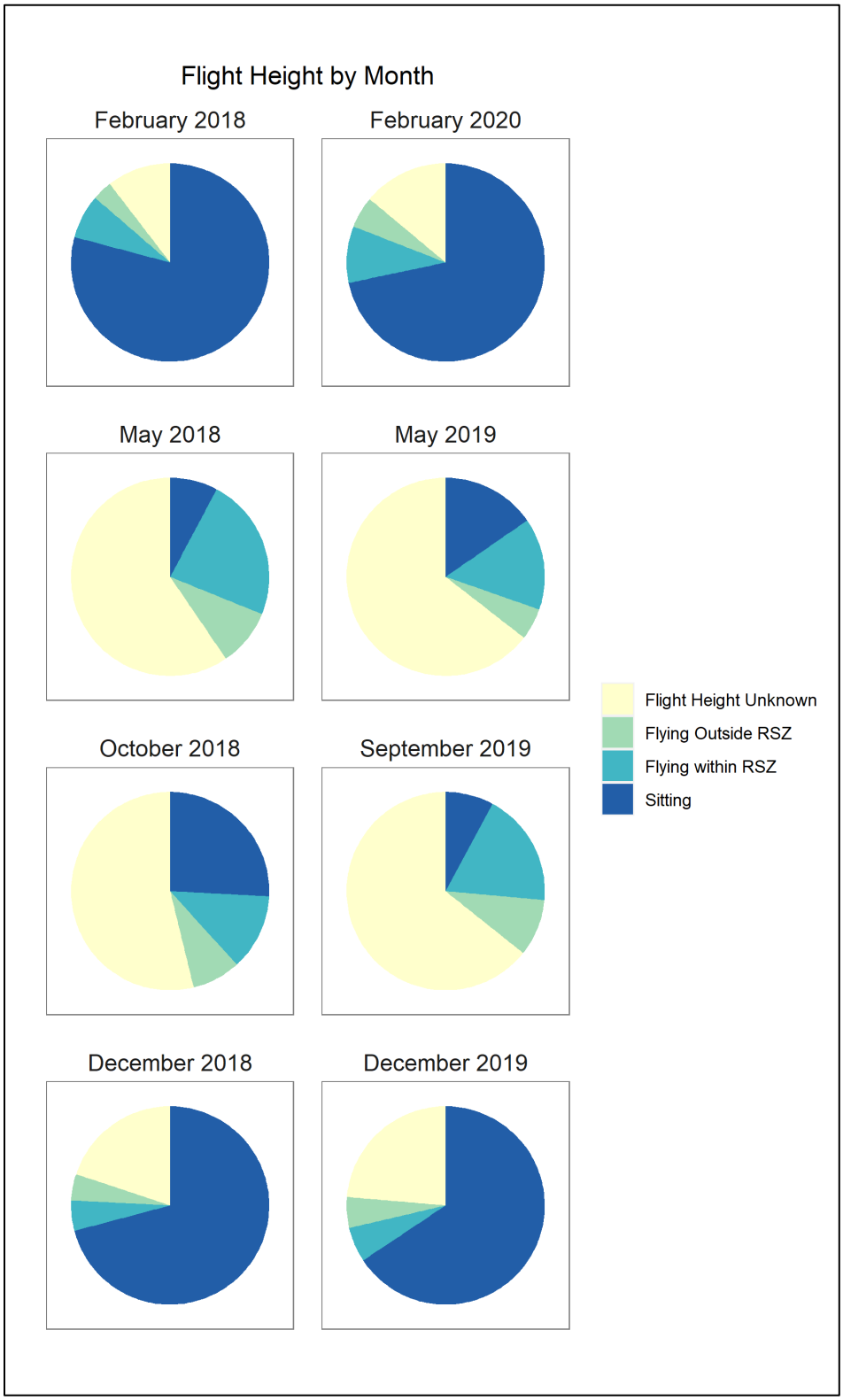

Figure 4–9. Relative abundance of all flying and sitting birds observed by survey for all areas

Table 4–19. Number of individuals, density per km^2, and percent within season of all flying and sitting birds observed by survey for all areas

Survey	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density	%	N	Density	%	N	Density	%	N	Density	%	
Feb 2018	6,424	2.7484	10.43	1,990	0.8514	3.23	4,429	1.8949	7.19	48,723	20.8456	79.14	61,566
Feb 2020	6,830	2.936	13.94	2,515	1.0811	5.13	4,529	1.9469	9.24	35,131	15.1016	71.69	49,005
May/Jun 2018	153	0.0709	59.53	24	0.0111	9.34	60	0.0278	23.35	20	0.0093	7.78	257
May 2019	487	0.2073	64.5	39	0.0166	5.17	113	0.0481	14.97	116	0.0494	15.36	755
Oct 2018	1,174	0.519	53.83	173	0.0765	7.93	270	0.1194	12.38	564	0.2493	25.86	2,181
Sep 2019	1,512	0.6471	64.29	218	0.0933	9.27	437	0.187	18.58	185	0.0792	7.87	2,352
Dec 2018	3,509	1.4946	19.89	761	0.3241	4.31	868	0.3697	4.92	12,501	5.3245	70.87	17,639
Dec 2019	3,385	1.5285	23.64	719	0.3247	5.02	815	0.368	5.69	9,400	4.2446	65.65	14,319
Totals	**23,474**	**10.1518**		**6,439**	**2.7788**		**11,521**	**4.9618**		**106,640**	**45.9034**		**148,074**

[1] RSZ = 23–319 m

Table 4–20. Number of individuals and median altitude (m) for flying birds (with known flight heights) by species group for each survey across all areas

Species Group	2018 Feb		2020 Feb		2018 May/Jun		2019 May		2018 Oct		2019 Sep		2018 Dec		2019 Dec	
	N	Median Altitude	N	Median Altitude	N	Median Altitude	N	Median Altitude	N	Median Altitude	N	Median Altitude	N	Median Altitude	N	Median Altitude
Duck	6	42.7	11	25.3	–	–	–	–	–	–	–	–	16	33.6	15	36.2
Loon	38	35.4	6	33.7	–	–	–	–	2	32.8	–	–	10	25.5	16	24.8
Fulmar	20	27.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Petrel	–	–	–	–	–	–	–	–	1	73.9	1	37.0	–	–	–	–
Shearwater	–	–	5	19.4	4	6.2	1	13.7	7	12.0	16	21.4	3	34.0	1	0.7
Gannet	761	34.4	550	26.8	–	–	–	–	15	81.8	–	–	453	25.1	588	23.6
Cormorant	1	40.8	3	22.0	–	–	–	–	6	29.5	–	–	3	23.5	1	66.3
Pelican	–	–	–	–	–	–	–	–	1	63.4	–	–	–	–	–	–
Ardeidae	–	–	–	–	–	–	–	–	15	123.3	1	188.4	–	–	–	–
Raptor	–	–	–	–	–	–	–	–	1	52.7	–	–	–	–	–	–
Shorebird	–	–	–	–	–	–	27	30.2	10	36.4	–	–	–	–	–	–
Phalarope	1,112	37.4	2,131	31.9	–	–	1	2.1	7	28.7	5	23.1	8	19.1	316	22.3
Skua	2	50.6	1	29.2	–	–	–	–	1	73.7	1	13.8	–	–	1	0.4
Auk	27	16.0	61	16.4	–	–	–	–	–	–	–	–	11	18.6	–	–
Gull	4,288	41.5	4,085	35.8	17	25.7	10	63.3	113	43.7	8	54.7	1,000	25.5	339	32.8
Tern	–	–	–	–	57	34.4	81	39.1	114	25.1	288	34.6	2	33.4	1	30.3
Sterna Tern	164	27.0	191	31.0	6	34.1	32	27.9	150	21.7	335	38.6	123	22.1	256	23.6

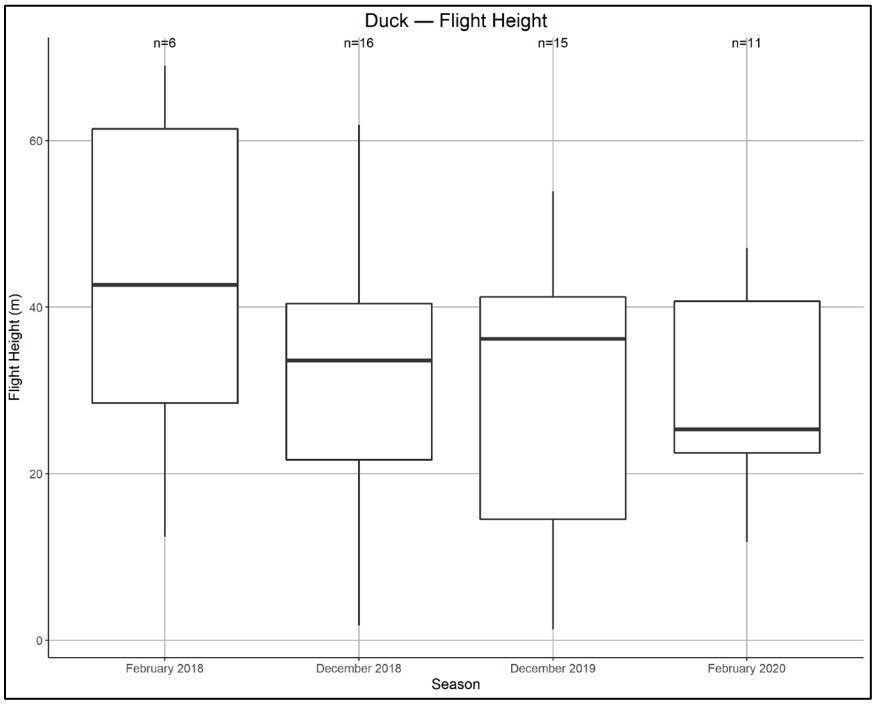

Figure 4–10. Distribution of known flight heights for ducks during the February 2018 through February 2020 surveys for all areas combined (total flying n=172; sitting n=823)

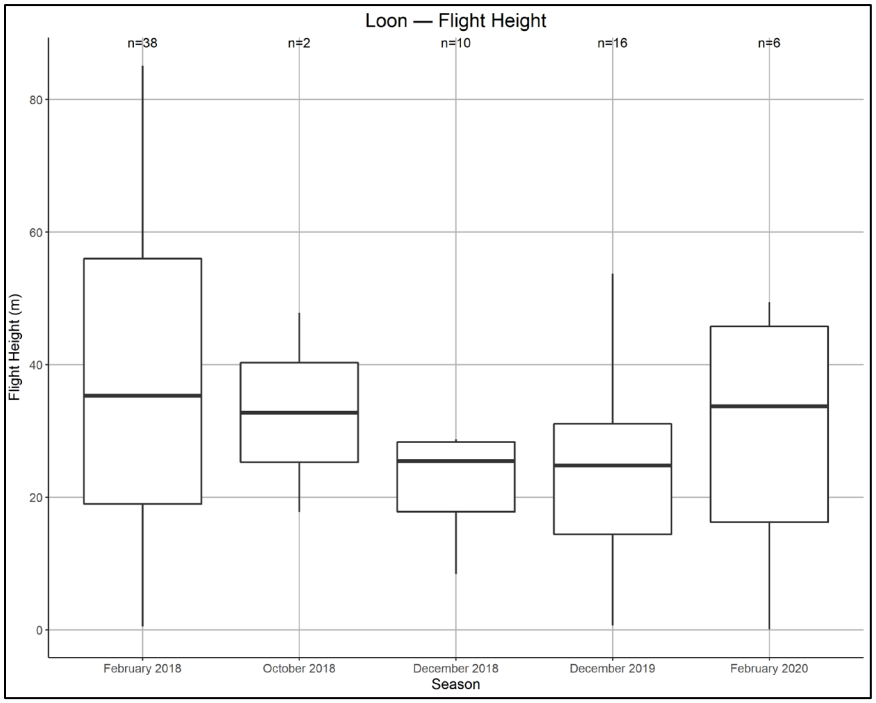

Figure 4–11. Distribution of known flight heights for loons during the February 2018 through February 2020 surveys for all areas combined (total flying n=311; sitting n=24,763)

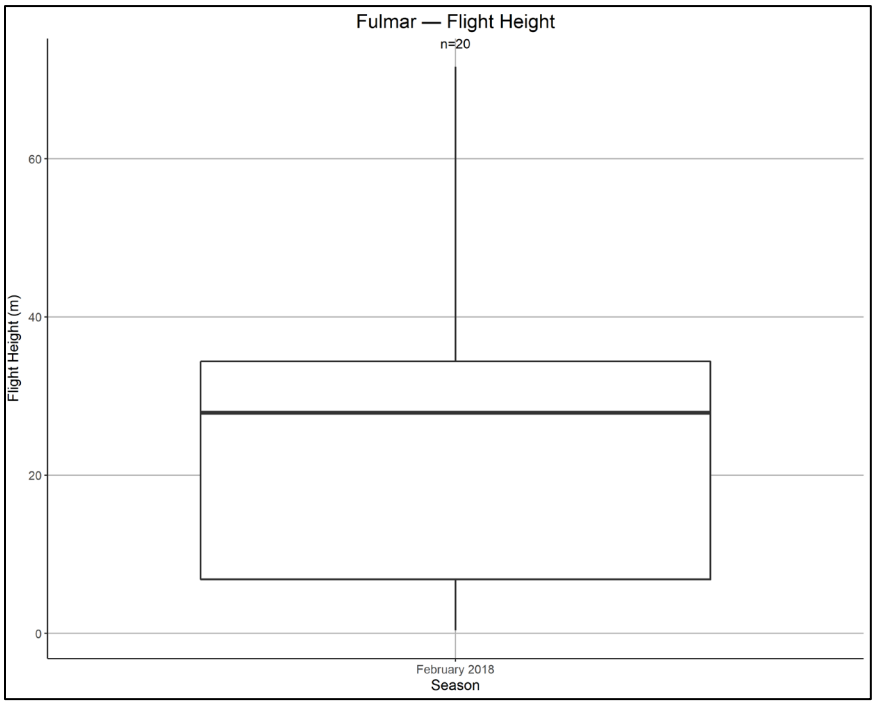

Figure 4–12. Distribution of known flight heights for fulmars during the February 2018 through February 2020 surveys for all areas combined (total flying n=44; sitting n=7)

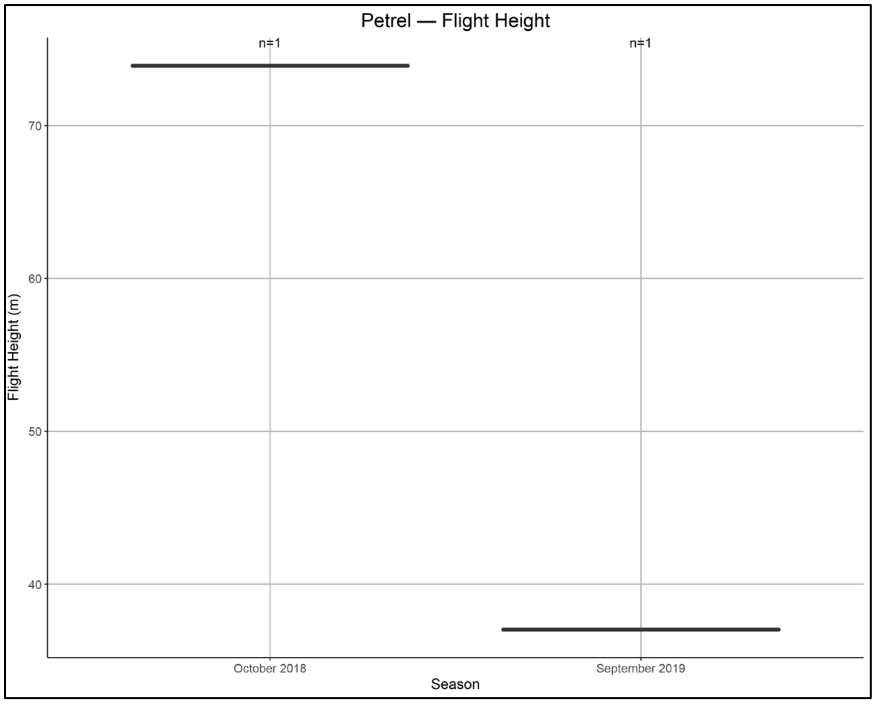

Figure 4–13. Distribution of known flight heights for petrels during the February 2018 through February 2020 surveys for all areas combined (total flying n=8; sitting n=6)

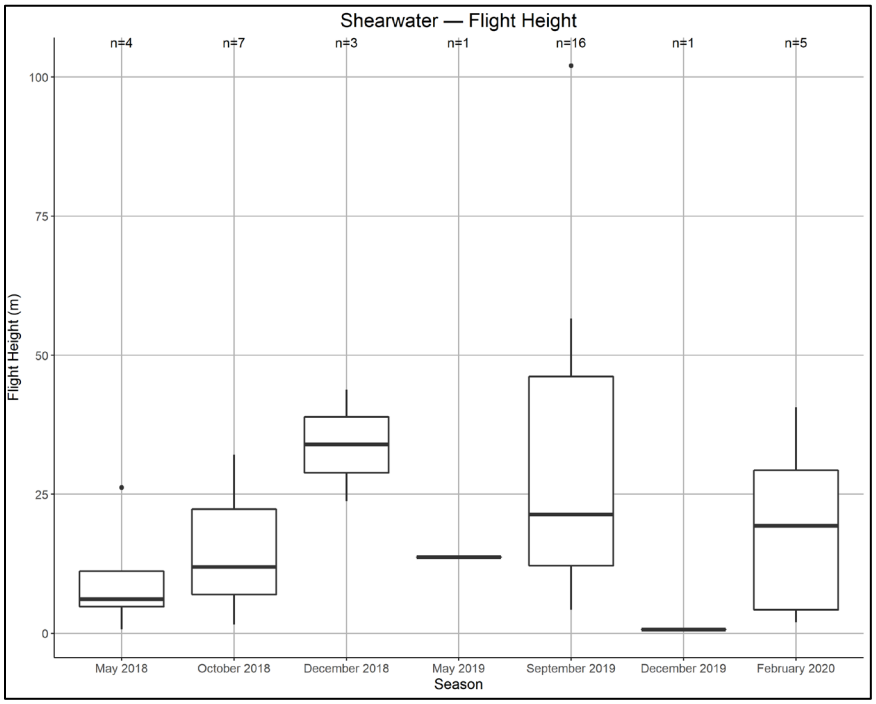

Figure 4–14. Distribution of known flight heights for shearwaters during the February 2018 through February 2020 surveys for all areas combined (total flying n=446; sitting n=363)

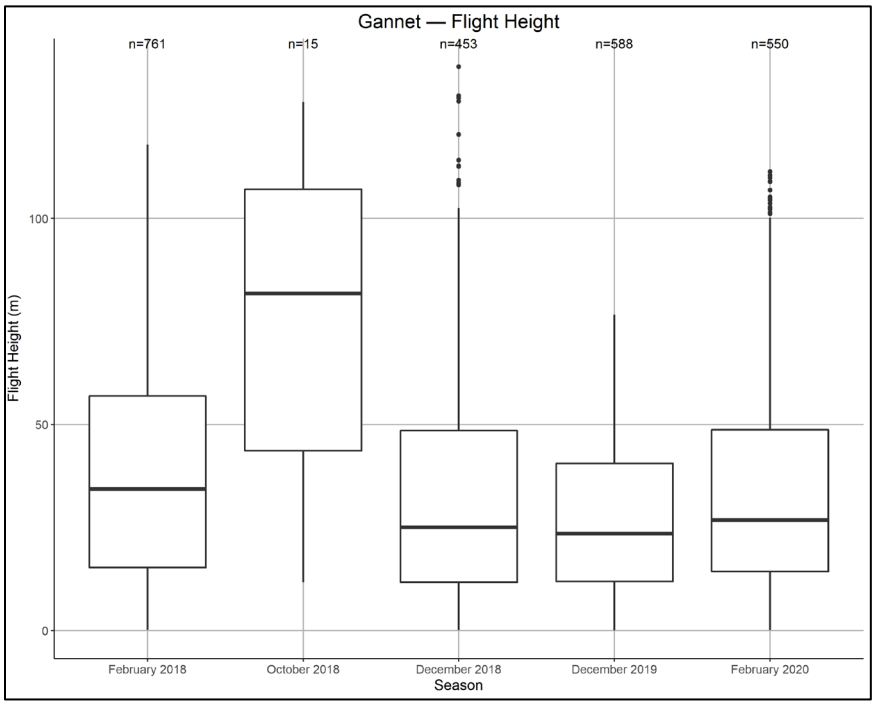

Figure 4–15. Distribution of known flight heights for gannets during the February 2018 through February 2020 surveys for all areas combined (total flying n=5,358; sitting n=15,402)

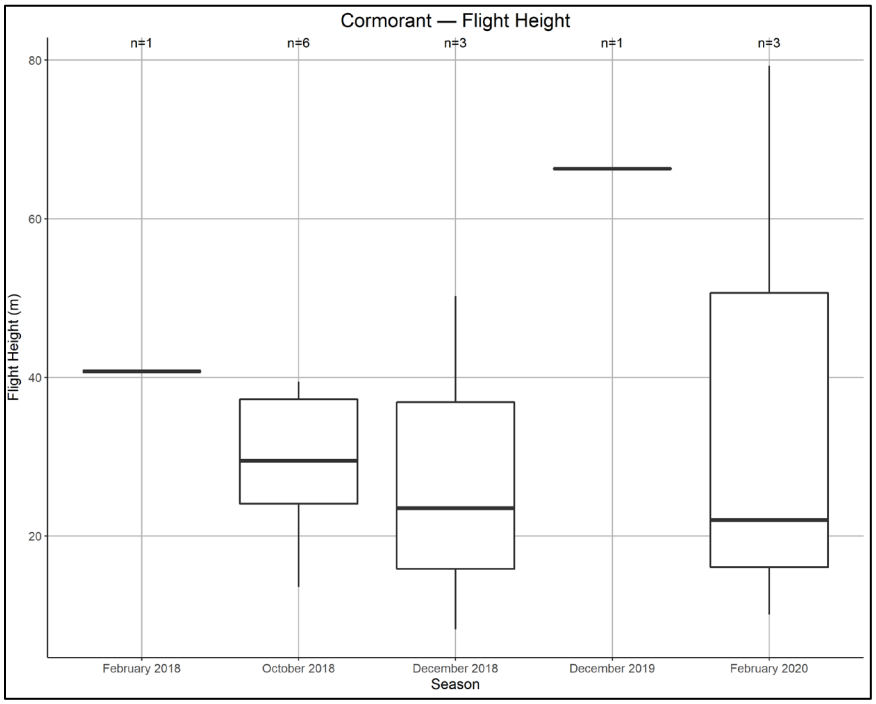

Figure 4–16. Distribution of known flight heights for cormorants during the February 2018 through February 2020 surveys for all areas combined (total flying n=24; sitting n=1,171)

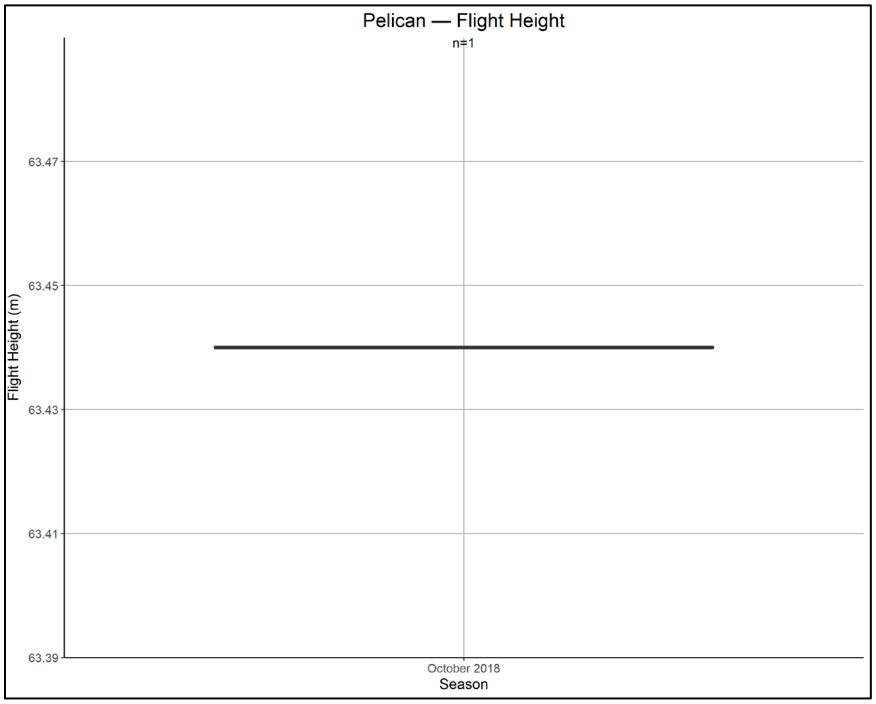

Figure 4–17. Distribution of known flight heights for pelicans during the February 2018 through February 2020 surveys for all areas combined (total flying n=31; sitting n=95

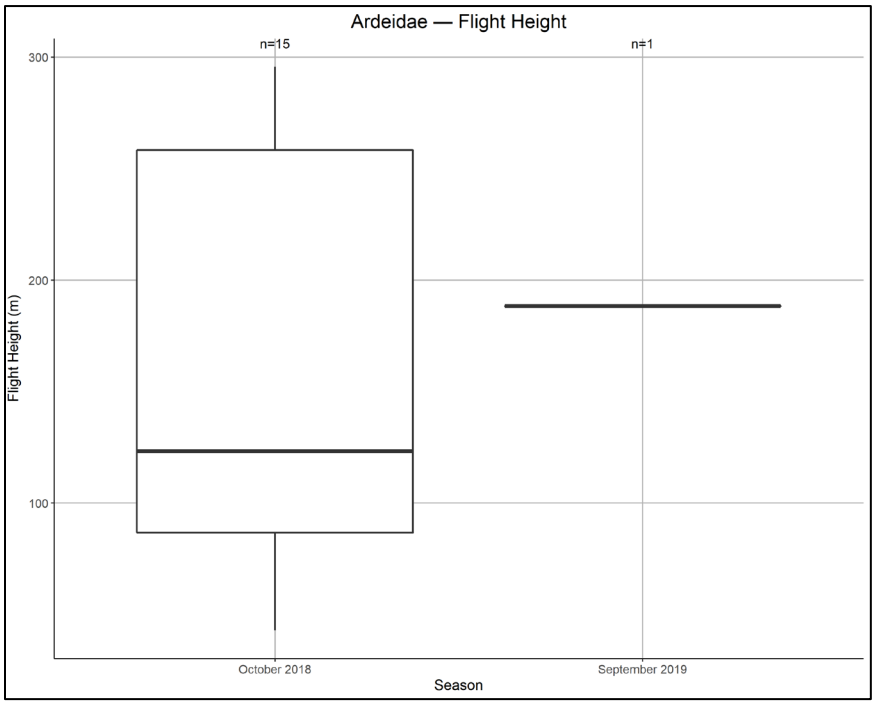

Figure 4–18. Distribution of known flight heights for Ardeidae during the February 2018 through February 2020 surveys for all areas combined (total flying n=18; sitting n=0)

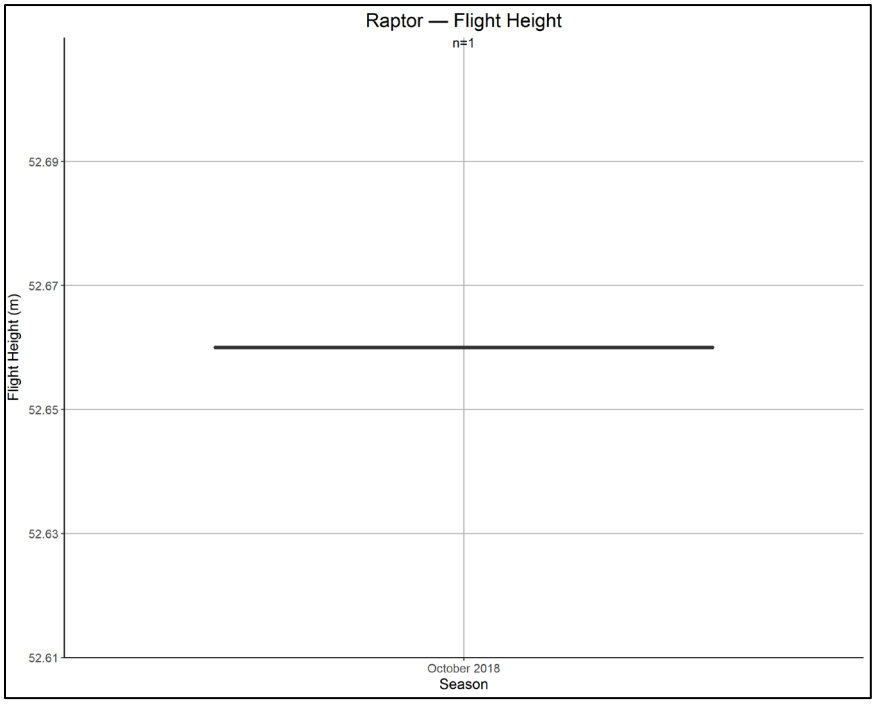

Figure 4–19. Distribution of known flight heights for raptors during the February 2018 through February 2020 surveys for all areas combined (total flying n=1; sitting n=0)

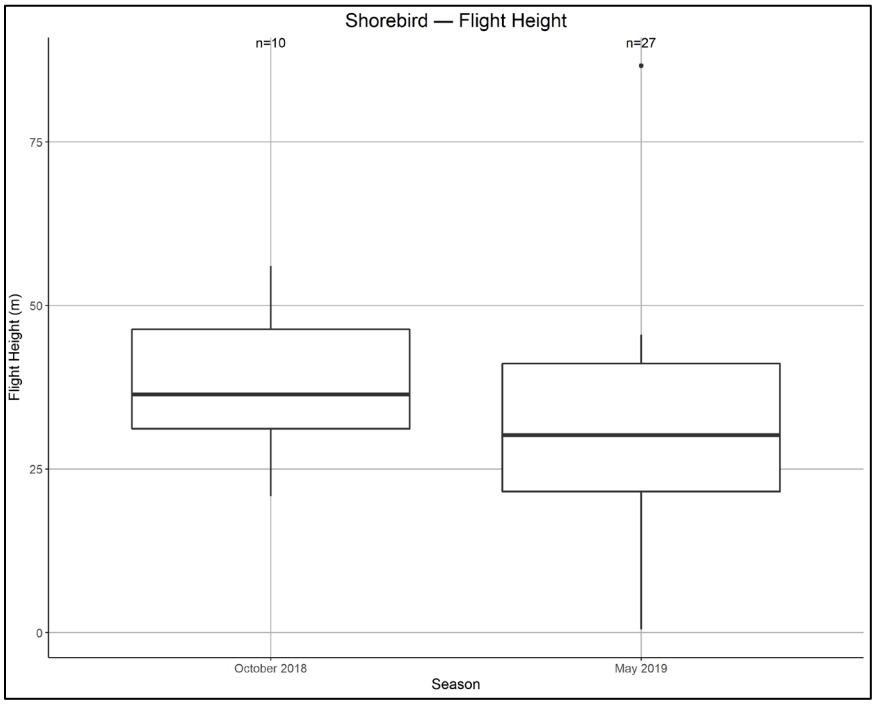

Figure 4–20. Distribution of known flight heights for shorebirds during the February 2018 through February 2020 surveys for all areas combined (total flying n=346; sitting n=0)

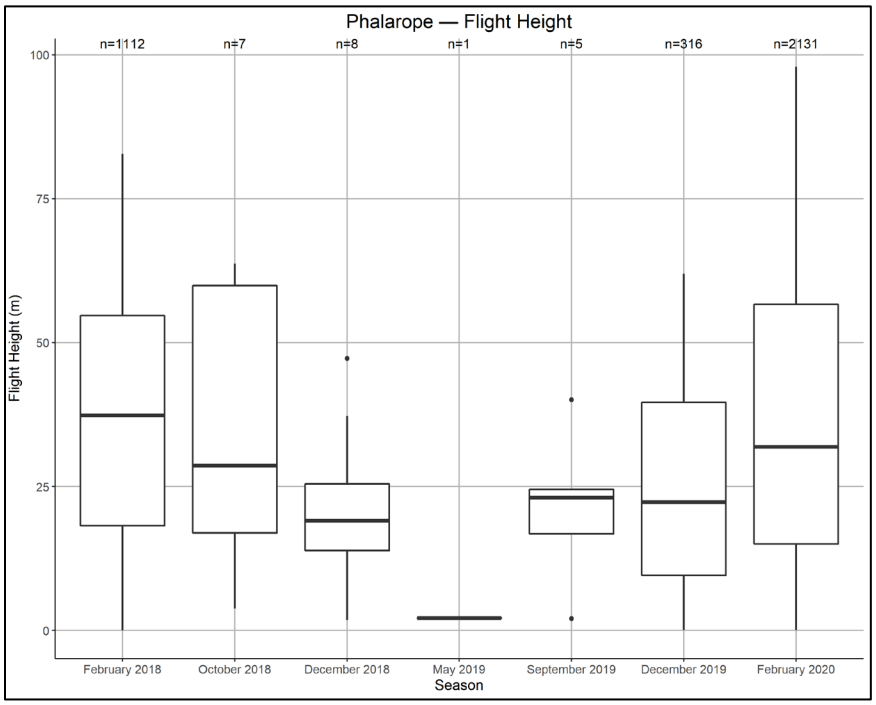

Figure 4–21. Distribution of known flight heights for phalaropes during the February 2018 through February 2020 surveys for all areas combined (total flying n=8,981; sitting n=27,429)

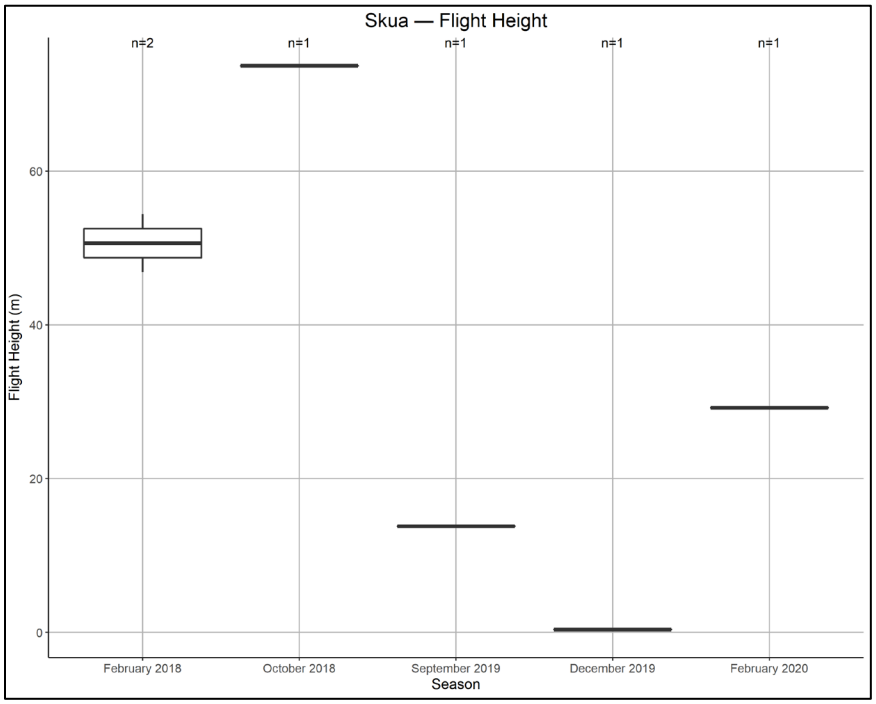

Figure 4–22. Distribution of known flight heights for skuas during the February 2018 through February 2020 surveys for all areas combined (total flying n=13; sitting n=17)

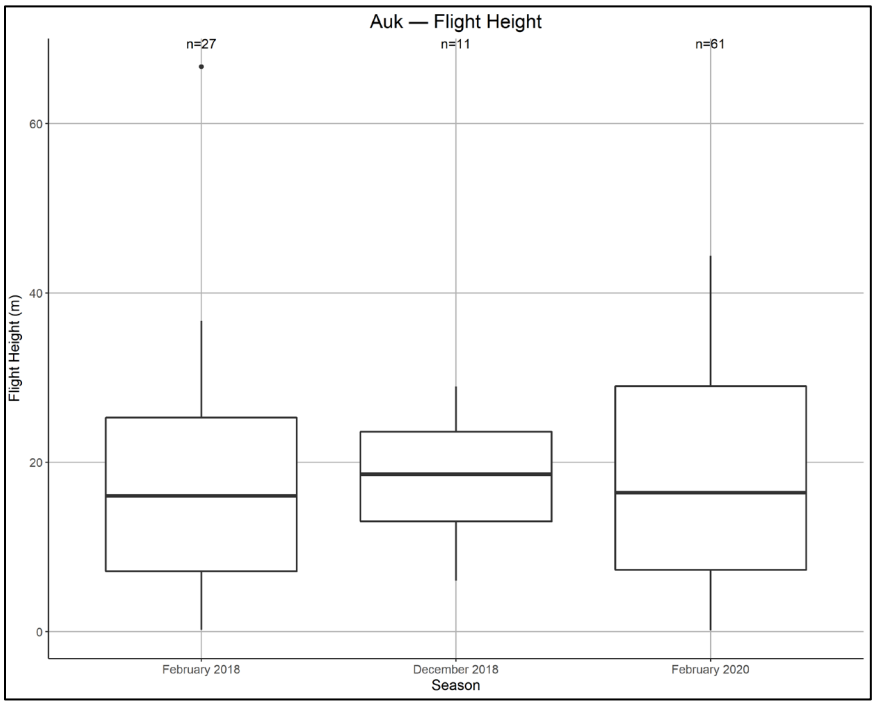

Figure 4–23. Distribution of known flight heights for auks during the February 2018 through February 2020 surveys for all areas combined (total flying n=1,452; sitting n=18,557)

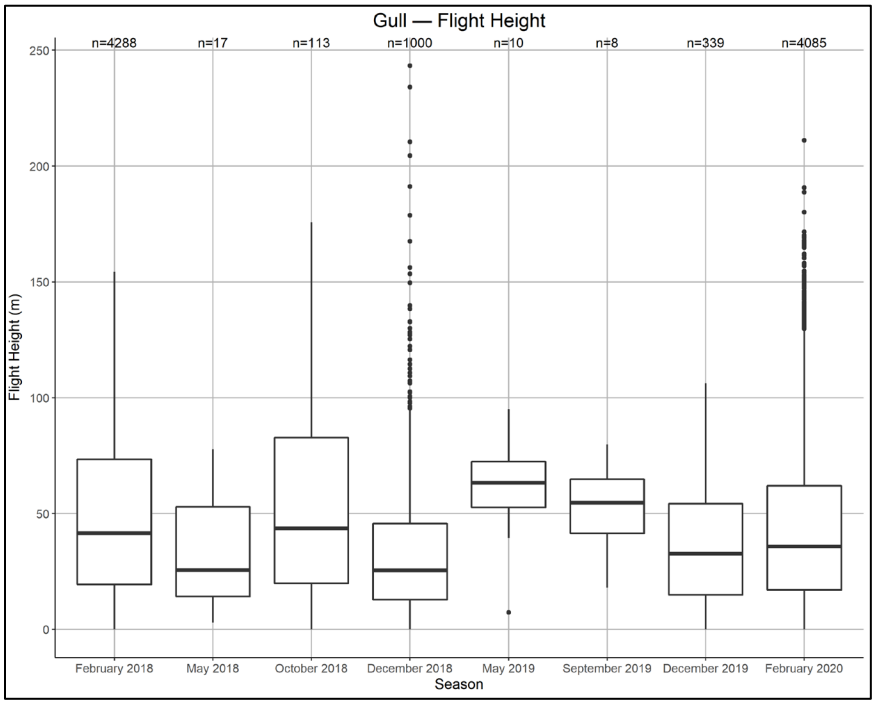

Figure 4–24. Distribution of known flight heights for gulls during the February 2018 through February 2020 surveys for all areas combined (total flying n=17,908; sitting n=17,648)

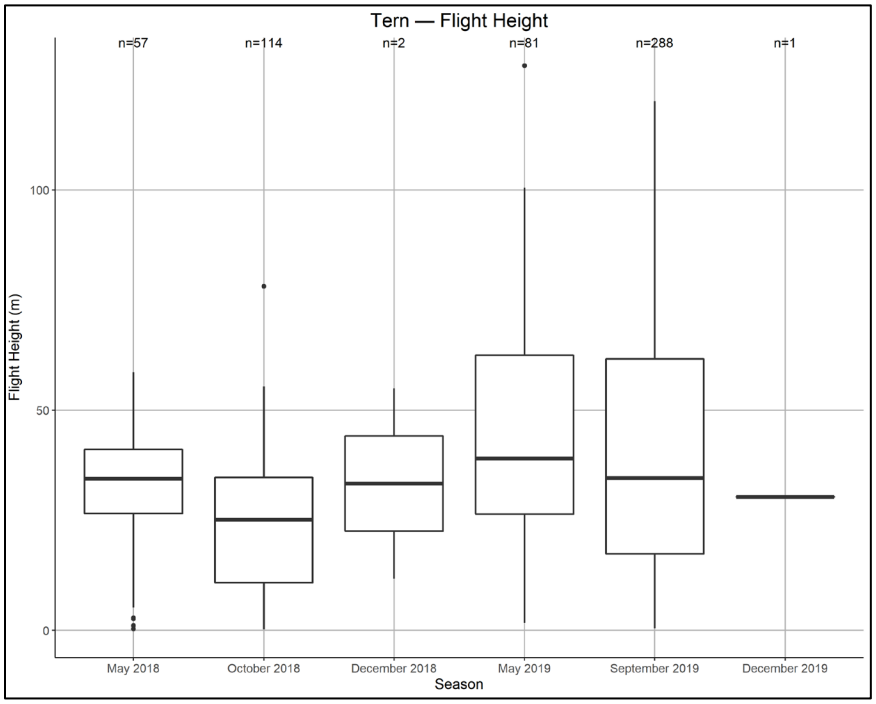

Figure 4–25. Distribution of known flight heights for terns during the February 2018 through February 2020 surveys for all areas combined (total flying n=1,650; sitting n=96)

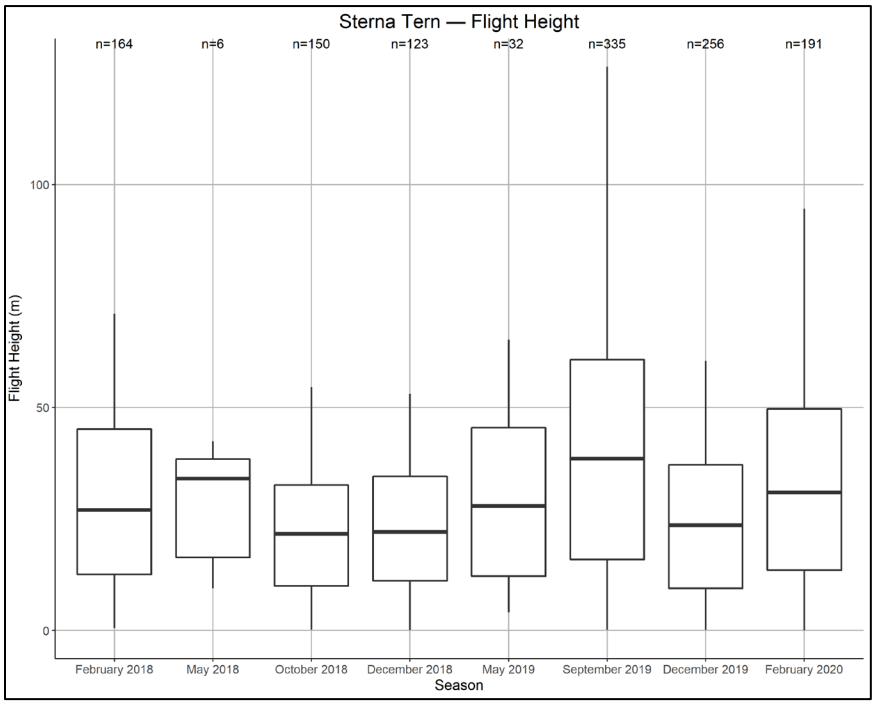

Figure 4–26. Distribution of known flight heights for *Sterna* terns during the February 2018 through February 2020 surveys for all areas combined (total flying n=4,636; sitting n=274)

4.5.6 Spatial Patterns of Flight Height

Spatial distribution of flying and sitting loons, gannets, and gulls during the February 2018 through December 2018 surveys for all areas is presented in Appendix C.8 (Figure C–295 through Figure C–303 [loons], Figure C–304 through Figure C–311 [gannets], and Figure C–312 through Figure C–323 [gulls]). Distribution of gulls varied seasonally.

Gulls were widely observed both in flight and sitting with no obvious spatial patterns across SASA (Figure C–312 through Figure C–323).

Gannets occur throughout SASA but were concentrated in the area during February and December. During December most northern gannets in GSCA and WW were observed sitting whereas this trend was less distinct during February (Figure C–304 through Figure C–311).

Loons were found sitting on the water during the surveys they were observed in SASA. With few individuals observed in flight, no obvious spatial flight height trends were evident (Figure C–295 through Figure C–303).

There were few flight height data for other species groups so spatial patterns were indistinct.

4.5.7 Sensitivity Analysis

Using the methods described in Section 3.6, we examined the broad-scale variation in relative sensitivity of birds to wind development within the SASA using three sensitivity indices developed in a BOEM

study (Robinson Willmott et al. 2013): population sensitivity, collision sensitivity, and displacement sensitivity. Population Sensitivity represents species with low global population numbers, which are potentially range restricted, have high adult survival rates, and correspondingly low fecundity. These species also have high conservation status at a State and/or Federal level. Collision Sensitivity generally represents species that frequently fly during twilight or at night, are not known to avoid wind farms in other parts of the world and spend considerable time in the area during a year, thus heightening risk of collision (Robinson Willmott et al. 2013). Displacement Sensitivity represents species that have restricted habitat flexibility for foraging opportunity as opposed to those species that forage in a variety of habitats. Species used in each sensitivity map are displayed in Table 4–21, Table 4–22, and Table 4–23. Single season avian sensitivity maps can be found in Appendix C.9.

Sensitivity indices and associated maps are readily interpretable and can used to inform siting decisions at broad scales. More spatially detailed data such as those collected using grid-design survey methodology with high coverage can be examined to help inform finer-scale siting decisions at the project level. The combined maps represent an average abundance across the eight surveys in each year (Figure 4–27, Figure 4–28, and Figure 4–29). Single season maps represent the total number of birds in each cell (Appendix C.9, Figure C–324 through Figure C–335).

When all data were pooled across the eight surveys, population sensitive species were observed across northern North Carolina around Cape Hatteras, except at the outer edge of SASA nearer the −60-m isobath with some sensitive species also showing nearer to shore in central North Carolina. Some nearer shore population-sensitive species were observed in a few cells in central and southern areas of South Carolina, but most of these cells are close to shore (Figure 4–27). Scattered collision-sensitive species were observed throughout SASA (Figure 4–28), although some displacement-sensitive species were observed around Cape Hatteras and in southern North Carolina and central to southern South Carolina (Figure 4–29).

Although population-sensitive species were distributed across SASA, timing of aggregations varied with most spatial concentrations in northern North Carolina and around Cape Hatteras mainly during February and December, with lower density of population-sensitive species at other times of year (Appendix C.9, Figure C–324 through Figure C–327). Outside of September/October, there are distinct concentrations of population-sensitive species occurring nearshore.

Collision-sensitive species were few in all survey periods and no spatial trends were evident (Appendix C.9, Figure C–328 through Figure C–331).

Displacement-sensitive species were most abundant during February and December, almost absent in the May/June survey period, and moderately abundant during September/October (Appendix C.9, Figure C–332 to Figure C–335). Displacement-sensitive species occurred uniformly in SASA north but tended to occur closer to shore in SASA south (Appendix C.9, Figure C–332 through Figure C–335). Much of this displacement sensitivity is driven by loon patterns of habitat use (Appendix C.4, Figure C–45 through Figure C–48) and razorbill patterns of habitat use (Appendix C.4, Figure C–158 and Figure C–159).

Table 4–21. Species used in Population-Sensitive bird abundance mapping and their sensitivity rank

Common Name	Population Sensitivity Rank
Black-capped Petrel	1
Petrel-species unknown	2
Least Tern	3
Cory's Shearwater	4
Audubon's Shearwater	5
Shearwater-species unknown-Large	6
Sterna Tern-species unknown	7
Surf Scoter	8
Royal Tern	9
Shearwater-species unknown-Small	10
Royal/Caspian Tern	11
Skua-species unknown	12
White-winged Scoter	13
Scoter unid.	14
Common Loon	15
Manx Shearwater	16
Northern Gannet	17
Iceland Gull	18
Great Shearwater	19
Storm-petrel-species unknown	20
Sandwich Tern	21
Pomarine Jaeger	22
Gull-billed Tern	23
Great Skua	24

Table 4–22. Species used in Collision-Sensitive bird abundance mapping and their sensitivity rank

Common Name	Collision Sensitivity Rank
Herring Gull	1
Great Black-backed Gull	2
Parasitic Jaeger	3
Red Phalarope	4
Long-tailed Jaeger	5
Pomarine Jaeger	6
Gull-species unknown - Large	7
Red/Red-necked Phalarope	8
Northern Gannet	9
Petrel-species unknown	10
Red-necked Phalarope	11
Black-capped Petrel	12
Common Tern	13
Commic/Forster's Tern	14
Commic Tern	15
Skua-species unknown	16



Table 4–23. Species used in Displacement-Sensitive bird abundance mapping and their sensitivity rank

Common Name	Displacement Sensitivity Rank
Atlantic Puffin	1
Razorbill	2
Surf Scoter	3
Duck-species unknown	4
Scoter unid.	5
Black Scoter	6
Auk-species unknown	7
Red-throated Loon	8
Loon-species unknown	9
Murre/Razorbill	10
White-winged Scoter	11
Common Loon	12
Great Black-backed Gull	13
Bridled Tern	14
Black-capped Petrel	15
Common Tern	16
Commic/Forster's Tern	17
Commic Tern	18



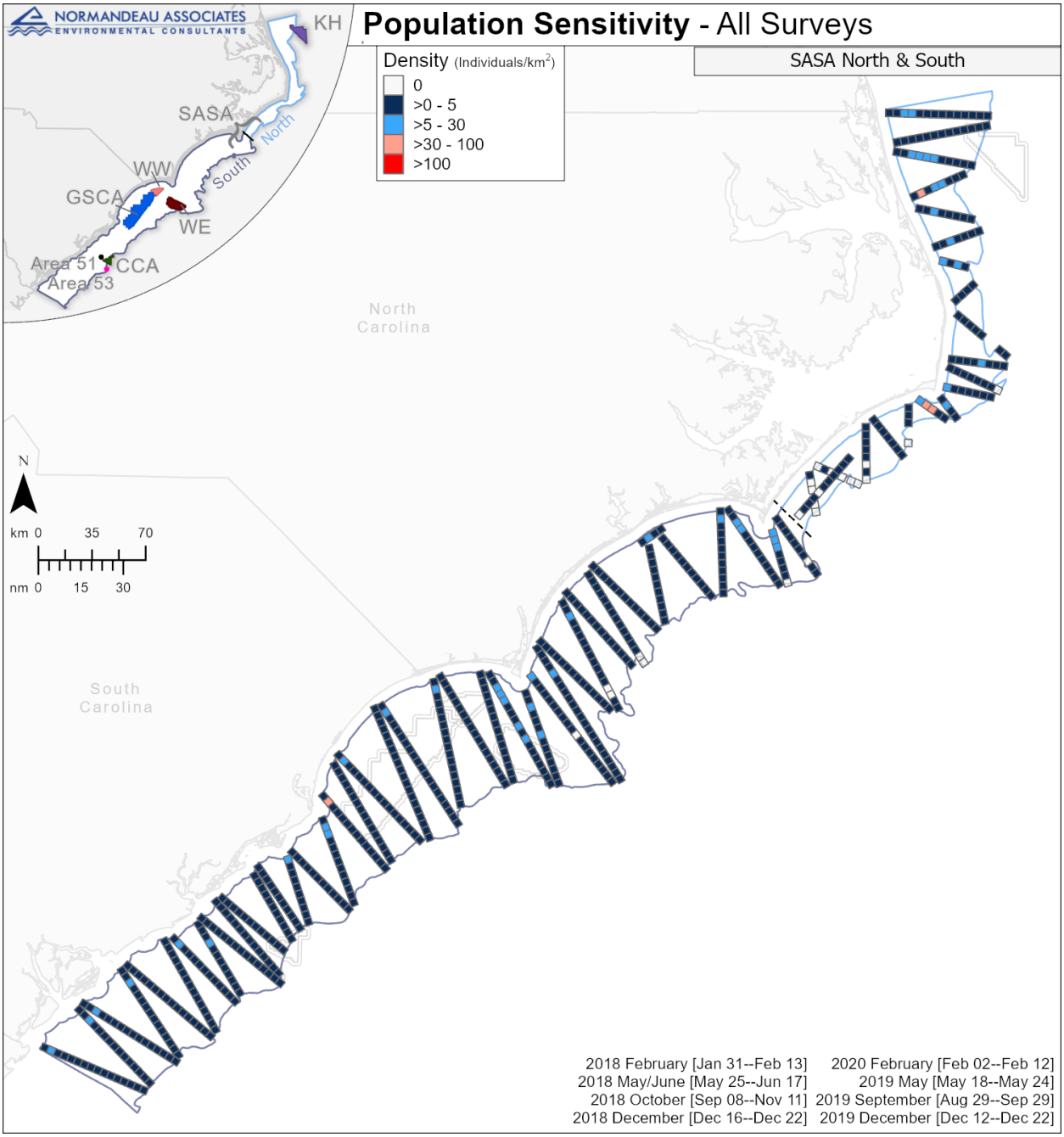

Figure 4–27. Population sensitivity of birds for all surveys

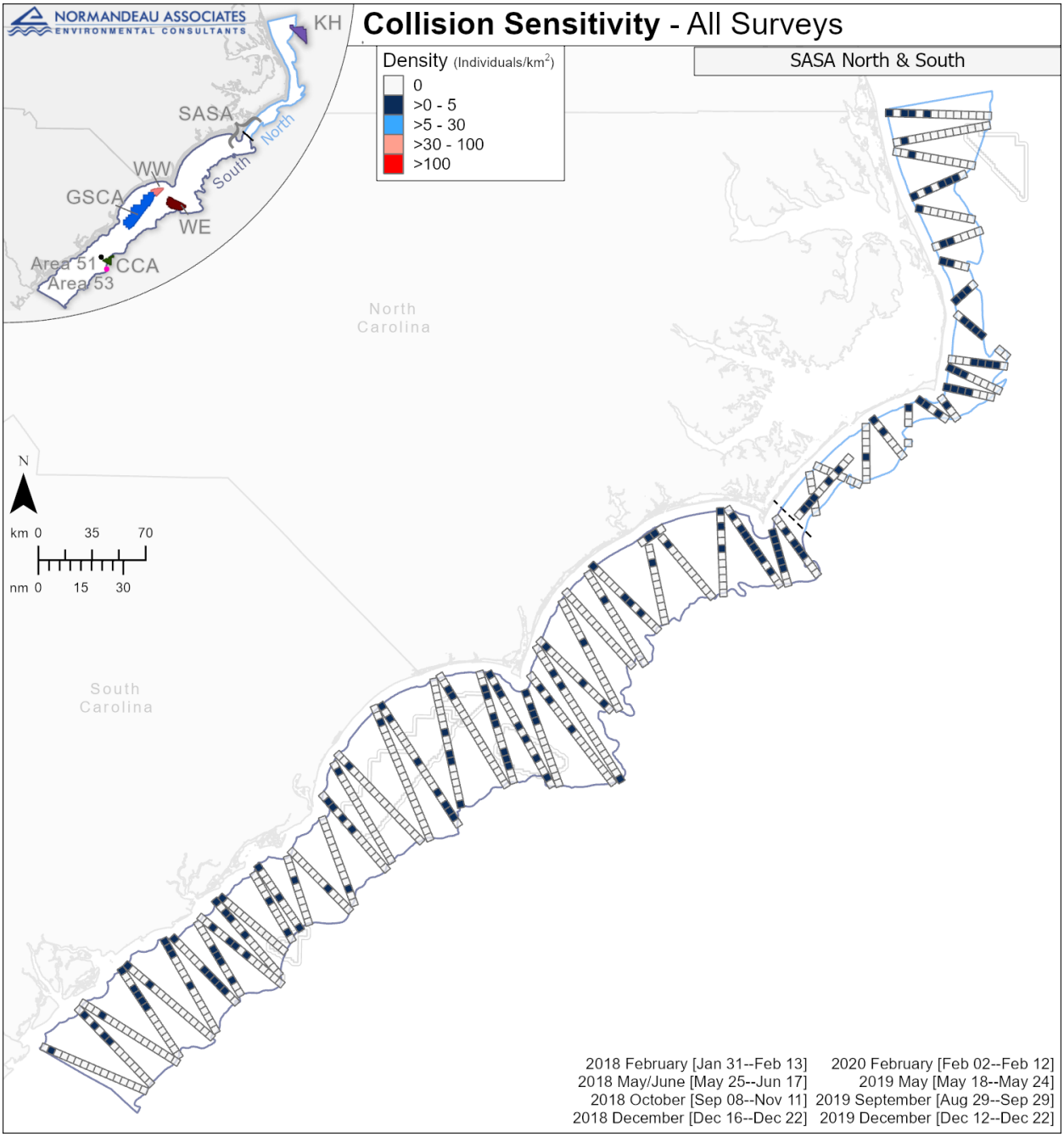

Figure 4–28. Collision sensitivity of birds for all surveys

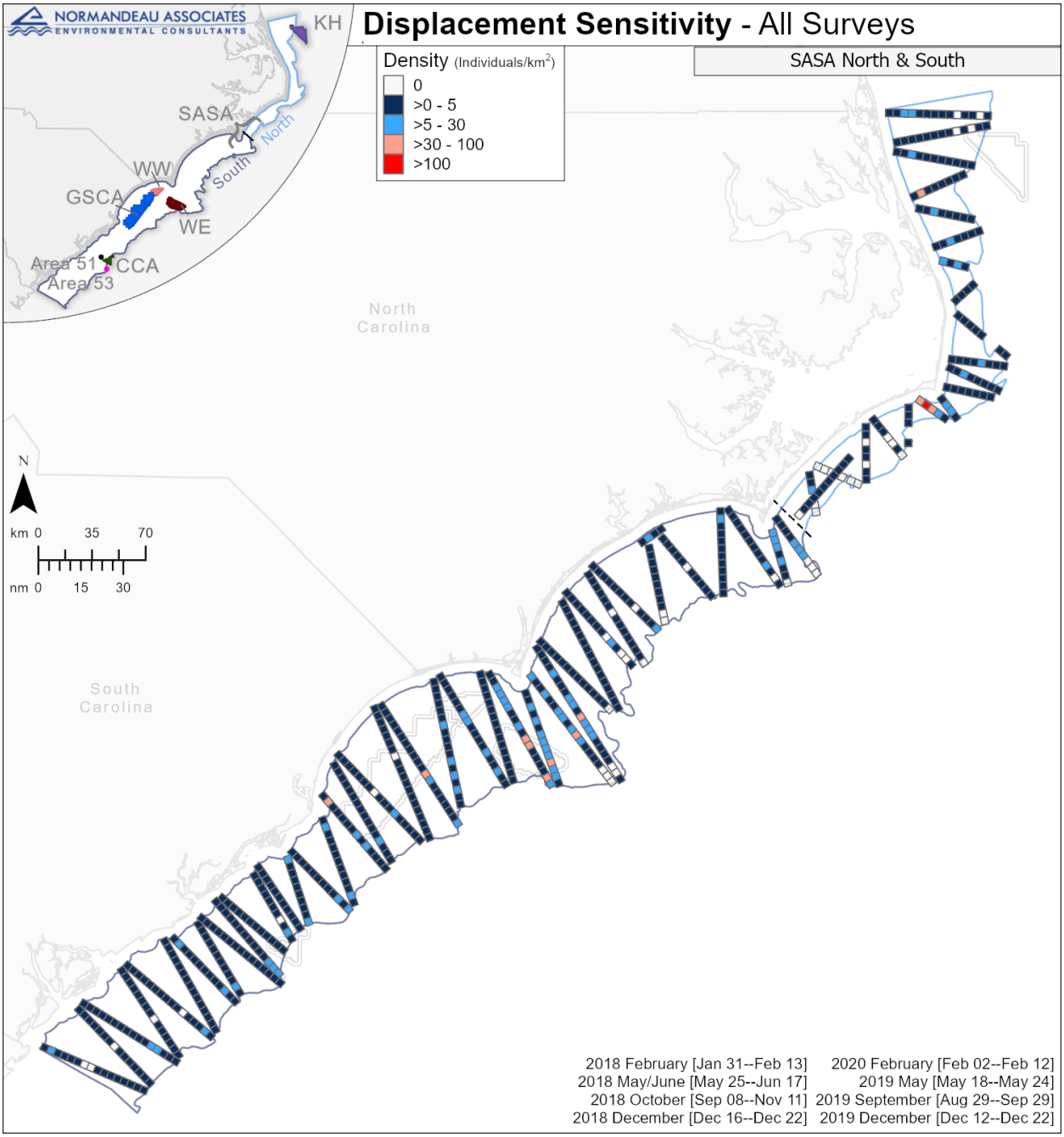

Figure 4–29. Displacement sensitivity of birds for all surveys

4.6 Turtles

4.6.1 Species Identification

Raw counts of turtle species identified in the February 2018 through February 2020 surveys for all areas are presented in Appendix D.1 (Table D–1). Over the eight surveys, 3,049 turtles were identified in imagery in all areas representing four species and one species blend (Appendix D.1, Table D–1). Of these, 63% (n=1,935) were ascribed to species; the remaining were ascribed to the species blend loggerhead/Kemp's (n=352) or were not ascribed to species (n=762). Of the 352 loggerhead/Kemp's species blend, 113 (32%) were significantly submerged and 318 (42%) of those not ascribed to any species were significantly submerged (Appendix D.1, Table D–1). Turtles identified in imagery for each area by survey are presented in Appendix D.1 (Table D–2 through Table D–9).

At the species-group level there was 99.9% agreement between the original identification and the QC identification; of 3,049 targets initially identified as turtles, 2 (one each) were assigned as "other" and "unknown."

At the species level, turtle identification accuracy was high (>95%) for all individual species (Table 4–24). Accuracy was lower for the species blend loggerhead/Kemp's turtle; however, this was expected given that species blends are used when confident species identification cannot be performed on a target. Of the 352 individuals initially identified as loggerhead/Kemp's, 53 individuals were QC'd as something else and 46 of those 53 individuals were QC'd as a Kemp's or loggerhead turtle. While the exact species blend was not matched in 53 cases, it was correctly matched to one of the two species in the blend 46 of 53 times. This suggests that most inaccuracies associated with species blends are likely due to identification confidence and the inability to ascribe the target to a single species.

Table 4–24. Initial identification accuracy and QC ID accuracy for turtle species

Species Group	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Leatherback Turtle	100.0%	96.2%	75	78
Loggerhead Turtle	96.1%	95.9%	1,185	1,188
Loggerhead/Kemp's Turtle	84.9%	86.7%	352	345
Green Turtle	100.0%	100.0%	6	6
Kemp's Ridley Turtle	96.1%	97.7%	669	658
Turtle-species unknown	95.8%	94.6%	762	772
other object	NA*	0.0%	0	1
unknown object	NA*	0.0%	0	1

*An NA value means that no individuals of that species group were identified by the respective observer.

4.6.2 Species Composition and Density

Encounters for turtles were fairly even across all surveys for all areas; the lowest encounters were observed during May/June 2018 and September 2019 with 8% (0.11 and 0.10 individuals per km^2, respectively) of the total (Table 4–25, Figure 4–30). Overall, loggerhead turtles were the most frequently encountered species consisting of 39% of the total observations while turtle-species unknown accounted for 25% (0.34 per km^2) of the total observations over all surveys.

In the February 2018 survey, peak encounters were loggerhead (0.06 individuals per km^2; 39%) and Kemp's ridley turtles (0.06 per km^2; 35%). The total density for this survey was 0.16 per km^2, or 12% of the total for all surveys (Table 4–25).

Encounters in February 2020 were dominated by loggerhead (0.05 per km^2; 31%) and turtle-species unknown (0.04 per km^2; 27%) followed by Kemp's ridley turtle (0.04 per km^2; 26%). This survey also comprised 12% (0.15 per km^2) of the total for all surveys (Table 4–25).

The May/June 2018 survey had the second fewest encounters of any other survey with 0.11 individuals per km^2 (8% of the total). The most frequently encountered species was loggerhead (0.08 per km^2; 72%), (Table 4–25).

The May 2019 survey was dominated by loggerhead turtles (0.09 per km^2; 49%), which were most abundant in this survey than all other surveys (17% of all surveys combined), closely followed by the October 2018 survey (0.09 per km^2; 16% of all surveys). The total density of this survey was 0.18 per km^2, or 14% of the overall total (Table 4–25).

In the October 2018 survey, loggerhead was the most dominant species with 0.09 individuals per km^2 (49%). The total density of this survey closely matched the May 2019 survey with 0.17 individuals per km^2, or 13% of the overall total (Table 4–25).

The September 2019 survey had the lowest density (0.10 individuals per km^2) with just 7.7% of the overall total. Loggerhead was the dominant species encountered (0.05 per km^2) with 0.03 km^2 of turtle-species unknown (Table 4–25).

The December 2018 survey was dominated by Kemp's ridley turtles (0.06 per km^2; 41%) and loggerhead turtles (0.05 km^2; 33%). The total density for this survey was 0.15 individuals per km^2, or 11% of the overall total (Table 4–25).

Turtle density was highest in the December 2019 survey accounting for 22% of the total observations with turtle-species unknown being the most dominant with 0.13 individuals per km^2 (42%) followed by Kemp's ridley turtle (0.09; 29%) and loggerhead turtles (0.06; 19%) (Table 4–25).

Six green turtles were observed (2 in February 2018, 1 in February 2020, 1 in October 2018, and 2 in December 2019; Table D–1) with a density per km^2 of 0.0009, 0.0004, 0.0004, and 0.0009, respectively (Table 4–25, Figure 4–30).

The density per km^2 of turtle species for each area for each survey is shown in Appendix D.2 (Table D–10 through Table D–17; Figure D–1). When counted by area, SASA counts include all of A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–25. Values in Table D–10 through Table D–17 will allow assessment of individual survey areas for each survey period.

Table 4–25. Density per km^2 and percent within season of all turtles observed by survey for all areas

Species	Density (per km^2)																Total
	2018 Feb		2020 Feb		2018 May/Jun		2019 May		2018 Oct		2019 Sep		2018 Dec		2019 Dec		
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Leatherback Turtle	0.0098	30.67	0.0009	2.67	0.0009	2.67	0.0081	25.33	0.0066	20.00	0.0047	14.67	0.0004	1.33	0.0009	2.67	0.0324
Loggerhead Turtle	0.0633	12.49	0.0473	9.28	0.0797	14.51	0.0881	17.47	0.0849	16.20	0.0479	9.45	0.0486	9.62	0.0587	10.97	0.5185
Loggerhead/Kemp's Turtle	0.0171	11.36	0.0232	15.34	0.0111	6.82	0.0302	20.17	0.0199	12.78	0.0146	9.66	0.0098	6.53	0.0275	17.33	0.1535
Green Turtle	0.0009	33.33	0.0004	16.67	—	—	—	—	0.0004	16.67	—	—	—	—	0.0009	33.33	0.0026
Kemp's Ridley Turtle	0.0569	19.88	0.0387	13.45	0.0046	1.49	0.0111	3.89	0.0270	9.12	0.0047	1.64	0.0601	21.08	0.0890	29.45	0.2920
species unknown	0.0141	4.33	0.0413	12.60	0.0153	4.33	0.0417	12.86	0.0354	10.50	0.0291	8.92	0.0281	8.66	0.1300	37.80	0.3350
Total	**0.1622**	**12.43**	**0.1517**	**11.58**	**0.1116**	**7.90**	**0.1792**	**13.81**	**0.1742**	**12.92**	**0.1010**	**7.74**	**0.1469**	**11.32**	**0.3071**	**22.30**	**1.3339**

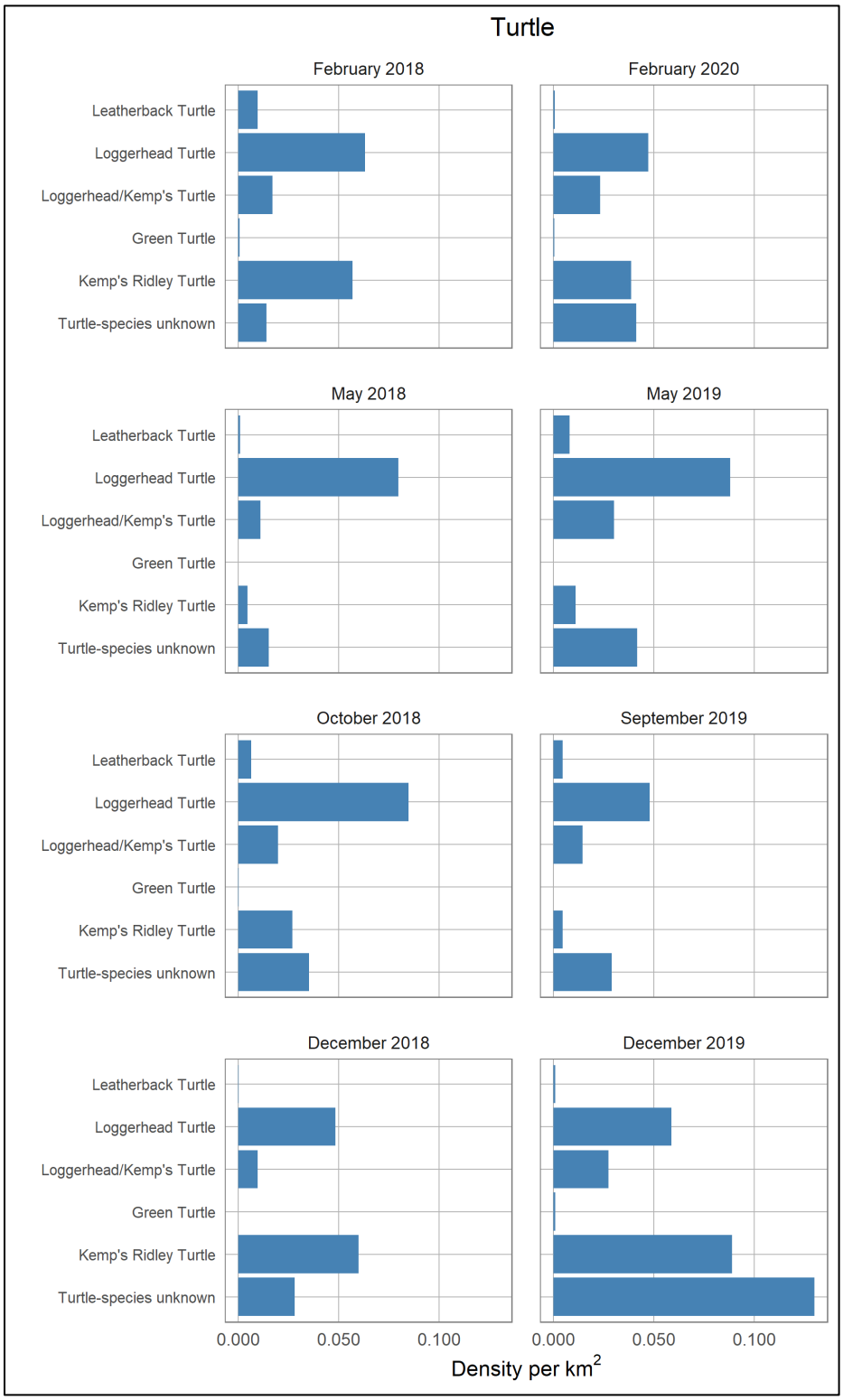

Figure 4–30. Density per km^2 of turtle species encountered during the February 2018 through February 2020 surveys for all areas by survey

4.6.3 Spatial Distribution

The spatial distribution of turtles encountered during all surveys is shown in Figure 4–31 through Figure 4–34. The spatial distribution of individual turtle species for each survey is presented in Appendix D.3 (Figure D–2 through Figure D–24).

Leatherback turtle was found throughout SASA across the year. Among the call areas, it was found in WE and GSCA in February, KH in May/June, KH and GSCA in September/October, and no call areas in December (Figure D–2 through Figure D–5). Loggerhead turtle was found throughout SASA and the call areas in all survey periods. Loggerhead turtle was more abundant in SASA north in all survey periods with higher densities in KH during May/June and September/October (Figure D–6 through Figure D–9). There were too few observations of green turtle to make any conclusions about spatial distribution (Figure D–14 through Figure D–16). Kemp's ridley turtle was most abundant in SASA south, GSCA, and WE in February, SASA north in May/June, SASA north and KH in September/October, and SASA south, GSCA, and WE in December (Figure D–17 through Figure D–20).

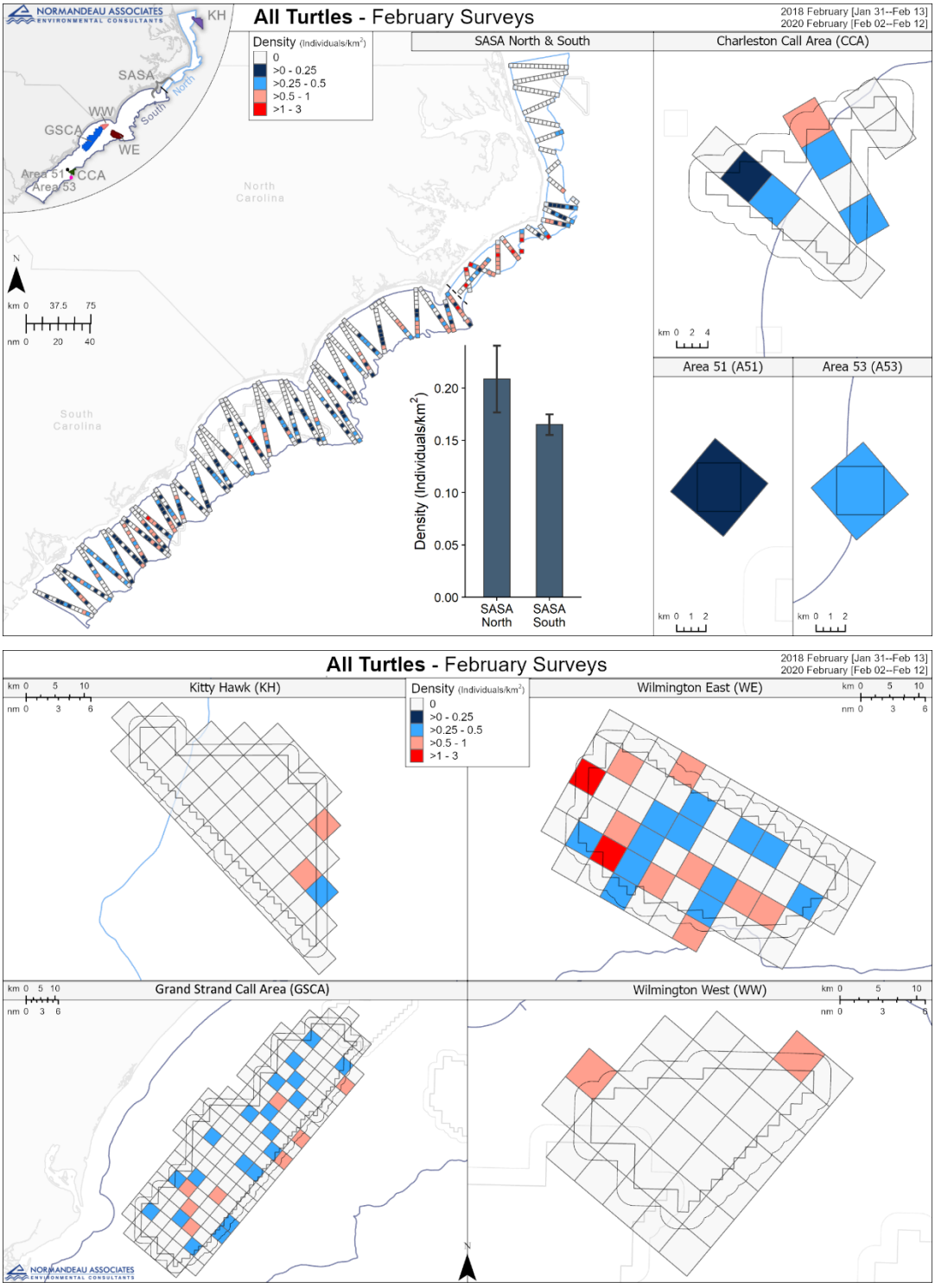

Figure 4–31. Spatial distribution of all turtles during the February surveys across all areas

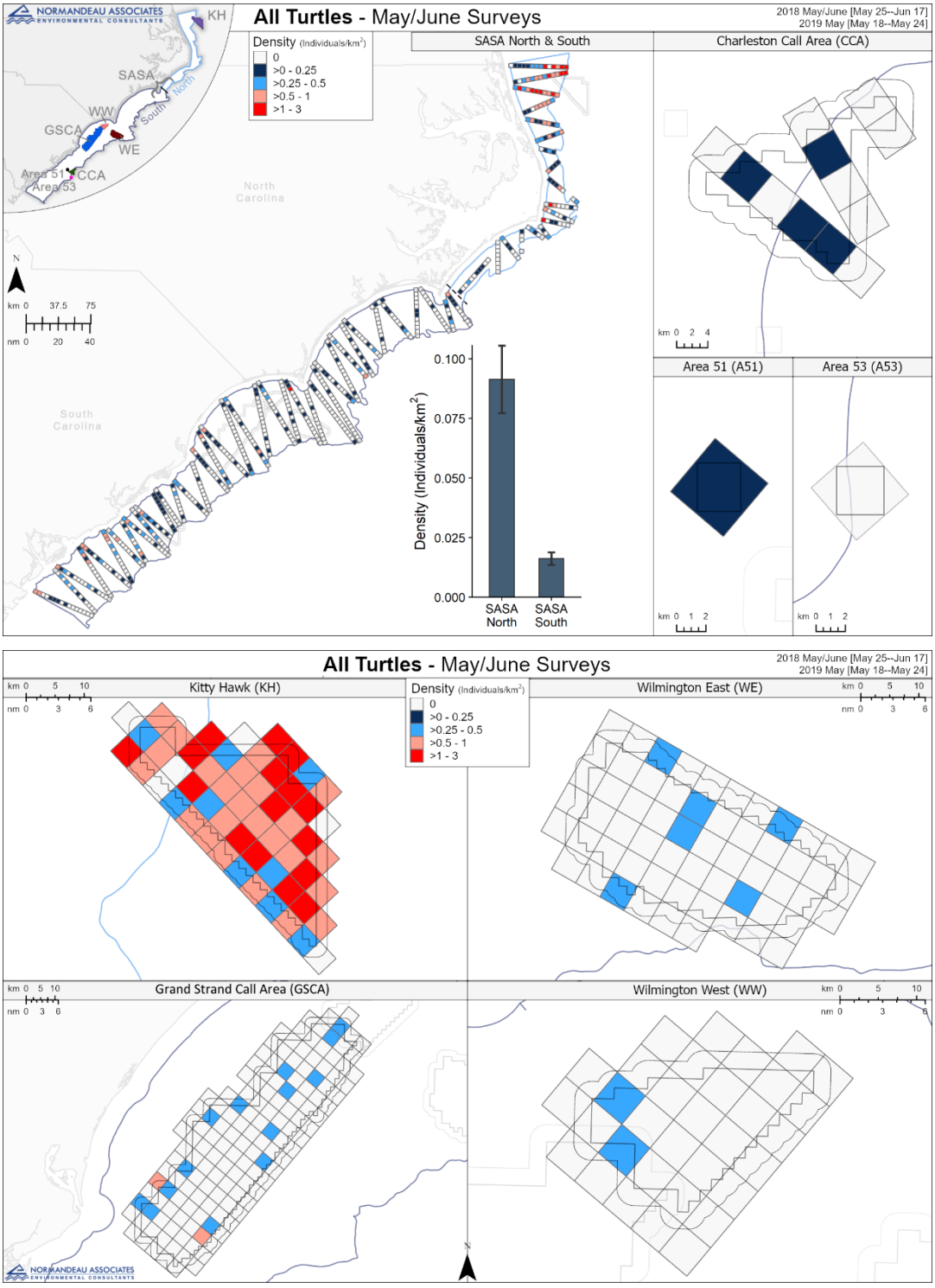

Figure 4–32. Spatial distribution of all turtles during the May/June surveys across all areas

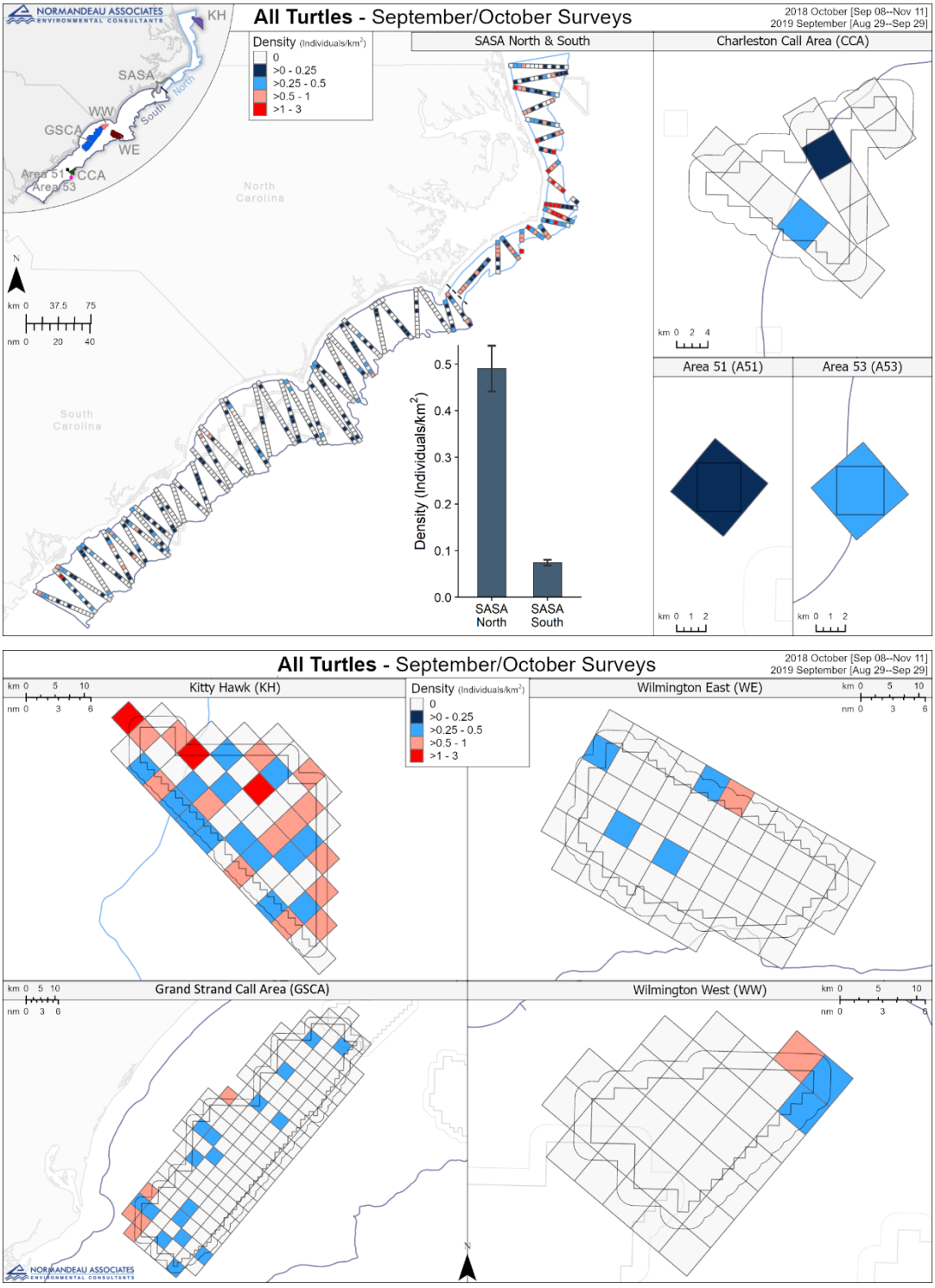

Figure 4–33. Spatial distribution of all turtles during the September/October surveys across all areas

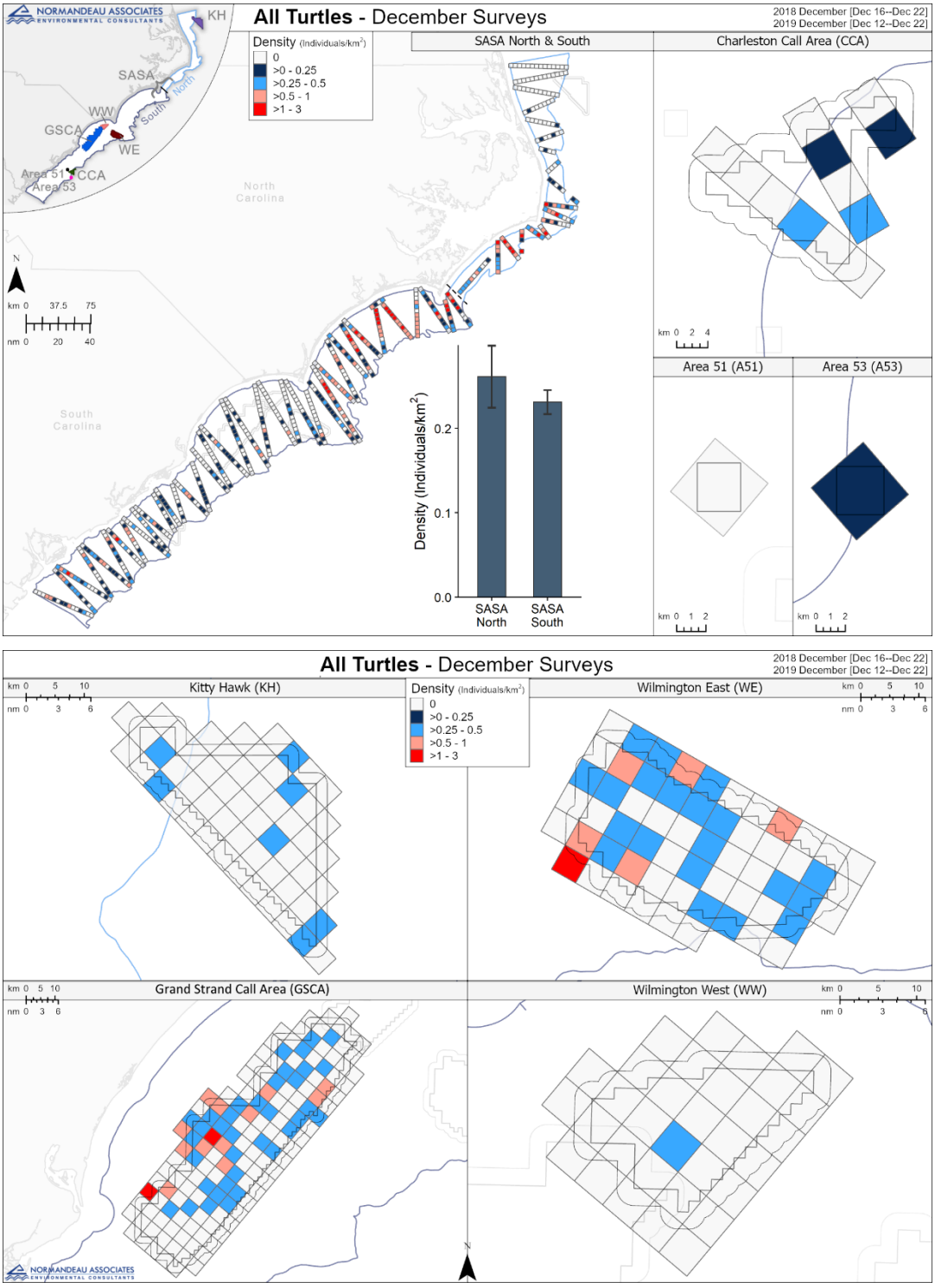

Figure 4–34. Spatial distribution of all turtles during the December surveys across all areas

4.6.4 Direction of Travel

Direction of travel for turtles is illustrated in Figure 4–35 for SASA. Turtle travel direction predominately followed a WSW to SSW direction in the February, October/September, and December surveys and a NE direction during May/June Surveys (Figure 4–35).

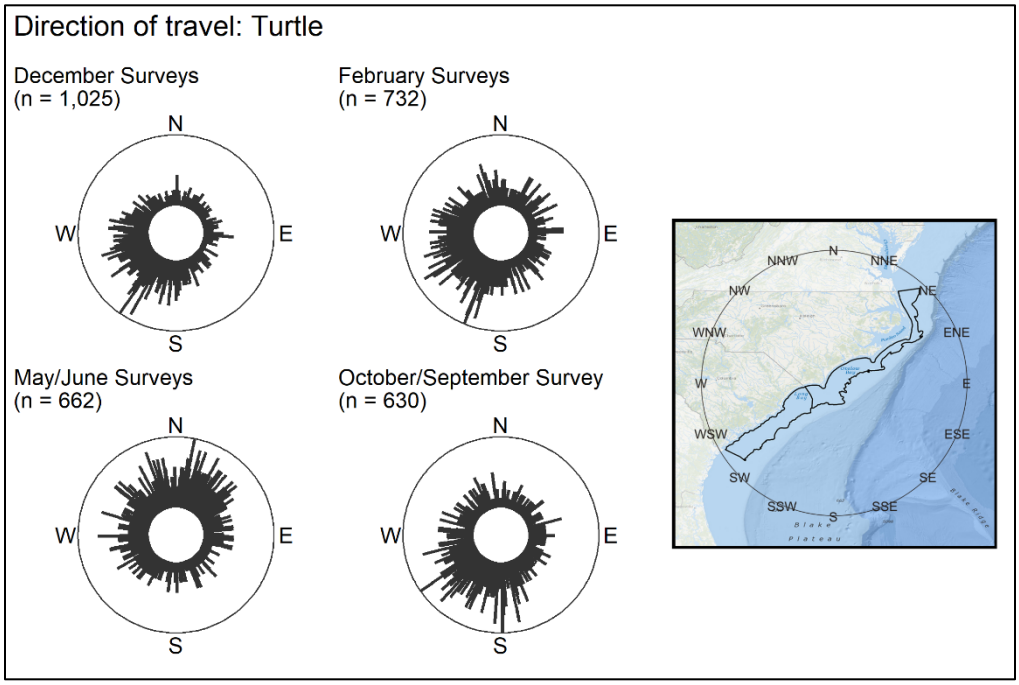

Figure 4–35. Direction of travel for turtles observed during each survey in the South Atlantic Survey Area (SASA)

4.7 Marine Mammals

4.7.1 Species Identification

Raw counts of marine mammal species identified in the February 2018 through February 2020 surveys are presented in Appendix E.1 (Table E–1). Over the eight surveys, 4,191 marine mammals were identified in imagery across all areas (Table E–1). Identification rates between marine mammal taxonomic groups varied with most (99%) mammals found being dolphins (n=4,161) and >0.25% were whales (n=10). There were 18 unidentified mammals (>0.5%). Marine mammals identified in imagery for each area by survey are presented in Appendix E.1 (Table E–2 through Table E–8).

For dolphins, 2,300 were not ascribed to species. These included a species blend of bottlenose/Atlantic spotted dolphin (n=502) and unidentified dolphins (n=1,798), which provided an identification rate of 45% (Appendix E.1, Table E–1). Of the 502 dolphins added to the species blend bottlenose/Atlantic spotted dolphins, 215 (43%) were significantly submerged. Of the 1,798 unidentified dolphins, 1,314 (73%) were significantly submerged (Appendix E.1, Table E–1). Of the 18 unidentified mammals, 14 (78%) were significantly submerged.

Across all surveys, 10 whales were found in the imagery; 9 (90%) were identified to species and 1 (10%) remained as whale-species unknown. The one unidentified whale was significantly submerged (Appendix E.1, Table E–1).

Accuracy assessments for marine mammals showed an overall 100% accuracy at the species-group level (Table 4–26) and a 94.9% accuracy at the species level. At the species level, identification accuracy was more variable due to the increasing difficulty of identifying targets at lower taxonomic levels. Whales had 100% identification accuracy across all species, although only 7 whales were observed. Species-specific dolphin identifications were lower than whales, though still high (>90%). The bottlenose/Atlantic spotted dolphin species blend had lower identification accuracy, but this is not surprising given that multiple species can be ascribed to these categories, and they are used when species-specific identifications cannot be made (Table 4–27).

Table 4–26. Initial identification accuracy and QC ID accuracy for marine mammal species groups

Species Group	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Seal	100.0%	100.0%	1	1
Whale	100.0%	100.0%	7	7
Dolphin	100.0%	100.0%	829	829
Unid. Mammal	100.0%	100.0%	6	6

Table 4–27. Initial identification accuracy and QC ID accuracy for marine mammal species

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Seal-species unknown	100.0%	100.0%	1	1
North Atlantic Right Whale	100.0%	100.0%	1	1
Humpback Whale	100.0%	100.0%	6	6
Common Dolphin	100.0%	90.9%	10	11
Risso's Dolphin	0.0%	NA*	1	0
Atlantic Spotted Dolphin	97.2%	96.5%	253	255
Clymene Dolphin	0.0%	NA*	1	0
Pantropical Spotted Dolphin	96.3%	96.3%	27	27
Bottlenose Dolphin	90.8%	93.4%	109	106
Harbor Porpoise	100.0%	100.0%	3	3
Bottlenose/Atlantic Spotted	83.1%	89.2%	89	83
Dolphin-species unknown	97.6%	95.3%	336	344
Unid. Mammal-species unknown	100.0%	100.0%	6	6

*An NA value means that no individuals of that species were identified by the respective observer.

4.7.2 Species Composition and Density

Marine mammal species identified and the density (per km^2) of individuals for each survey across all areas is shown in Table 4–28, Figure 4–36, and Figure 4–37. During all surveys, marine mammal observations included 99% dolphins, >0.5% unidentified mammals, and >0.25% whales (Table 4–28). Density per km^2 for marine mammal species for each area by survey can be found in Appendix E.2 (Table E–9 through Table E–16; Figure E–1, Figure E–2). When counted by area, SASA counts include all of

A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–28. Values in Table E–9 through Table E–16 will allow assessment of individual survey areas for each survey period.

Whale density was even (0.0004 individuals per km^2) during the February 2018 survey and consisted of north Atlantic right whales, common minke whales, and humpback whales. This was the most diverse survey and whales comprised 30% of the overall total. Humpback whales (0.0009 per km^2) were the only species observed during the February 2020 survey. There were no whales observed during the May/June 2018 or May 2019 surveys (Table 4–28; Figure 4–36). Humpback whales (0.0004 per km^2) and whale-species unknown (0.0004 per km^2) were the only species observed during the October 2018 survey. There were no whales observed during the September 2019 survey. During the December 2018 and December 2019 surveys, humpback whales were the only species observed (0.0004 and 0.0009 per km^2, respectively) (Table 4–28; Figure 4–36).

Bottlenose dolphins accounted for 34% of the individuals recorded in the February 2018 survey, and there were 0.10 individuals per km^2 (48%) that could not be ascribed to species (Table 4–28, Figure 4–37). This was the most diverse survey period with 7 dolphin species or species groups identified. The overall density was 0.21 per km^2, or 12% of the total for all surveys.

During the February 2020 survey, Atlantic spotted dolphins and dolphin-species unknown were the most dominant (0.15 per km^2; 32%) followed by the bottlenose/Atlantic spotted dolphin species blend (0.09 per km^2; 19%). This was the most abundant survey with 0.46 individuals per km^2 (25% of the overall total), and there were 6 species or species groups identified (Table 4–28).

The May/June 2018 survey was the least diverse with only 3 species identified. It was also the least abundant with 0.05 individuals per km^2 (2.5% of the total). Dolphin-species unknown (0.024 per km^2; 50%) and Atlantic spotted dolphins (0.015 per km^2; 32%) were the most abundant species encountered (Table 4–28, Figure 4–37). It is the only survey where Atlantic white-sided dolphins were observed.

The May 2019 survey was also dominated by dolphin-species unknown (0.066 per km^2; 41%) and Atlantic spotted dolphin (0.061 per km^2; 38%). This was the second least diverse group (along with October 2018) with 4 species or species groups identified. Overall, the density for this survey period was 0.16 individuals per km^2 (9%) (Table 4–28, Figure 4–37).

During the October 2018 survey, 34% of the individuals were Atlantic spotted dolphin (0.053 per km^2), and there were 0.03 (18%) individuals per km^2 in the bottlenose/Atlantic spotted dolphin species group and 0.05 (34%) unidentified dolphin species per km^2 (Table 4–28, Figure 4–37). The October 2018 survey was the second least abundant survey (along with May 2019) with an overall density of 0.16 individuals per km^2 (8.5% of all surveys) and the second least diverse survey with 4 species or species groups identified (Table 4–28, Figure 4–37).

The September 2019 survey was dominated by dolphin-species unknown (0.11 per km^2; 46%) and Atlantic spotted dolphin (0.07 per km^2; 30%). This is the only survey where Clymene dolphins and rough-toothed dolphins were observed and there were 6 species or species groups identified. The overall density for this survey was 0.24 km^2, or 14% of the overall total (Table 4–28, Figure 4–37).

The December 2018 survey had 5 species or species groups identified and was the second most abundant (0.28 per km^2; 16% of the total). The dominant species were bottlenose dolphin (0.05 per km^2; 19%) and Atlantic spotted dolphin (0.049 per km^2; 14%). There were 0.12 (44%) individuals per km^2 that could not be identified (Table 4–28, Figure 4–37).

During the December 2019 survey, 64% of the individuals were dolphin-species unknown (0.16 per km^2) followed by 16% Atlantic spotted dolphin (0.04 per km^2) and 11% bottlenose/Atlantic spotted dolphins (0.03 km^2). There were 5 species or species groups identified. The overall density for this survey was 0.25 per km^2, or 13% of all surveys combined (Table 4–28, Figure 4–37).

Overall, the most encountered species was Atlantic spotted dolphins (0.44 per km^2; 25%); although, 33% were encountered in the February 2020 survey (Table 4–28). The second most abundant species was bottlenose dolphins (0.24 per km^2; 13%), found mostly in the February 2018 and October 2018 surveys (0.07 and 0.05 per km^2, respectively) (Table 4–28). There were 43% unidentified species (0.79 per km^2), most of which (55%) occurred during the February 2020, December 2018, and December 2019 surveys (Table 4–28, Figure 4–37).

For some mammals, their depth in the water column or angle at image capture is such that key morphometric characters are obscured, and it is impossible to distinguish whether they can be categorized as whale, dolphin or seal; 0.008 individuals per km^2 fell into this category (Table 4–28).

Table 4–28. Density per km^2 of all marine mammals observed by survey for all areas

Subtype/Species	Density per km^2																
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Total
SEAL	**—**	**—**	**—**	**—**	**—**	**—**	**0.0009**	**100.00**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**0.0009**
species unknown	—	—	—	—	—	—	0.0009	100.00	—	—	—	—	—	—	—	—	0.0009
WHALE	**0.0013**	**30.00**	**0.0009**	**20.00**	**—**	**—**	**—**	**—**	**0.0009**	**20.00**	**—**	**—**	**0.0004**	**10.00**	**0.0009**	**20.00**	**0.0044**
North Atlantic Right Whale	0.0004	100.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0004
Common Minke Whale	0.0004	100.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0004
Humpback Whale	0.0004	14.29	0.0009	28.57	—	—	—	—	0.0004	14.29	—	—	0.0004	14.29	0.0009	28.57	0.0031
species unknown	—	—	—	—	—	—	—	—	0.0004	100.00	—	—	—	—	—	—	0.0004
DOLPHIN	**0.2126**	**11.94**	**0.4539**	**25.38**	**0.0477**	**2.48**	**0.1613**	**9.11**	**0.1565**	**8.51**	**0.2414**	**13.55**	**0.2837**	**16.01**	**0.2447**	**13.03**	**1.8019**
Common Dolphin	0.0090	11.35	0.0447	56.22	—	—	—	—	—	—	—	—	0.0256	32.43	—	—	0.0792
Risso's Dolphin	0.0009	66.67	—	—	—	—	—	—	—	—	—	—	—	—	0.0005	33.33	0.0013
Atlantic White-sided Dolphin	—	—	—	—	0.0005	100.00	—	—	—	—	—	—	—	—	—	—	0.0005
Rough-toothed dolphin	—	—	—	—	—	—	—	—	—	—	0.0004	100.00	—	—	—	—	0.0004
Atlantic Spotted Dolphin	0.0150	3.42	0.1449	32.97	0.0153	3.23	0.0613	14.09	0.0535	11.84	0.0715	16.34	0.0409	9.39	0.0402	8.71	0.4425
Clymene Dolphin	—	—	—	—	—	—	—	—	—	—	0.0004	100.00	—	—	—	—	0.0004
Pantropical Spotted Dolphin	0.0017	5.56	0.0004	1.39	—	—	—	—	—	—	0.0111	36.11	0.0175	56.94	—	—	0.0307
Bottlenose Dolphin	0.0714	29.77	0.0297	12.30	0.0083	3.21	0.0128	5.35	0.0212	8.56	0.0257	10.70	0.0541	22.64	0.0190	7.49	0.2422
Harbor Porpoise	0.0017	26.67	0.0009	13.33	—	—	0.0004	6.67	0.0013	20.00	—	—	—	—	0.0023	33.33	0.0066
Bottlenose/Atlantic Spotted	0.0120	5.58	0.0873	40.44	—	—	0.0204	9.56	0.0274	12.35	0.0218	10.16	0.0221	10.36	0.0262	11.55	0.2172
species unknown	0.1010	13.13	0.1462	18.91	0.0236	2.84	0.0664	8.68	0.0531	6.67	0.1104	14.35	0.1235	16.13	0.1567	19.30	0.7808
UNID. MAMMAL	**0.0004**	**5.56**	**0.0026**	**33.33**	**0.0005**	**5.56**	**0.0021**	**27.78**	**0.0009**	**11.11**	**—**	**—**	**—**	**—**	**0.0014**	**16.67**	**0.0078**
species unknown	0.0004	5.56	0.0026	33.33	0.0005	5.56	0.0021	27.78	0.0009	11.11	—	—	—	—	0.0014	16.67	0.0078
TOTAL	**0.2143**	**11.95**	**0.4574**	**25.39**	**0.0482**	**2.48**	**0.1643**	**9.21**	**0.1583**	**8.54**	**0.2414**	**13.46**	**0.2841**	**15.92**	**0.2470**	**13.05**	**1.8149**

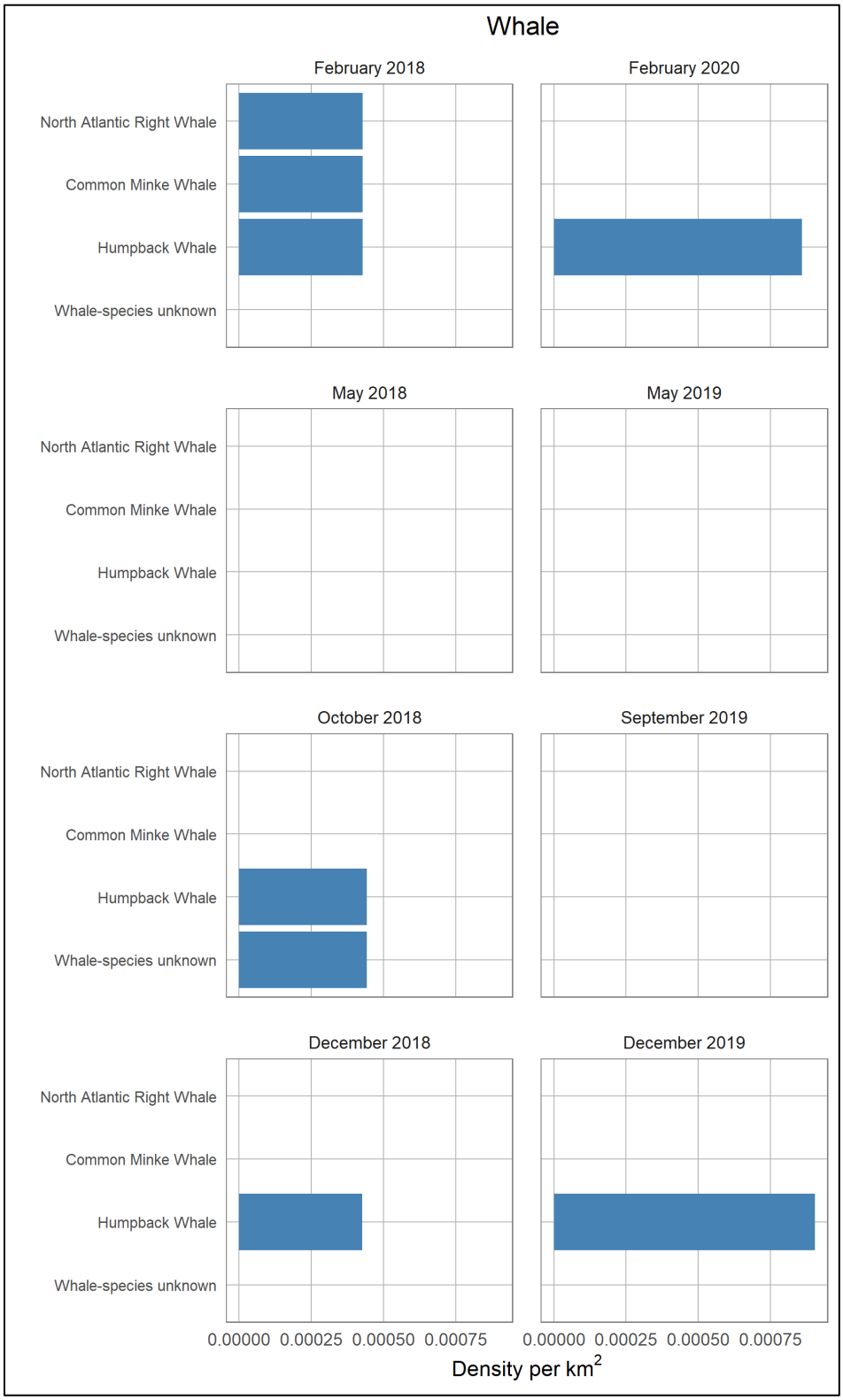

Figure 4–36. Density (per km^2) of whale species encountered during the February 2018 through February 2020 surveys for all areas by survey

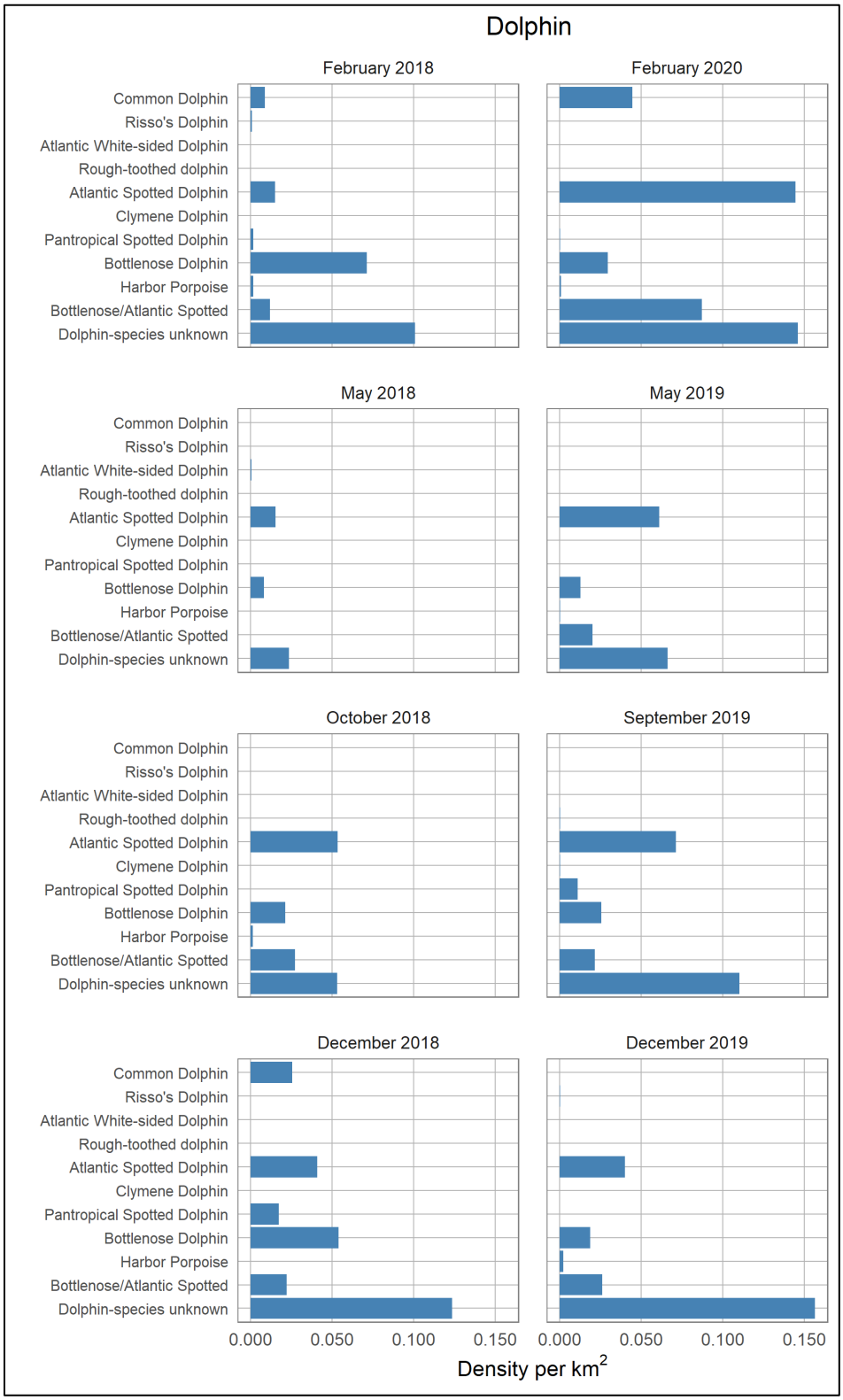

Figure 4–37. Density (per km^2) of dolphin species encountered during the February 2018 through February 2020 surveys for all areas by survey

4.7.3 Spatial Distribution

The spatial distribution of all cetaceans encountered during all surveys is shown in Figure 4–38 through Figure 4–41. The spatial distribution of all seals is shown in Figure E–3, all whale species are shown in Figure 4–42 through Figure 4–44, and all dolphin species are shown in Figure 4–45 through Figure 4–48. The spatial distribution of individual whale and dolphin species is shown in Appendix E.3, Figure E–4 through Figure E–9 and Figure E–10 through Figure E–35, respectively.

There were too few seal observations to understand spatial trends in the data (Figure E–1).

North Atlantic right whale and common minke whale were only observed at KH during February (Figure E–4 and Figure E–5). There were too few humpback whale observations to make definitive conclusions about spatial distributions (Figure E–6 through Figure E–8).

Common dolphins were only observed in SASA north and KH during February and December (Figure E–10 and Figure E–11). Risso's dolphin was only observed in KH in February and in SASA south during December (Figure E–12 and Figure E–13). Within SASA, Atlantic spotted dolphin was observed in all survey periods with higher densities in SASA north during February and September/October; SASA south had the highest densities during May/June and December. Within SASA, bottlenose dolphin was more common in SASA north in all periods except May/June (Figure E–24 through Figure E–27).

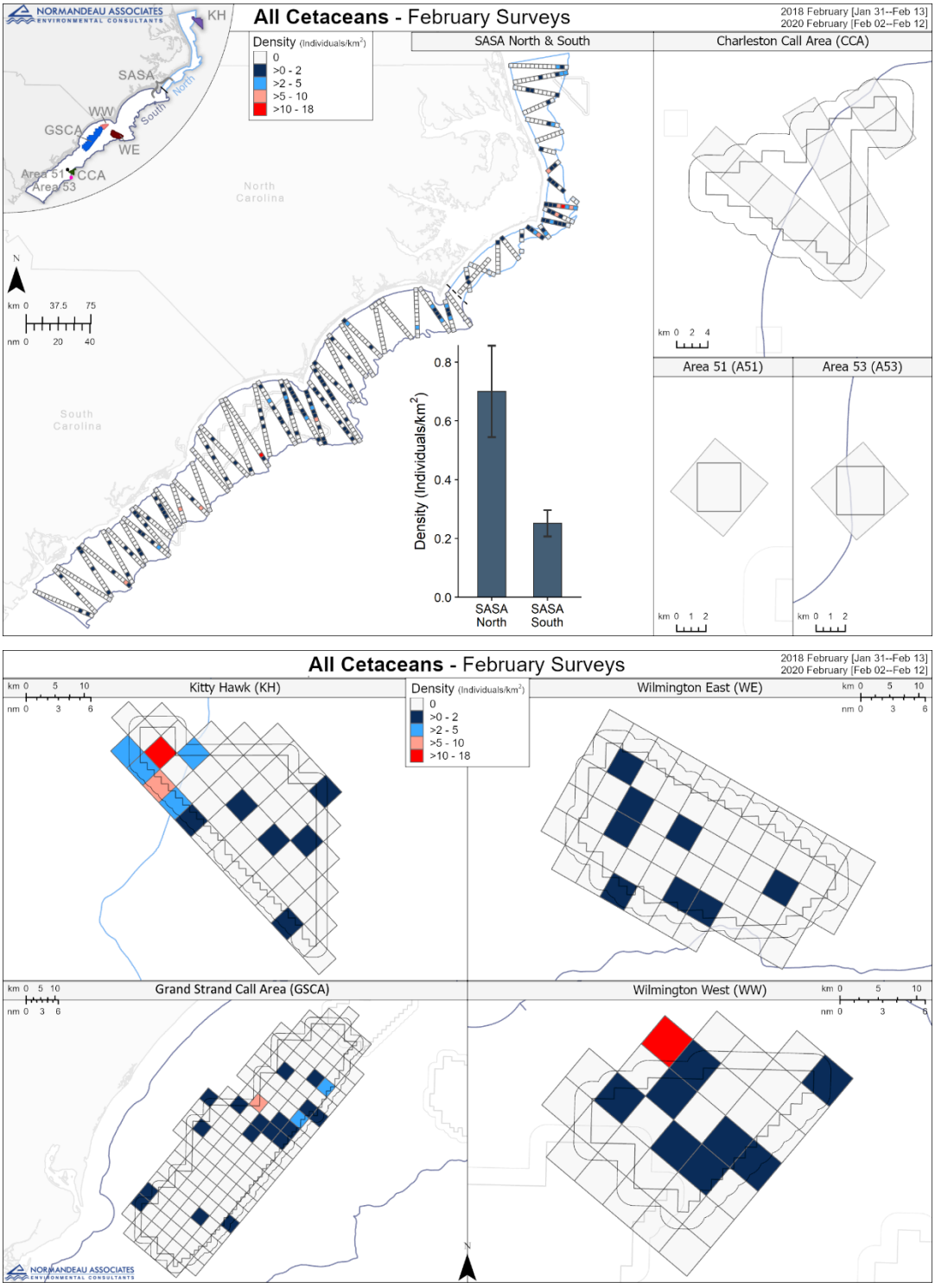

Figure 4–38. Spatial distribution of all cetacean species during the February surveys for all areas

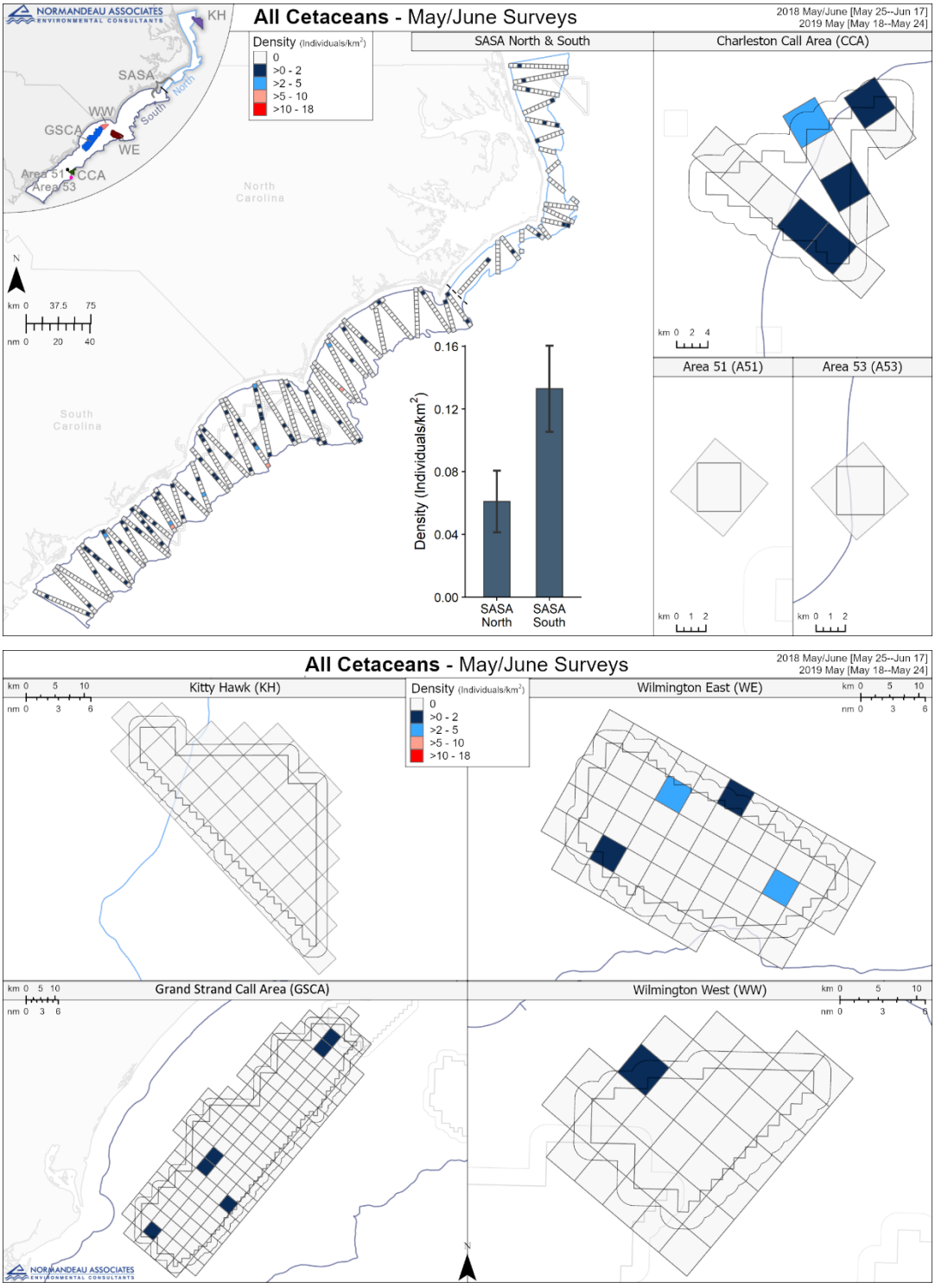

Figure 4–39. Spatial distribution of all cetacean species during the May/June surveys for all areas

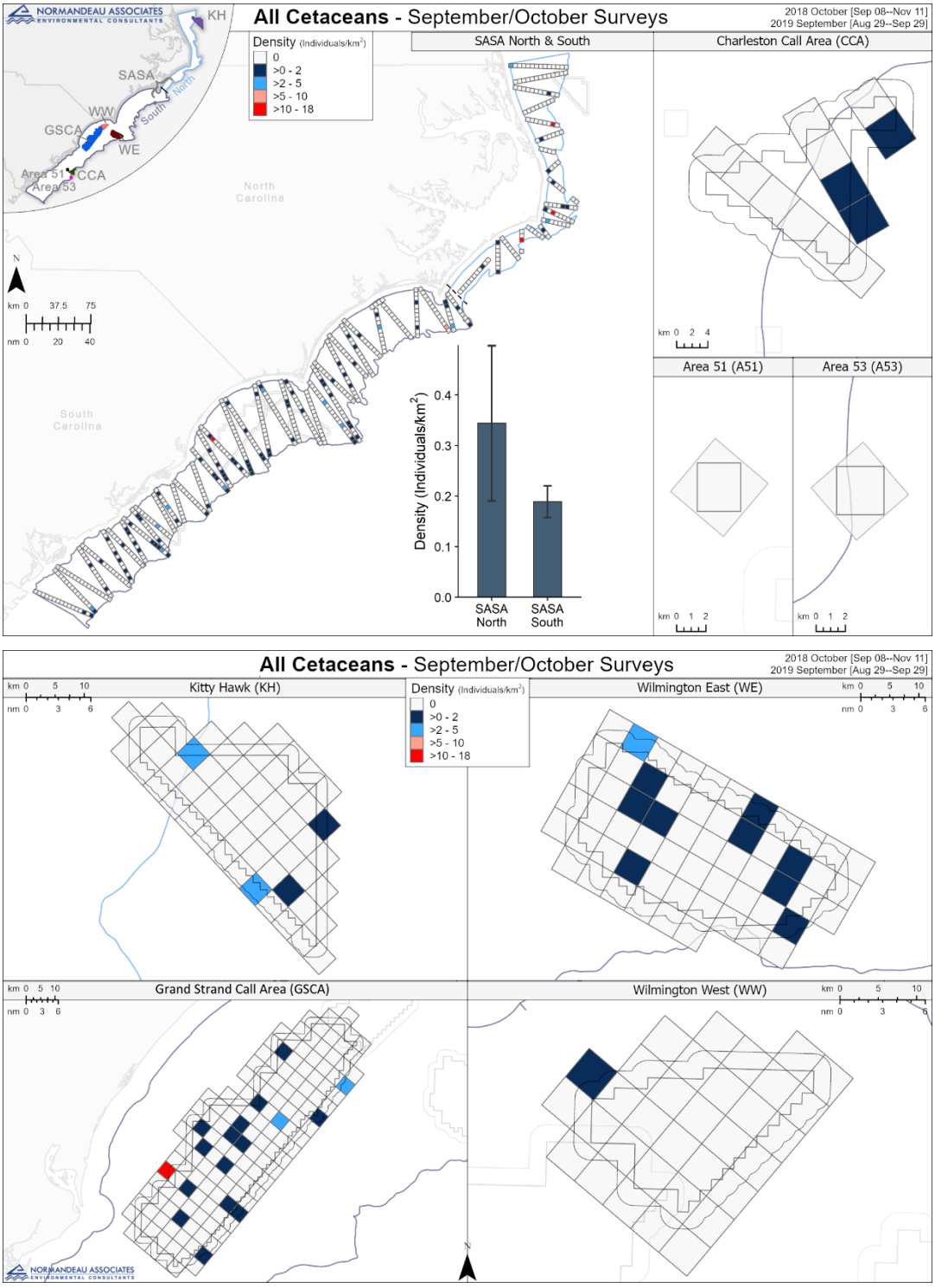

Figure 4–40. Spatial distribution of all cetacean species during the September/ October surveys for all areas

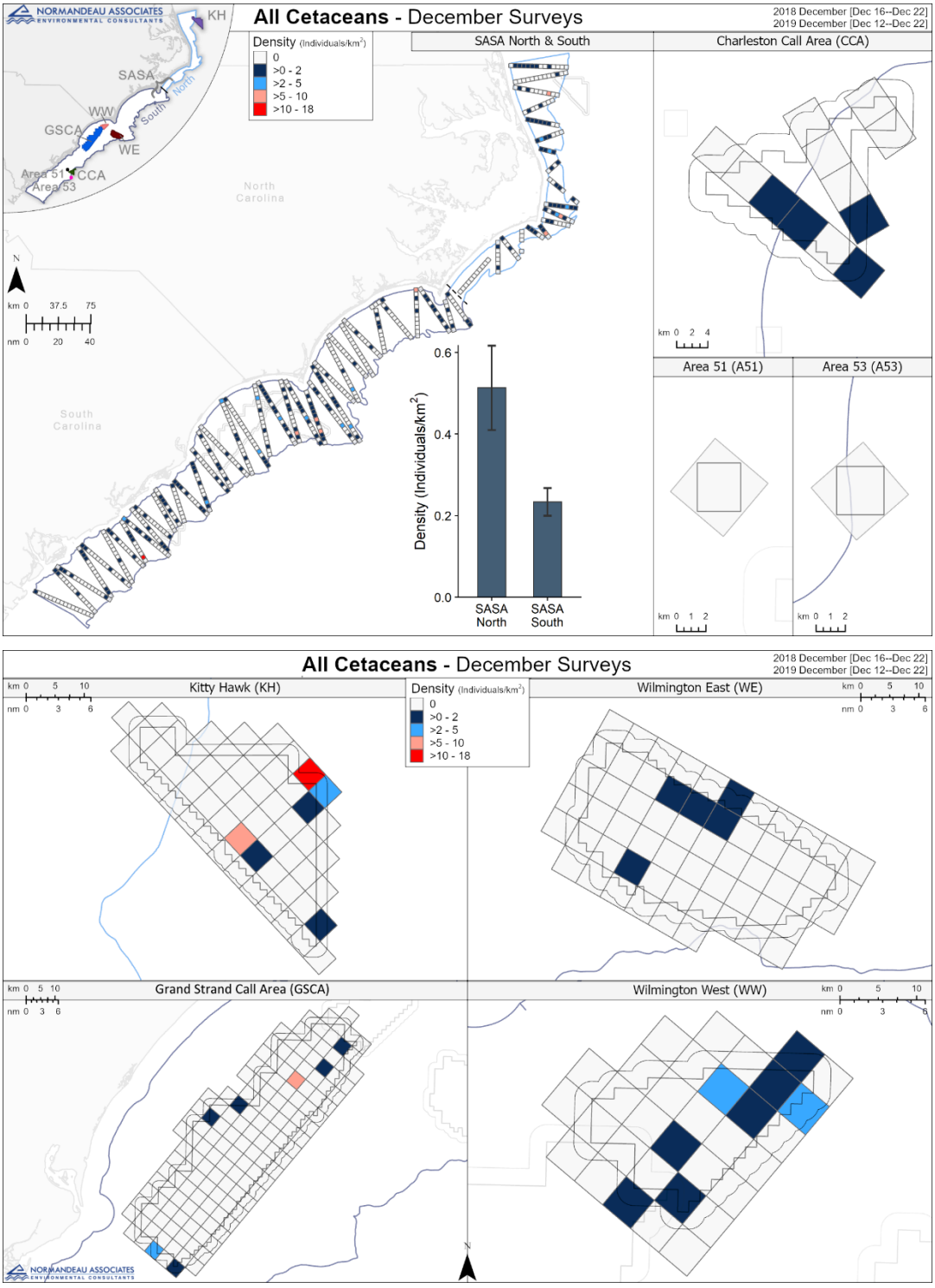

Figure 4–41. Spatial distribution of all cetacean species during the December surveys for all areas

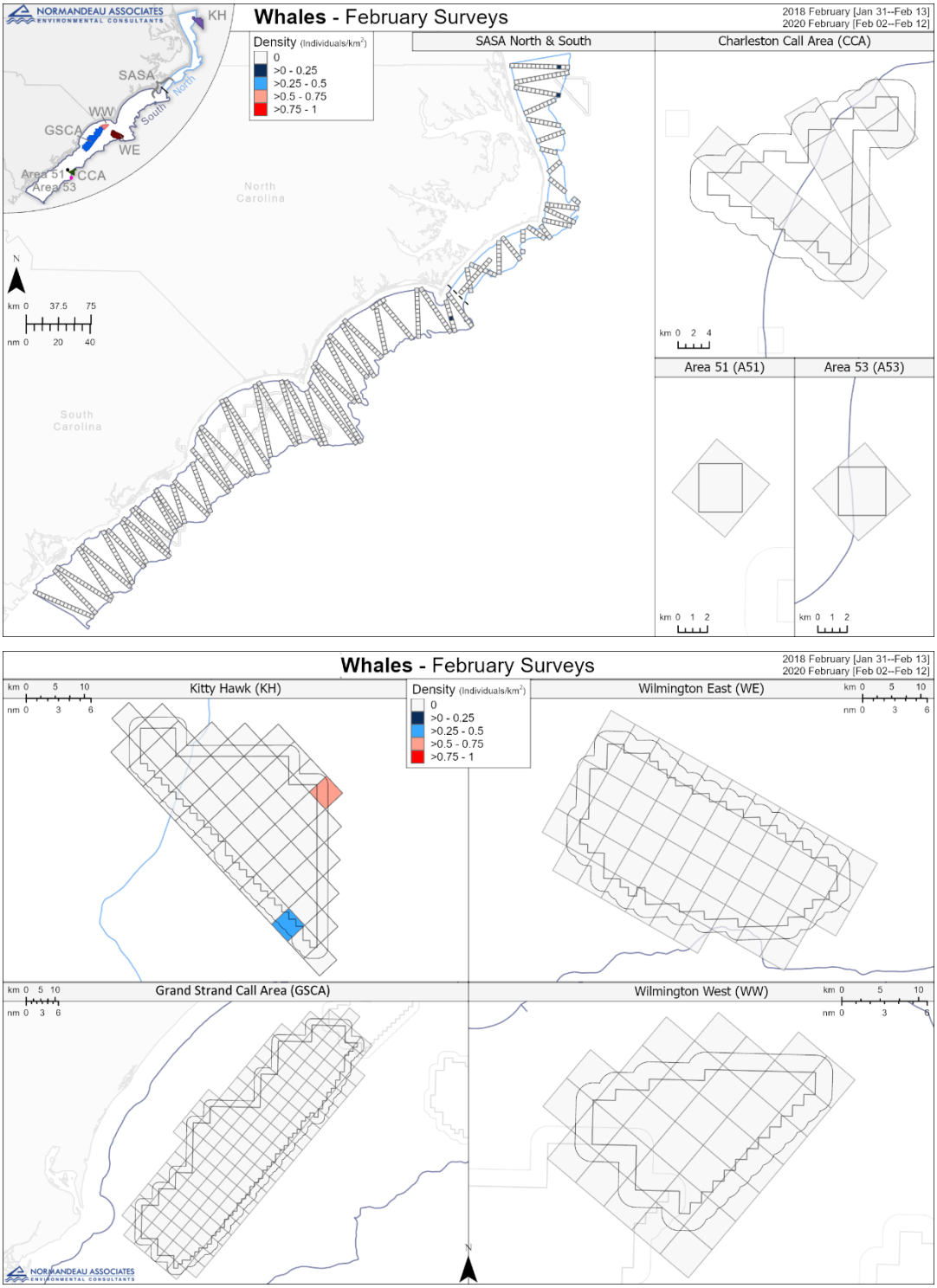

Figure 4–42. Spatial distribution of all whale species during the February surveys for all areas

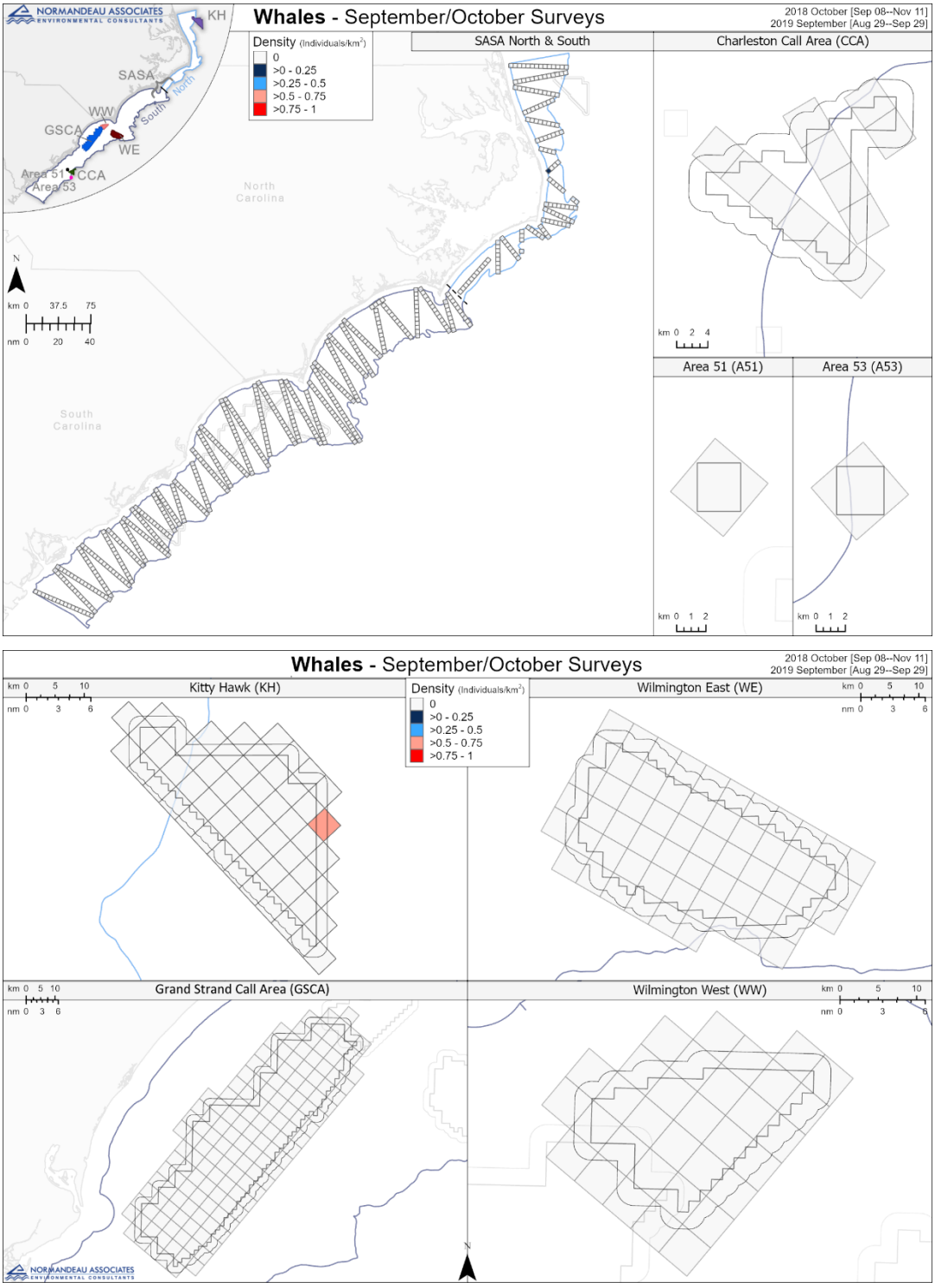

Figure 4–43. Spatial distribution of all whale species during the September/October surveys for all areas

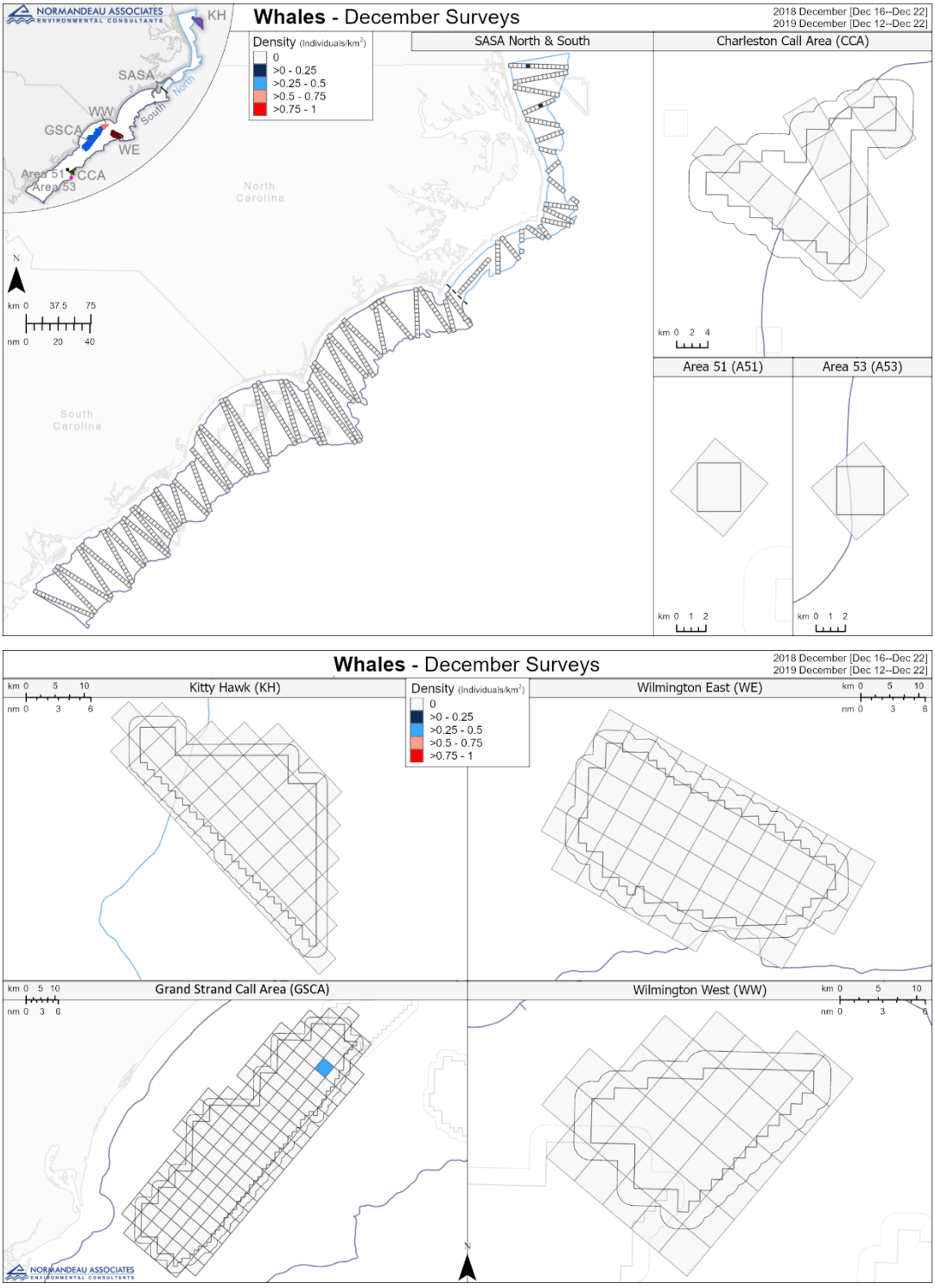

Figure 4–44. Spatial distribution of all whale species during the December surveys for all areas

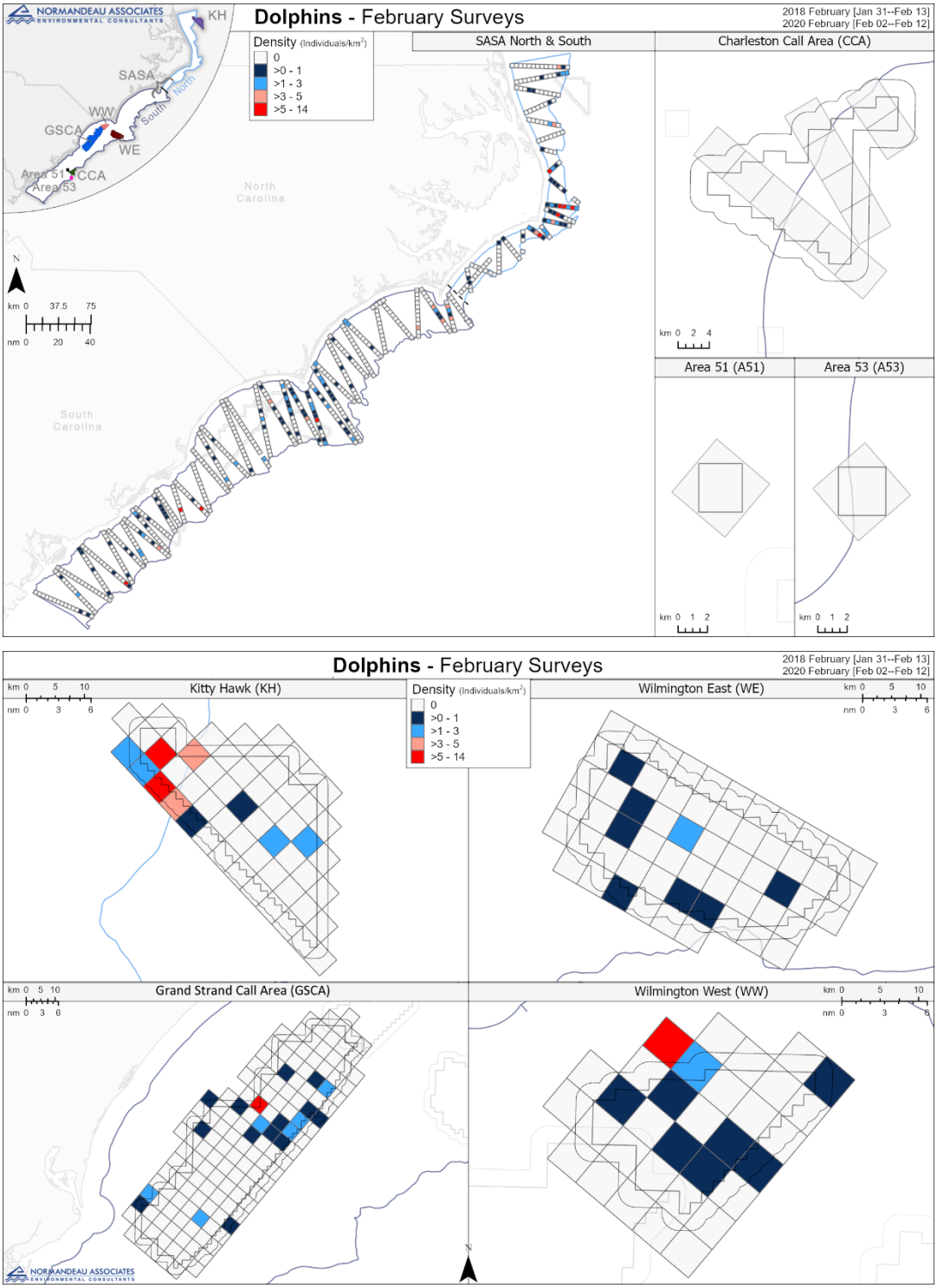

Figure 4–45. Spatial distribution of all dolphin species during the February surveys for all areas

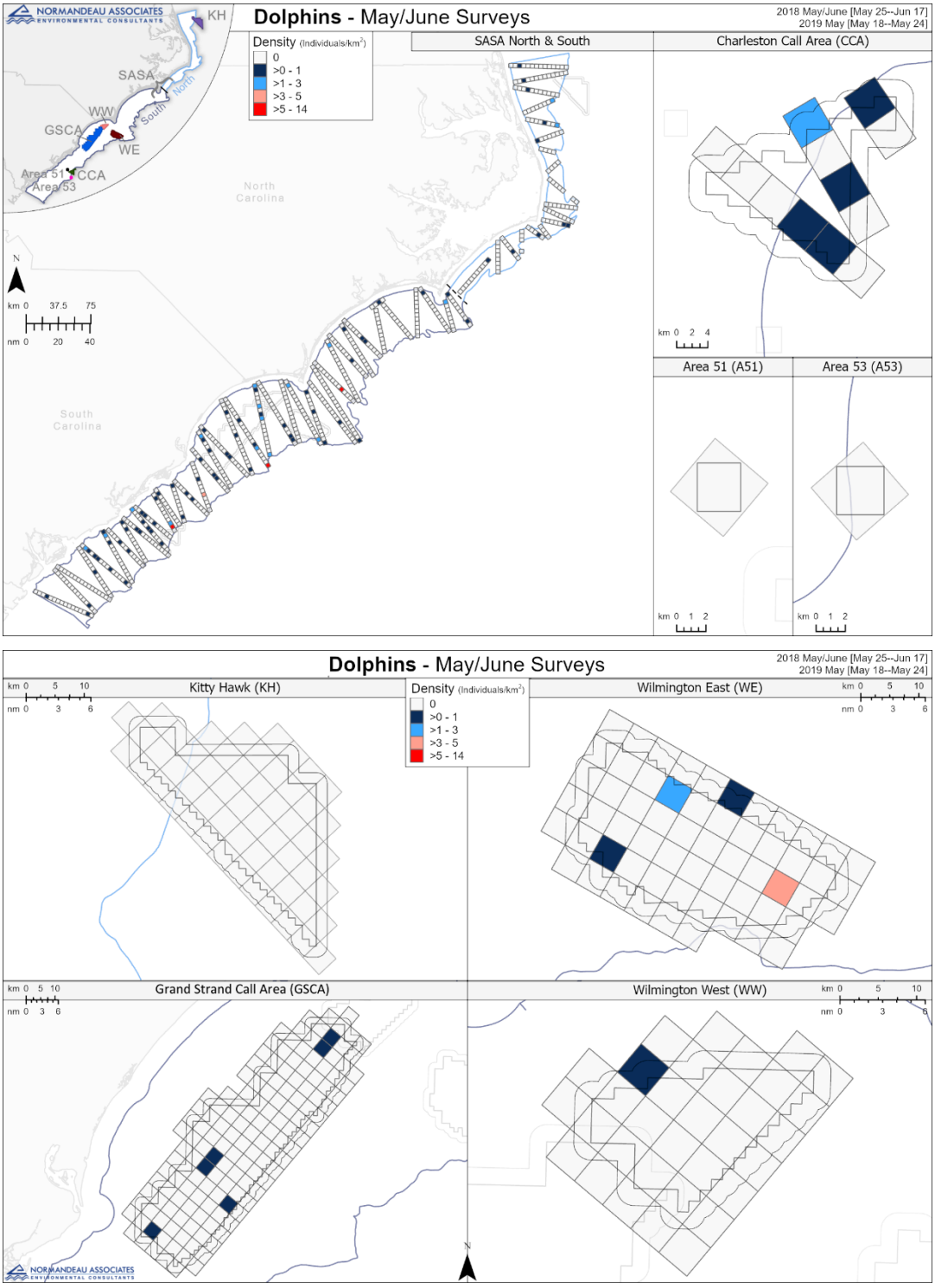

Figure 4–46. Spatial distribution of all dolphin species during the May/June surveys for all areas

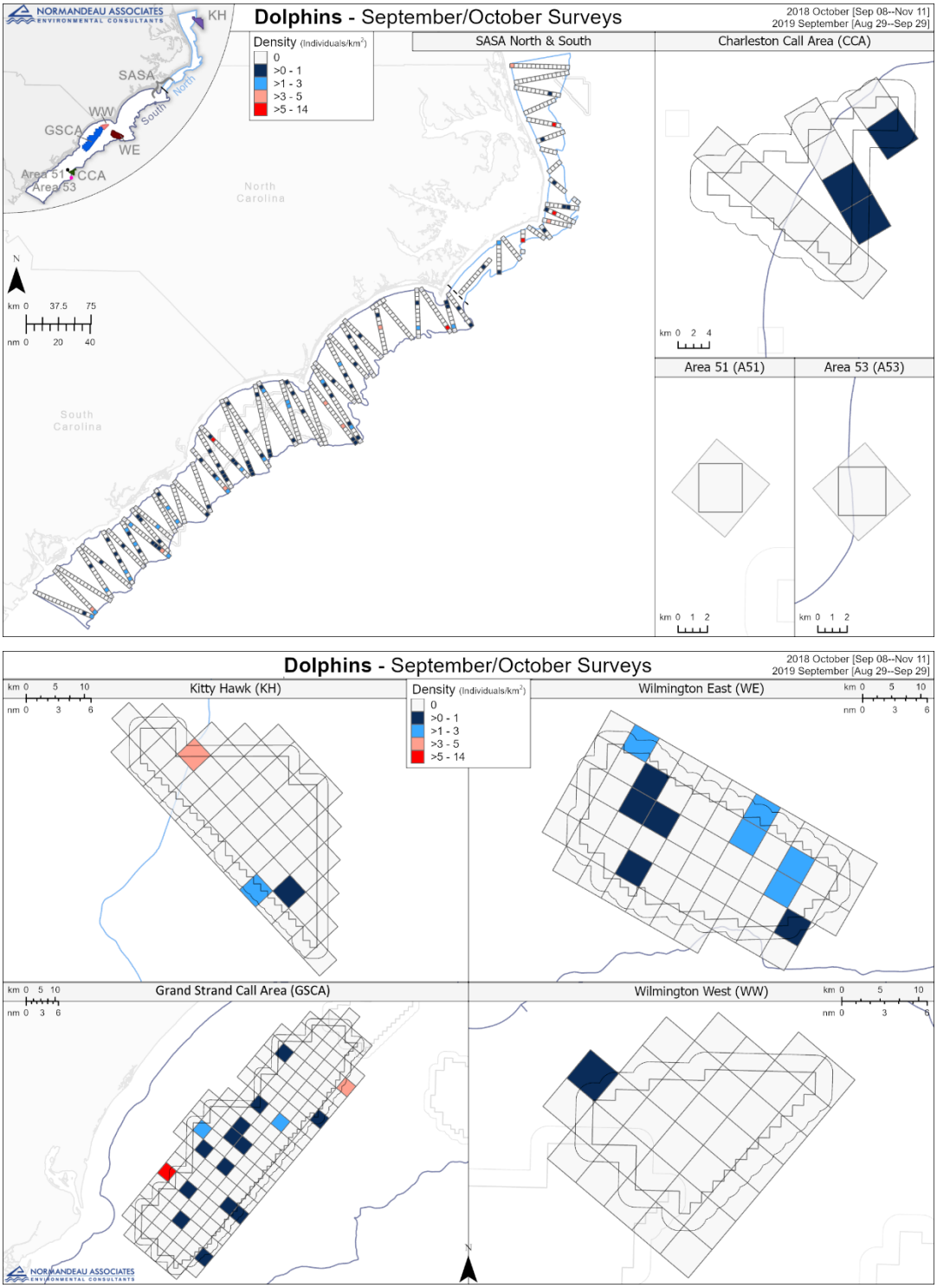

Figure 4–47. Spatial distribution of all dolphin species during the September/ October surveys for all areas

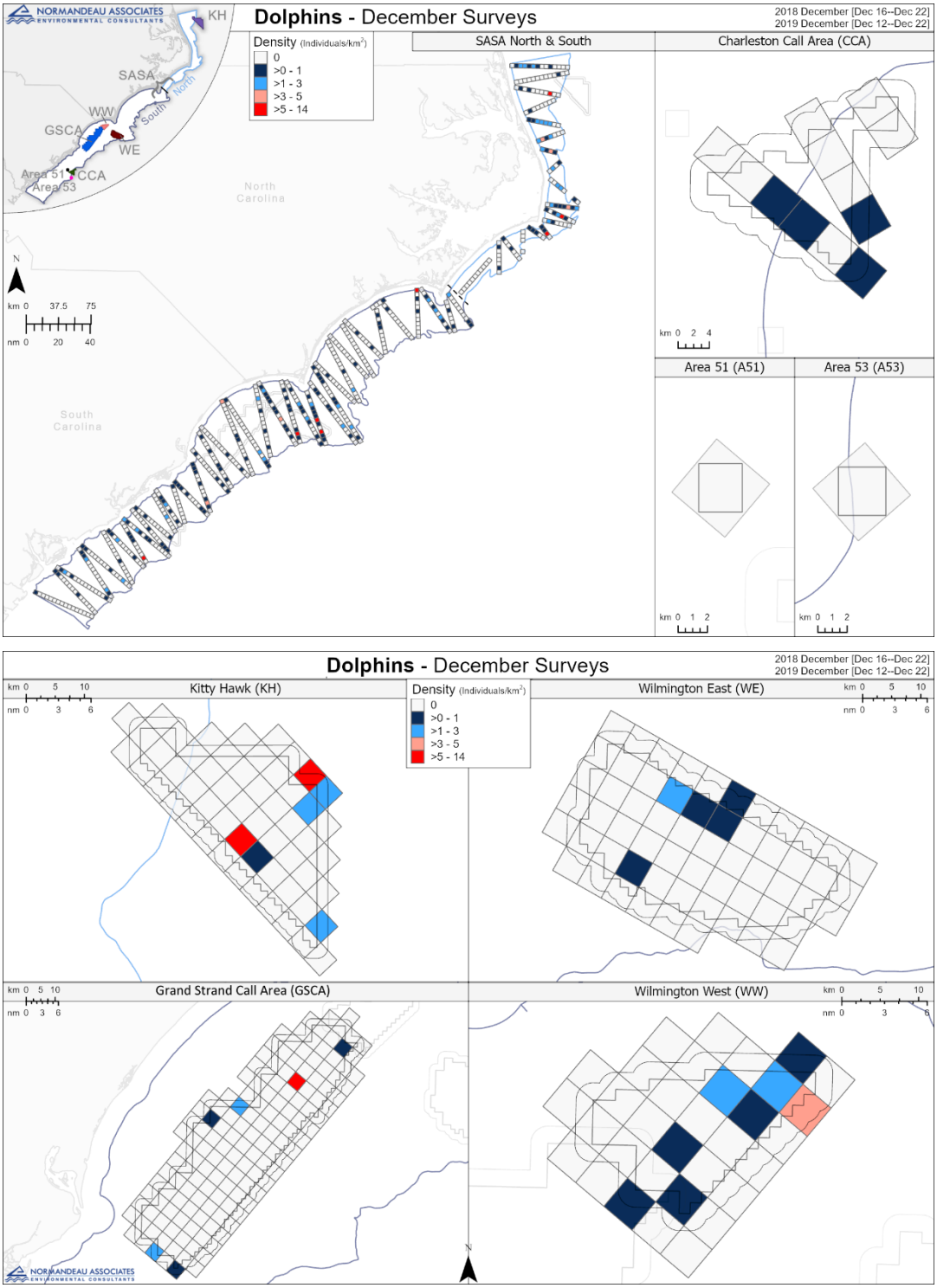

Figure 4–48. Spatial distribution of all dolphin species during the December surveys for all areas

4.7.4 Direction of Travel

Direction of travel for whales and dolphins in SASA is illustrated in Figure 4–49 and Figure 4–50. Too few whales were observed to draw conclusions about travel direction (Figure 4–49). There were no whales observed during May 2018. Dolphin travel direction was variable. During December travel direction was slightly biased towards the South and during February surveys most individuals traveled WNW (Figure 4–50). Dolphin travel direction was mixed showed no clear trends in May/June and October/September surveys (Figure 4–50).

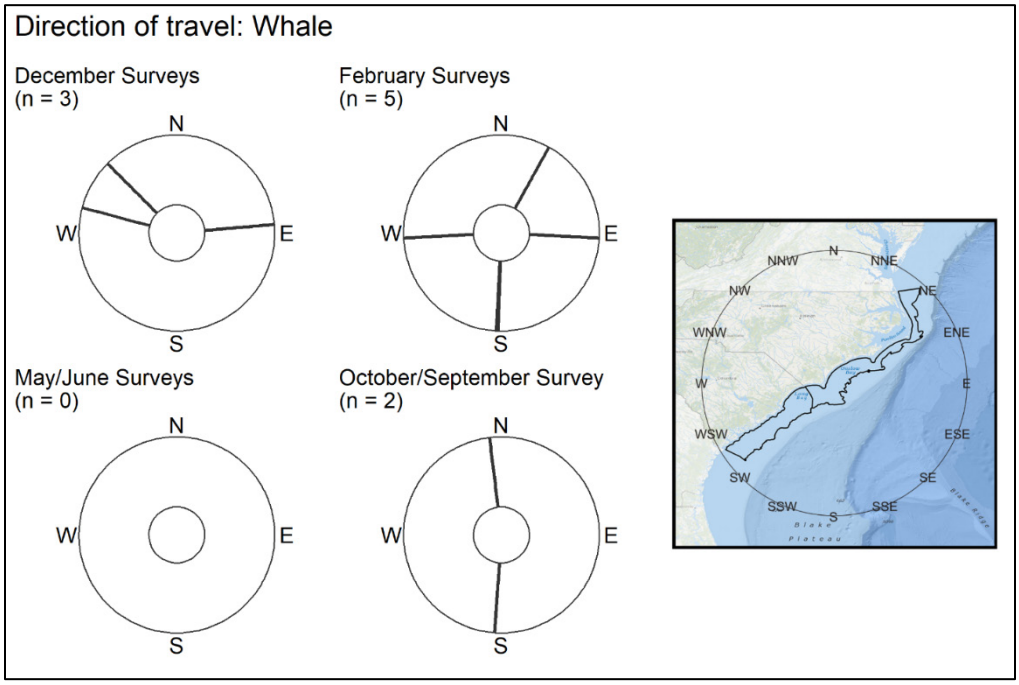

Figure 4–49. Direction of travel for whales observed during each survey in the South Atlantic Survey Area (SASA)

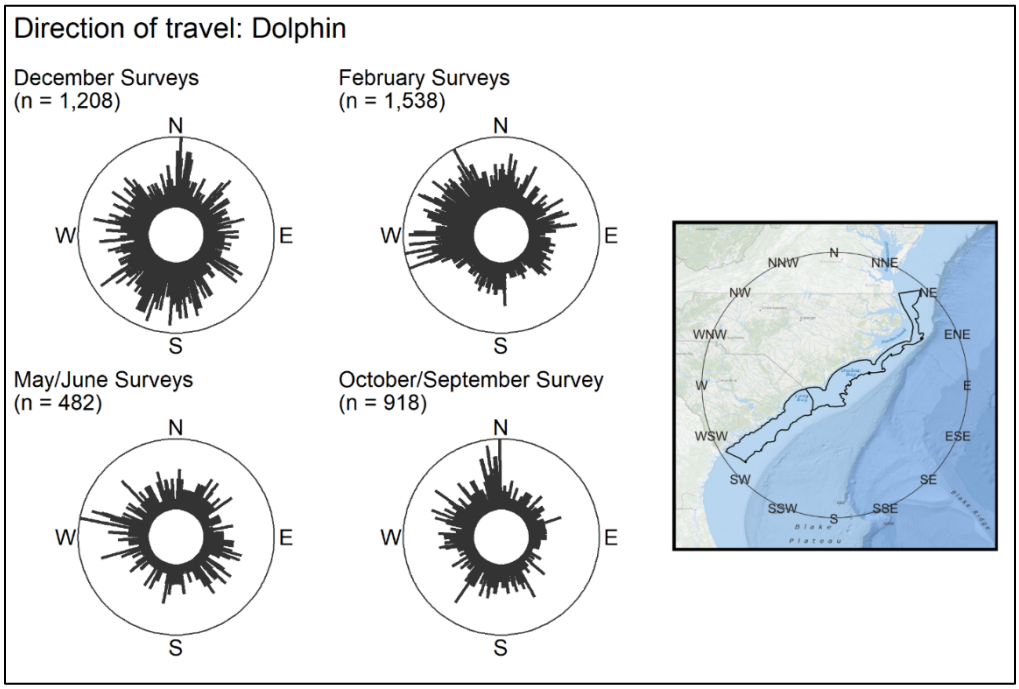

Figure 4–50. Direction of travel for dolphins observed during each survey in the South Atlantic Survey Area (SASA)

4.8 Rays and Sharks

4.8.1 Species Identification

Raw counts of ray and shark species identified in the February 2018 through February 2020 surveys are presented in Appendix F.1 (Table F–1). Ray and shark species identified in imagery for each area by survey are presented in Appendix F.1 (Table F–2 through Table F–8).

There were 23,380 rays found in the imagery across all areas and surveys (Appendix F.1, Table F–1). Few rays were found in the February 2018 (n=3) and February 2020 (n=8) surveys. Across all surveys, 93% of rays (n=21,819) were ascribed to species. There were 1,392 rays ascribed to the species blend cownose/bullnose ray and 169 as ray-species unknown (Appendix F.1, Table F–1). Of the cownose/bullnose ray group, 86% (n=1,196) were rated as significantly submerged as were 44% (n=75) of the ray-species unknown (Appendix F.1, Table F–1).

Over all surveys, the identification success for sharks varied among species (Appendix F.1, Table F–1). Of the 3,034 sharks found, 31% (n=942) were spurdogs, most of which were found in the May/June 2018 (n=356) and May 2019 (n=324) surveys (Appendix F.1, Table F–1). Of the remaining sharks, 27% (n=803) were identified as Carcharhinidae (unid.), 15% as hammerhead (unid.) (n=457), and 14% (n=411) were unidentified species, making 1,671 unidentified sharks and an identification success rate of 45% to species (Appendix F.1, Table F–1). Many of these species are difficult to distinguish even at close quarters. There were 318 (40%) of the Carcharhinidae (unid.), 140 (31%) of the hammerhead (unid.), and 312 (76%) of the shark-species unknown that were significantly submerged (Appendix F.1, Table F–1).

At the species-group level for rays there was 99.9% agreement between the original identification and the QC identification; of 4,696 targets initially identified as rays, 2 were assigned as “other.” Ray individual

species accuracy ranged widely from 75% to 100% though sample sizes were small for most individual species other than cownose ray (Table 4–29). Further identification review was undertaken by NOAA staff and marinemegafauna.org of large rays, with a particular focus on the genus *Mobula.*

At the species group level for sharks there was 99.9% agreement between the original identification and the QC identification; of 870 targets initially identified as sharks, only 1 was assigned as "unknown." Initial identification accuracy was >90% for all species except for the smooth hammerhead; 2 individuals initially identified as smooth hammerhead were QC'd as scalloped hammerhead (Table 4–30).

Table 4–29. Initial identification accuracy and QC ID accuracy for ray species

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Giant Manta Ray	91.3%	100.0%	23	21
Giant Devil Ray	100.0%	83.3%	5	6
Chilean Devil Ray	100.0%	50.0%	1	2
Spotted Eagle Ray	75.0%	100.0%	4	3
Bullnose Ray	100.0%	75.0%	3	4
Cownose/Bullnose Ray	80.7%	99.5%	244	198
Cownose Ray	100.0%	98.9%	4,403	4,448
Ray-species unknown	84.6%	91.7%	13	12
other object	NA	0.0%	0	1
needs id	NA	0.0%	0	1

Table 4–30. Initial identification accuracy and QC ID accuracy for shark species

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Whale Shark	100.0%	100.0%	2	2
Thresher Shark	100.0%	100.0%	1	1
Basking Shark	100.0%	100.0%	2	2
White Shark	94.7%	94.7%	19	19
Blacktip Shark	100.0%	100.0%	31	31
Blue Shark	100.0%	100.0%	2	2
Carcharhinidae (unid.)	91.7%	98.8%	180	167
Tiger Shark	100.0%	100.0%	1	1
Great Hammerhead	100.0%	50.0%	4	8
Smooth Hammerhead	80.0%	61.5%	10	13
Scalloped Hammerhead	96.0%	87.8%	75	82
Hammerhead (unid.)	93.9%	99.0%	313	297
Spurdog	98.7%	100.0%	157	155
Shark-species unknown	94.5%	78.4%	73	88
unknown object	NA	0.0%	0	1
Lemon Shark	NA	0.0%	0	1

4.8.2 Species Composition and Density

Ray and shark species identified and the density per km^2 of individuals for each survey across all areas is shown in Table 4–31 and Table 4–32; Figure 4–51 and Figure 4–52. Density per km^2 for ray and shark

species for each area by survey can be found in Appendix F.2 (Table F–9 through Table F–24; Figure F–1 and Figure F–2). When counted by area, SASA counts include all of A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–31 and Table 4–32. Values in Table F–9 through Table F–24 will allow assessment of individual survey areas for each survey period.

Rays were observed during all surveys (Table 4–31, Figure 4–51) with densities greatest in the May 2019 survey (6.17 per km^2; 62%). Only 0.01% of the ray observations (0.001 rays/km^2) occurred in the February 2018 survey. Of the three rays recorded during the February 2018 survey, one giant devil ray, one giant manta ray, and one ascribed to the cownose/bullnose ray species group were identified (Appendix F.1, Table F–1).

There were 0.03% (0.003 per km^2) ray observations in the February 2020 survey (Table 4–31, Figure 4–51). Similar to February 2018, diversity was also low with one giant devil ray, two cownose rays, one cownose/bullnose ray, and four ray-species unknown (Appendix F.1, Table F–1).

The density of rays during the May/June 2018 survey was 1.76 rays/km^2, or 16% of the total (Table 4–31), the second highest density of all surveys. Of the 4,403 rays recorded in the May/June 2018 survey, 74% (1.5 per km^2) were cownose rays, 12% (0.24 per km^2) were identified as cownose/bullnose rays, and <1% for bullnose ray, giant devil ray, Chilean devil ray, and giant manta rays (Appendix F.1, Table F–1). The remaining <1% of rays were not ascribed to species or species group (Appendix F.1, Table F–1). May/June 2018, May 2019, and September 2019 had the greatest diversity with 7 species or species groups (Table 4–31). Bullnose ray was only observed during this survey.

The May 2019 survey had the greatest density of all surveys (6.17 per km^2) with 62% of the occurrences Table 4–31). Of the 7 species or species groups, cownose rays were dominant with 6.14 rays/km^2 (99%) (Table 4–31). The only occurrence of Atlantic devil ray occurred during this survey.

October 2018 had similar distribution of species as May/June 2018 but with much lower density; however, there were 0.0009 spotted eagle rays per km^2 and no bullnose rays, which were only observed in the May/June 2018 survey (Table 4–31, Figure 4–51). The density was 3.5% of the total with 0.36 rays/km^2 and was dominated by cownose rays comprising 83% (0.39 per km^2) of the total (Table 4–31, Figure 4–51).

The September 2019 survey had an overall density of 15% (1.51 per km^2) of all surveys (Table 4–31, Figure 4–51). The diversity was similar to May/June 2018 but with the only occurrence of Atlantic stingray and no bullnose rays. The most dominant species in this survey was cownose rays with 1.2 rays/km^2 (79%) followed by the species group cownose/bullnose rays (0.26 per km^2; 17%) (Table 4–31, Figure 4–51).

There were 2.6% (0.26 per km^2) ray observations in the December 2018 survey (Table 4–31, Figure 4–51). The dominant species was cownose rays (0.25 per km^2) with 98% of the total. This survey (and December 2019) had the lowest diversity of all surveys with 1 species and 1 species group (Table 4–31, Figure 4–51).

During the December 2019 survey, only 0.06 rays/km^2 (0.6% of the total) were observed. Similar to the December 2018 survey, the diversity was low with 1 species and 1 species group observed. The survey was dominated by cownose/bullnose species group with 0.06 rays/km^2 (96%), with spotted eagle rays being the other identified species (Table 4–31, Figure 4–51).

Table 4–31. Density per km^2 of all rays observed by survey for all areas

Species	Density per km^2																
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Total
Atlantic Stingray	—	—	—	—	—	—	—	—	—	—	0.0004	100.00	—	—	—	—	0.0004
Giant Manta Ray*	0.0004	4.17	—	—	0.0023	20.83	0.0026	25.00	0.0009	8.33	0.0043	41.67	—	—	—	—	0.0105
Giant Devil Ray	0.0004	5.26	0.0004	5.26	0.0028	31.58	0.0009	10.53	0.0018	21.05	0.0021	26.32	—	—	—	—	0.0084
Chilean Devil Ray	—	—	—	—	0.0023	41.67	0.0021	41.67	0.0004	8.33	0.0004	8.33	—	—	—	—	0.0053
Atlantic Devil Ray	—	—	—	—	—	—	0.0004	100.00	—	—	—	—	—	—	—	—	0.0004
Spotted Eagle Ray	—	—	—	—	0.0005	5.56	0.0038	50.00	0.0009	11.11	0.0017	22.22	—	—	0.0009	11.11	0.0078
Bullnose Ray	—	—	—	—	0.0032	100.00	—	—	—	—	—	—	—	—	—	—	0.0032
Cownose/Bullnose Ray	0.0004	0.07	0.0004	0.07	0.2423	37.57	0.0030	0.50	0.0531	8.62	0.2585	43.39	0.0004	0.07	0.0610	9.70	0.6190
Cownose Ray	—	—	0.0009	0.01	1.5003	14.90	6.1441	66.40	0.2980	3.10	1.1966	12.86	0.2526	2.73	—	—	9.3924
species unknown	—	—	0.0017	2.37	0.0042	5.33	0.0098	13.61	0.0040	5.33	0.0475	65.68	0.0038	5.33	0.0018	2.37	0.0728
Total	**0.0013**	**0.01**	**0.0034**	**0.03**	**1.7579**	**16.23**	**6.1666**	**61.96**	**0.3590**	**3.47**	**1.5115**	**15.11**	**0.2568**	**2.58**	**0.0637**	**0.60**	**10.1203**

*Listed under the Endangered Species Act

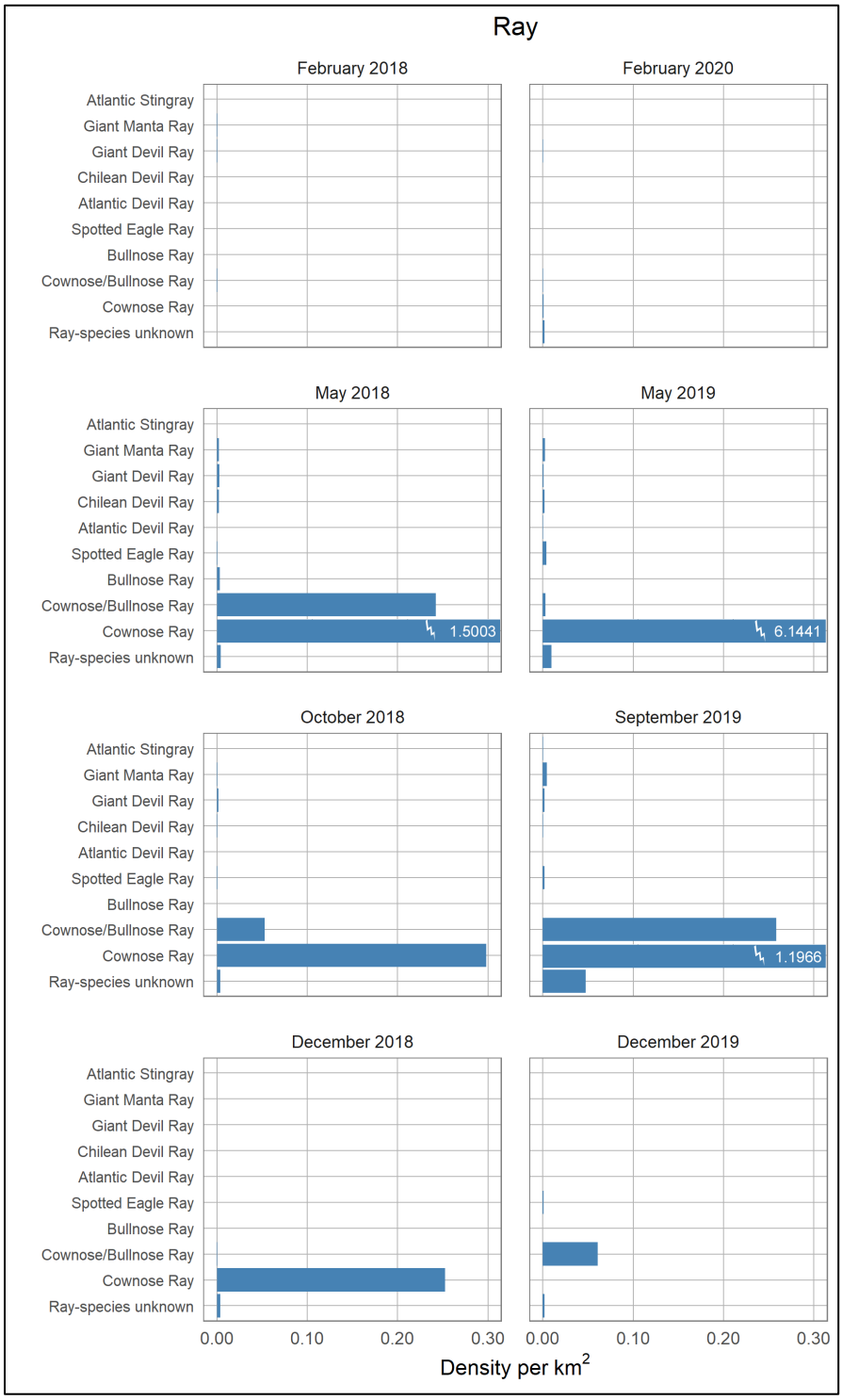

Figure 4–51. Density (per km^2) of ray species encountered during the February 2018 through February 2020 surveys for all areas by survey

The density of cownose rays in May 2018, May 2019, and September 2019 is truncated in this figure to permit a scale that represents all other season-species combinations

The majority (37%) of shark observations (0.48 per km^2) occurred during the May 2019 survey (Table 4–32). The remaining shark observations were mainly in the May/June 2018 (20%), September 2019 (12%), and October 2018 (12%) surveys (Table 4–32, Figure 4–52). Diversity was fairly even across all surveys with the most diverse survey period being May 2019 with 12 species or species groups followed by September 2019 with 9; February 2018 with 8; December 2019 and May/June 2018 with 7; and February 2019, October 2018, and December 2018 with 6 (Table 4–32, Figure 4–52).

The density for the February 2018 survey (0.12 sharks/km^2) was 9% of the overall total (Table 4–32, Figure 4–52). The survey was dominated by hammerhead (unid.) (0.08 per km^2; 65%). Basking sharks and silky sharks were only observed during this survey (Table 4–32, Figure 4–52). Spurdog were not observed during February 2018 or December 2019 but was observed in all other surveys comprising 31% of the total (Table 4–32, Figure 4–52).

The February 2020 survey was dominated by spurdog (0.02 per km^2; 32%) and Carcharhinidae (unid.) (0.01 per km^2; 31%). The overall density (0.04 per km^2) was just 3% of the total for all surveys (Table 4–31, Figure 4–51). This is the only survey where scalloped hammerheads and, along with December 2019, smooth hammerheads were not observed (Table 4–32, Figure 4–52).

The second highest density of all surveys was observed during May/June 2018 with 0.28 sharks/km^2 (20%). The dominant species was spurdog (0.17 per km^2; 59%) followed by Carcharhinidae (unid.) and shark-species unknown (0.04 per km^2; 15%) (Table 4–32, Figure 4–52). This is the only survey where thresher sharks were observed (Table 4–32, Figure 4–52).

May 2019 had the highest density of all surveys with 0.48 sharks/km^2 (37%) and was the most diverse with 12 species or species groups (Table 4–31, Figure 4–51). This survey was dominated by Carcharhinidae (unid.) (0.14 per km^2; 30%) and spurdog (0.14 per km^2; 29%). May 2019 was the only survey where blue sharks and dusky sharks were observed, was one of two surveys (December 2019) where blacktip sharks were observed, and one of two surveys (September 2019) where whale sharks were observed (Table 4–32, Figure 4–52).

The density of the October 2018 survey was 9% of the total with 0.12 sharks/km^2 and was dominated by Carcharhinidae (unid.) (0.08 per km^2) with 66% of the total (Table 4–32, Figure 4–52).

The September 2019 survey had a higher density with 12% (0.15 per km^2) and was dominated by spurdog (0.10 per km^2; 63%) (Table 4–32, Figure 4–52). This survey had the second greatest diversity with 9 species or species groups including 1 whale shark, 3 tiger sharks, and 2 great hammerheads (Appendix F.1, Table F–1).

The December 2018 survey had the lowest density of all surveys with just 1% of the total (0.02 sharks/km^2) and was dominated by hammerhead (unid.) (0.004 per km^2; 22%) and white sharks (0.002 per km^2; 12%) (Table 4–32, Figure 4–52). Half of the individuals recorded were unidentified shark species (0.009 per km^2; 51%). There were 6 species or species groups recorded (Table 4–32, Figure 4–52).

During the December 2019 survey, density was 9% of the total with 0.12 sharks/km^2 and was dominated by Carcharhinidae (unid.) (0.06 per km^2; 46%) (Table 4–32, Figure 4–52). There were no spurdog or smooth hammerheads observed during this survey, which is the same as February 2018 and February 2020, respectively. December 2019 was the only survey where bonnethead sharks were observed and one of two surveys (May 2019) where blacktip sharks were recorded (Table 4–32, Figure 4–52).

Overall, density was 1.33 sharks/km^2 and the most dominant species was spurdog with 31% of the total (0.42 sharks/km^2) followed by Carcharhinidae (unid.) (0.35 per km^2; 26%) (Table 4–32, Figure 4–52).

Table 4–32. Density per km^2 of all sharks observed by survey for all areas

Species	Density per km^2																
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Total
Whale Shark*	—	—	—	—	—	—	0.0004	50.00	—	—	0.0004	50.00	—	—	—	—	0.0009
Thresher Shark	—	—	—	—	0.0009	100.00	—	—	—	—	—	—	—	—	—	—	0.0009
Basking Shark	0.0107	100.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0107
White Shark	0.0034	10.81	0.0043	13.51	0.0046	13.51	0.0034	10.81	0.0022	6.76	0.0030	9.46	0.0021	6.76	0.0095	28.38	0.0326
Blacktip Shark	—	—	—	—	—	—	0.0762	95.21	—	—	—	—	—	—	0.0041	4.79	0.0803
Blue Shark	—	—	—	—	—	—	0.0017	100.00	—	—	—	—	—	—	—	—	0.0017
Carcharhinidae (unid.)	0.0017	0.50	0.0133	3.86	0.0426	11.46	0.1413	41.34	0.0783	22.04	0.0175	5.11	0.0004	0.12	0.0564	15.57	0.3517
Dusky Shark	—	—	—	—	—	—	0.0004	100.00	—	—	—	—	—	—	—	—	0.0004
Silky Shark	0.0004	100.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0004
Tiger Shark	0.0004	16.67	0.0004	16.67	—	—	0.0004	16.67	—	—	0.0013	50.00	—	—	—	—	0.0026
Bonnethead Shark	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0005	100.00	0.0005
Great Hammerhead	—	—	0.0004	9.09	—	—	0.0030	63.64	—	—	0.0009	18.18	—	—	0.0005	9.09	0.0047
Smooth Hammerhead	0.0030	28.00	—	—	0.0032	28.00	0.0030	28.00	0.0004	4.00	0.0009	8.00	0.0004	4.00	—	—	0.0109
Scalloped Hammerhead*	0.0026	7.41	—	—	0.0028	7.41	0.0153	44.44	0.0031	8.64	0.0013	3.70	0.0009	2.47	0.0095	25.93	0.0354
Hammerhead (unid.)*	0.0774	39.61	0.0013	0.66	0.0208	9.85	0.0502	25.82	0.0133	6.56	0.0103	5.25	0.0038	1.97	0.0212	10.28	0.1984
Spurdog	—	—	0.0138	3.40	0.1649	37.79	0.1379	34.39	0.0027	0.64	0.0950	23.57	0.0009	0.21	—	—	0.4151
species unknown	0.0193	10.95	0.0099	5.60	0.0417	21.90	0.0413	23.60	0.0190	10.46	0.0197	11.19	0.0089	5.11	0.0208	11.19	0.1805
Total	**0.1189**	**9.16**	**0.0434**	**3.33**	**0.2816**	**20.04**	**0.4746**	**36.75**	**0.1189**	**8.87**	**0.1502**	**11.57**	**0.0175**	**1.35**	**0.1224**	**8.93**	**1.3276**

*Listed under the Endangered Species Act

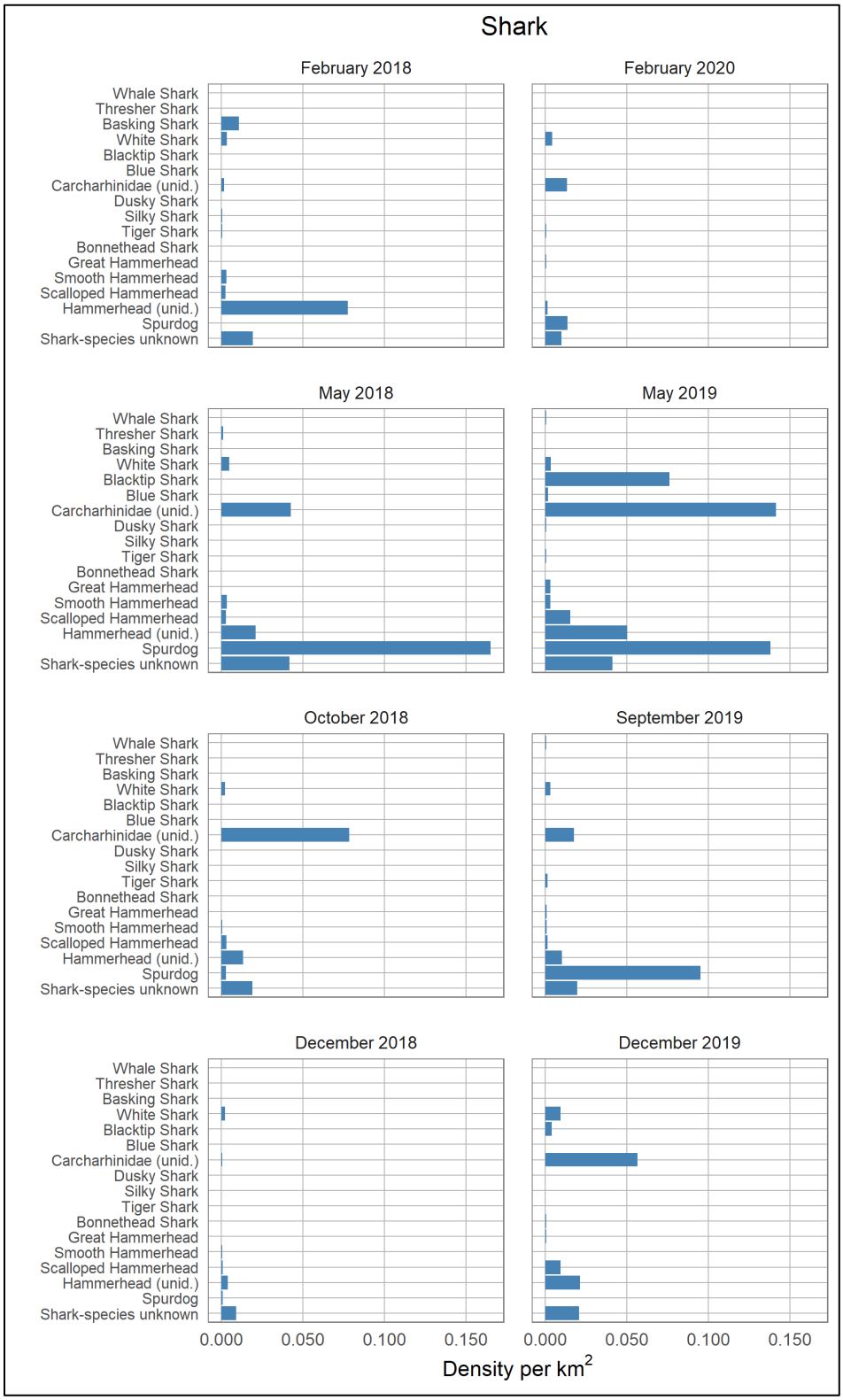

Figure 4–52. Density (per km^2) of shark species encountered during the February 2018 through February 2020 surveys for all areas by survey

4.8.3 Spatial Distribution

The spatial distribution of rays and sharks encountered during all surveys is shown in Figure 4–53 through Figure 4–60. Spatial distribution of individual species of rays and sharks is shown in Appendix F.3, Figure F–3 through Figure F–28 and Figure F–29 through Figure F–77, respectively.

Rays in general were distributed across SASA with Mary/June and September/October being the time periods where they were most widely distributed. They were also recorded in all call areas except A51 and A53 during some portion of the year (Figure 4–53 through Figure 4–56). Giant manta rays were observed across SASA with more observations in SASA south in May/June and more observations in SASA north in September/October (Figure F–4 through Figure F–6). Few giant devil rays were observed, but most observations were observed east of Pamlico Sound (Figure F–7 through Figure F–9). Cownose rays were widely distributed across SASA in May/June with a cluster of higher density observed at KH compared to other call areas during other time periods (Figure F–21 through Figure F–24).

Sharks were widely distributed across SASA and among the call areas with spatial distributions being the most widespread during May/June and September/October. Sharks were recorded in all call areas at some point during the year (Figure 4–57 through Figure 4–60). Sharks were more abundant in SASA north than SASA south during all time periods except May/June. Scalloped hammerhead sharks were more abundant in SASA south compared to SASA north in May/June but more abundant in SASA north during December (Figure F–62 through Figure F–65). Spurdog were more abundant in SASA south than in SASA north during May/June, but the opposite was true during September/October (Figure F–70 through Figure F–73). Spurdog were recorded at every call area between May–October.

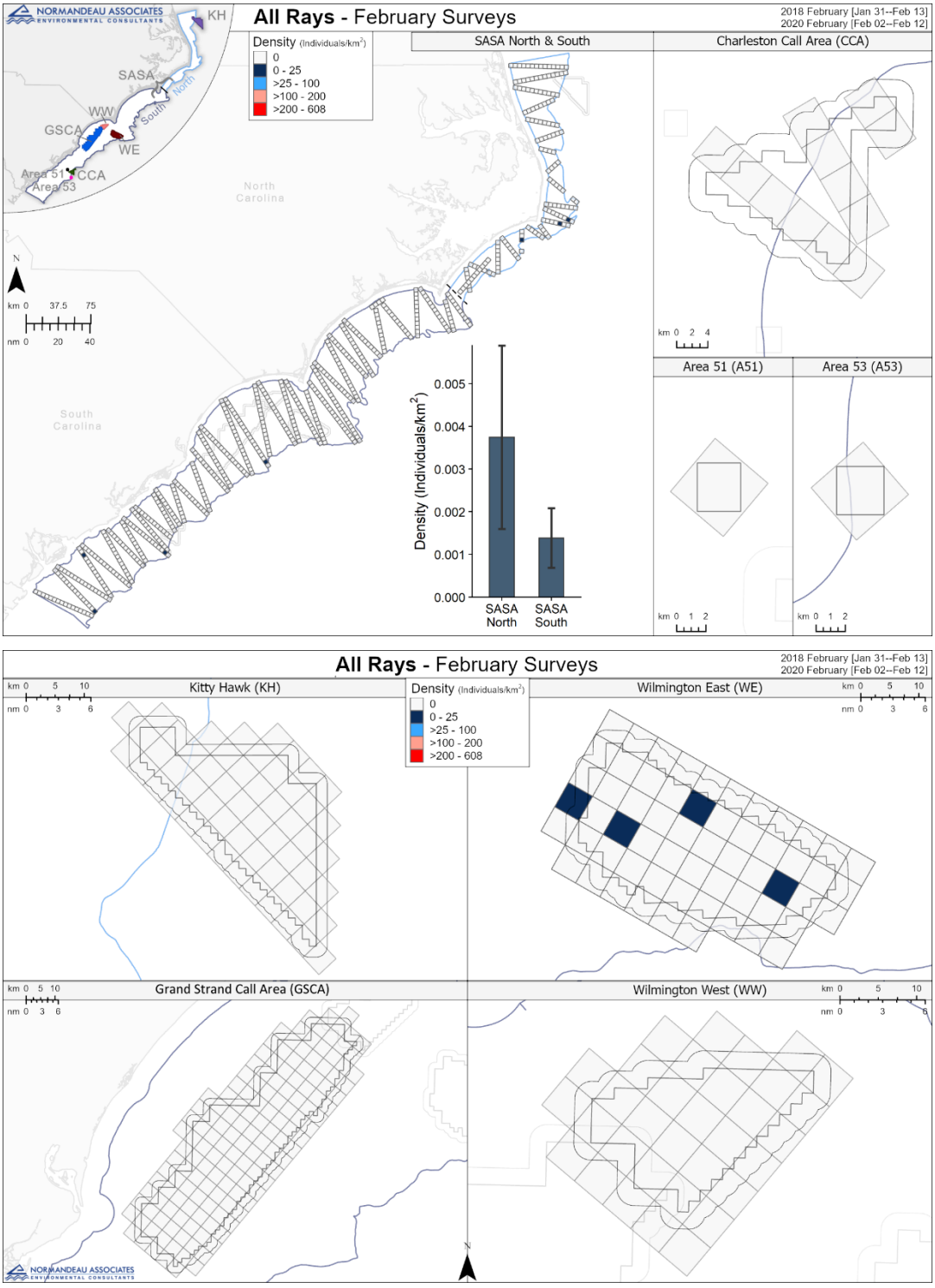

Figure 4–53. Spatial distribution of all ray species during the February surveys for all areas

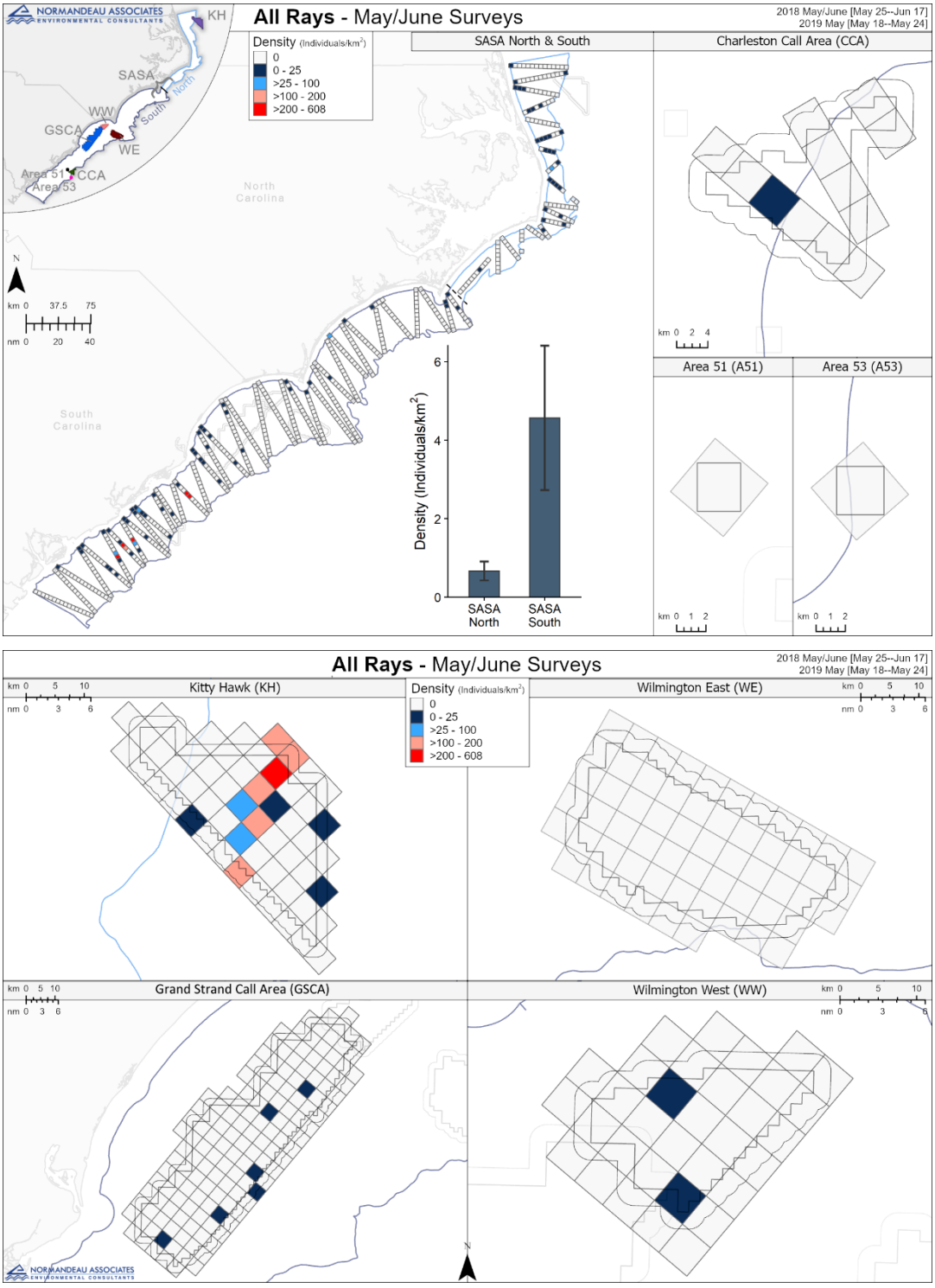

Figure 4–54. Spatial distribution of all ray species during the May/June surveys for all areas

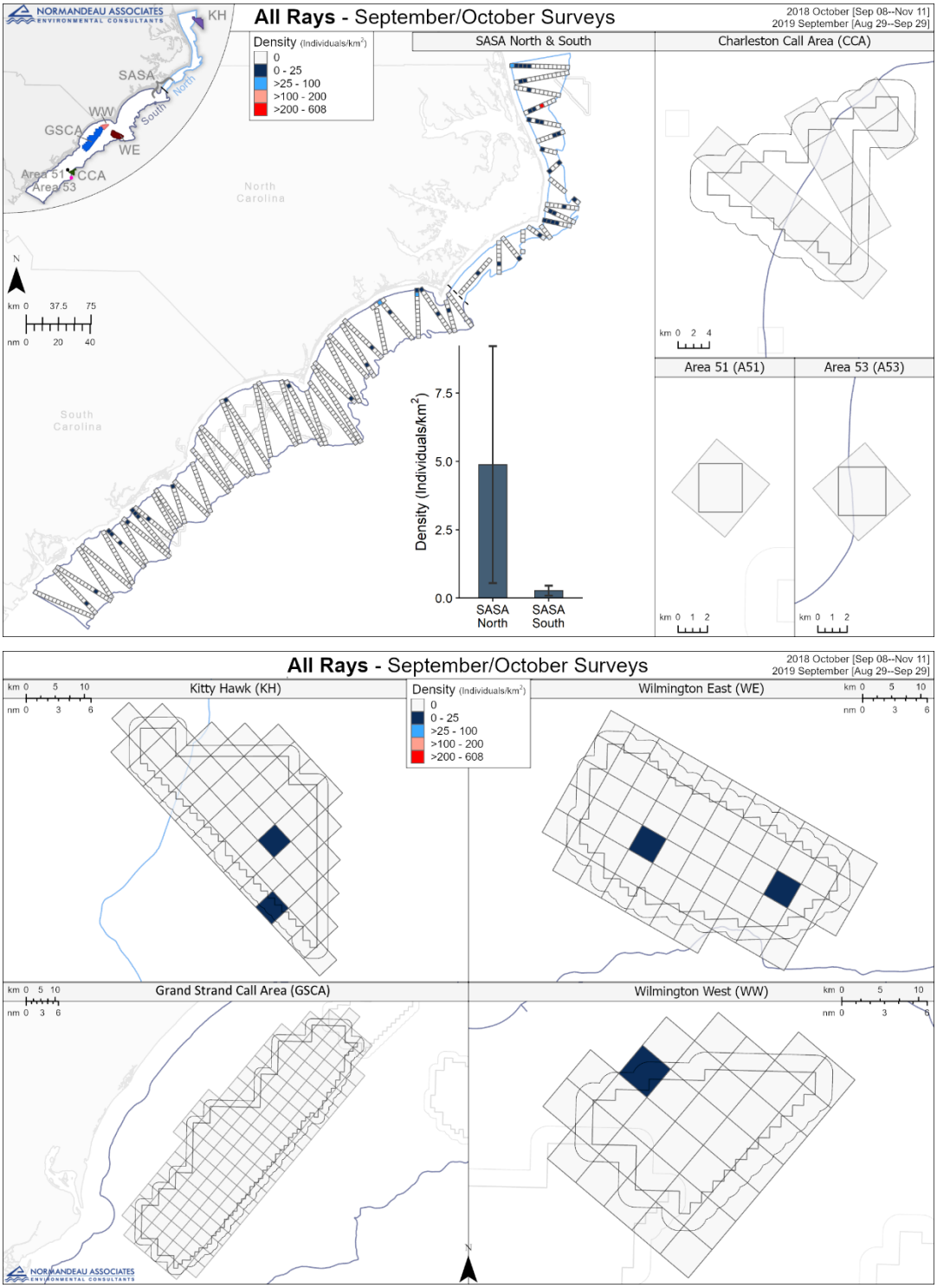

Figure 4–55. Spatial distribution of all ray species during the September/October surveys for all areas

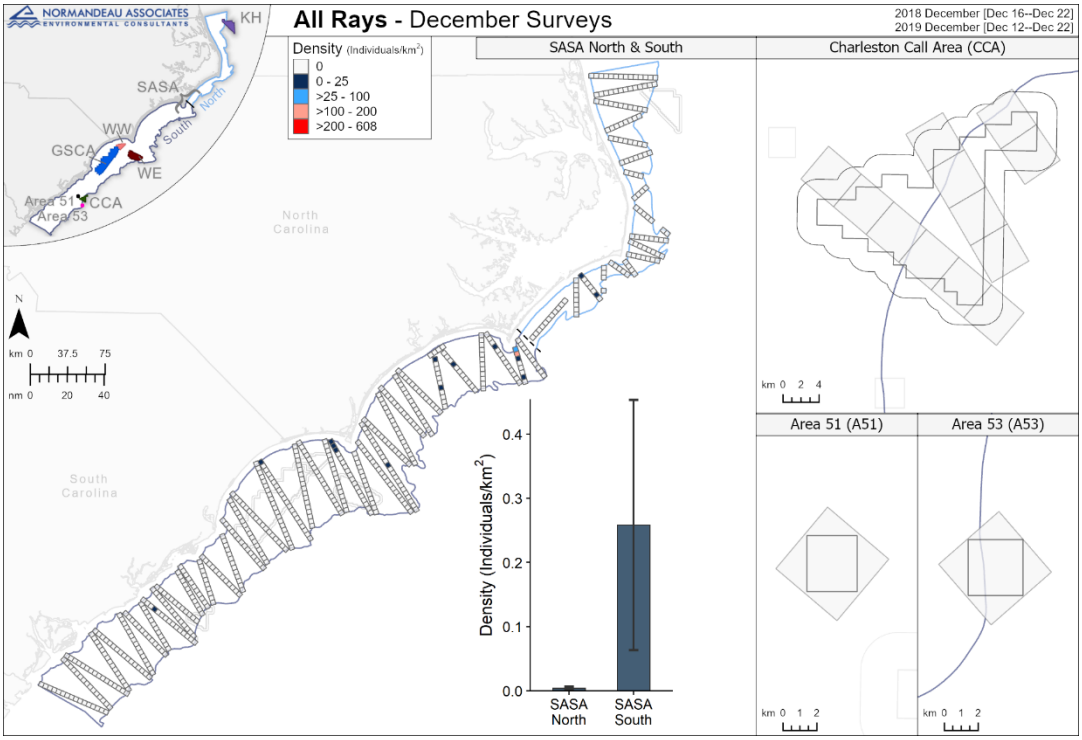

Figure 4–56. Spatial distribution of all ray species during the December surveys for all areas

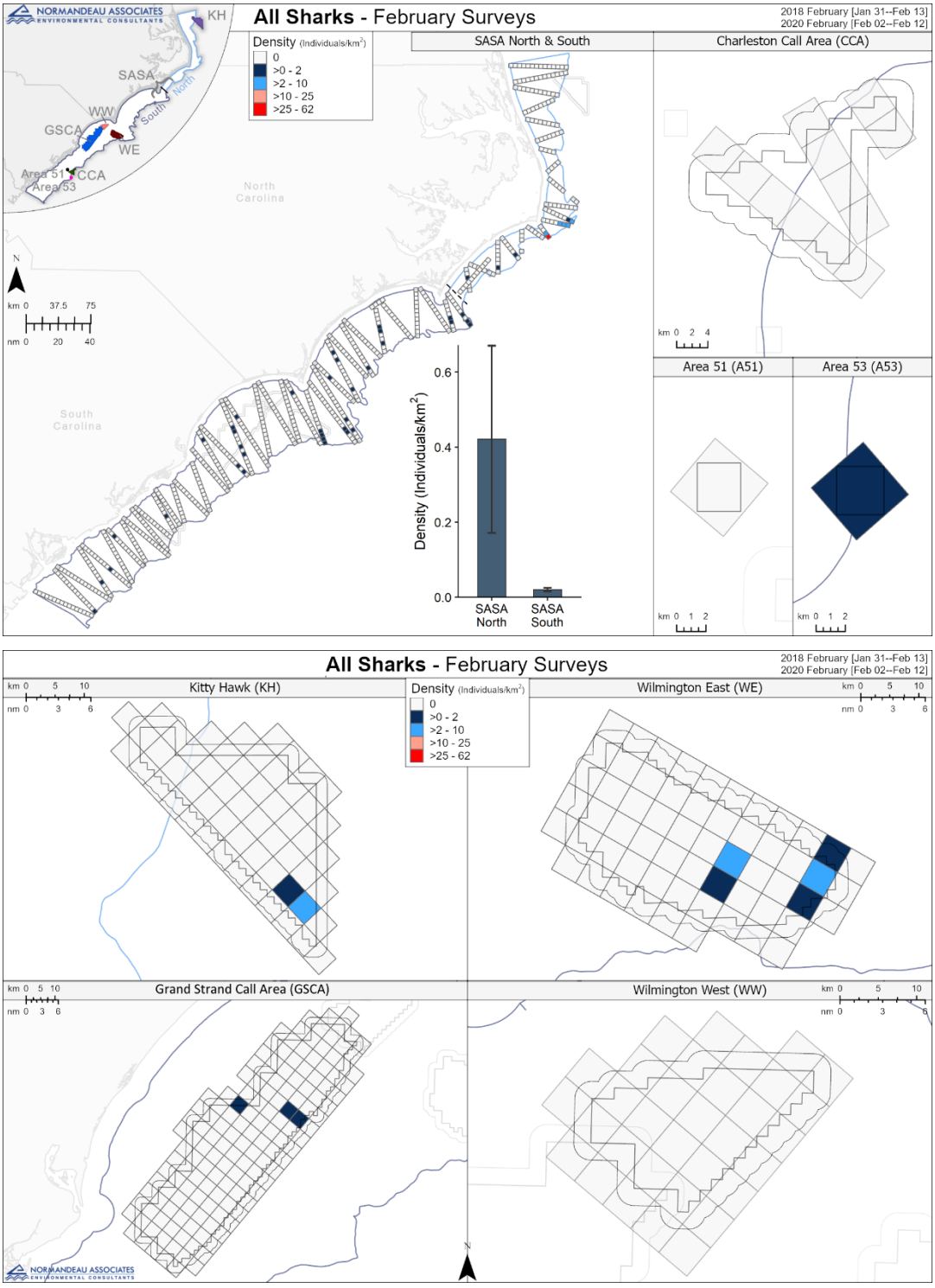

Figure 4–57. Spatial distribution of all shark species during the February surveys for all areas

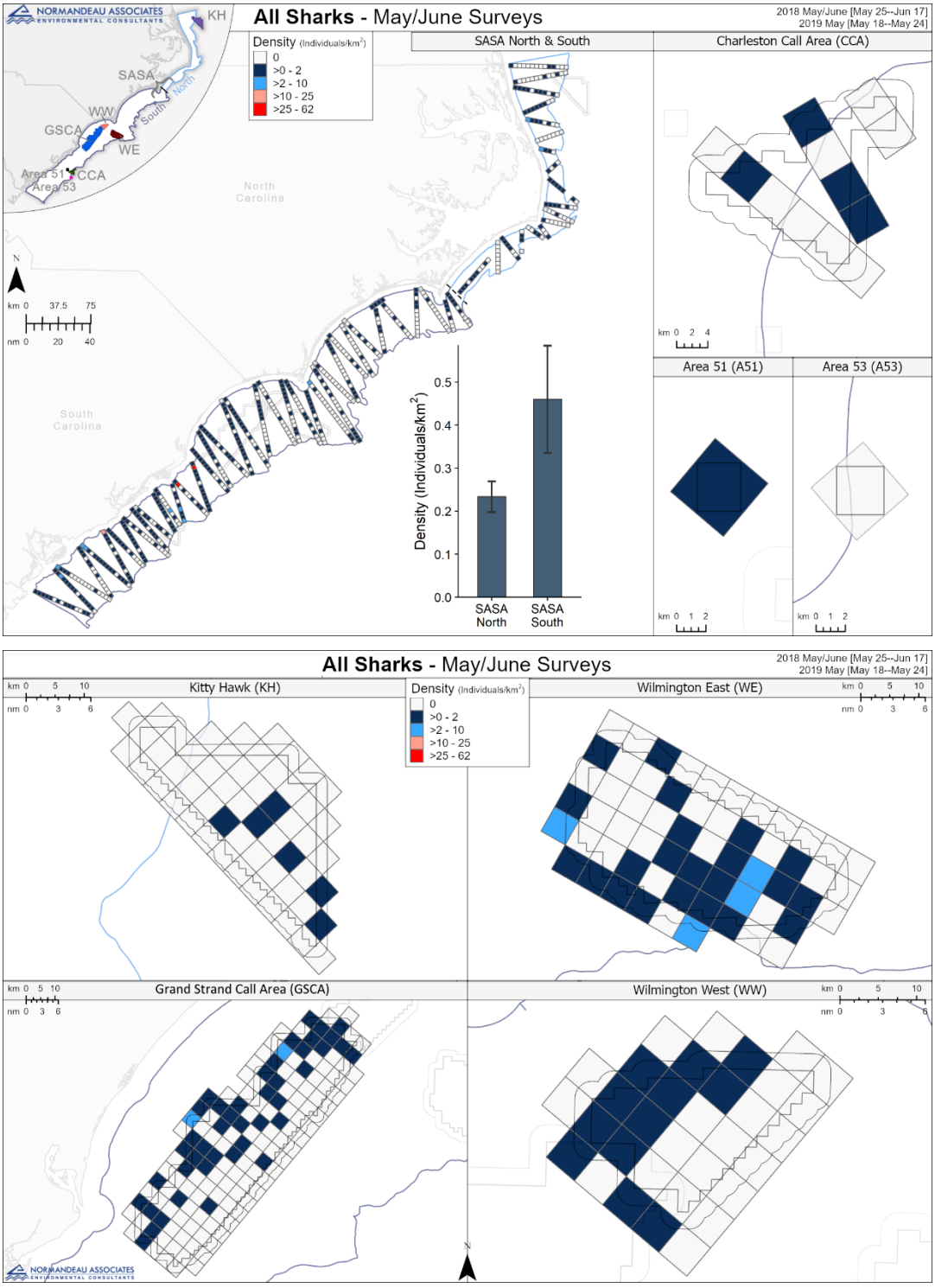

Figure 4–58. Spatial distribution of all shark species during the May/June surveys for all areas

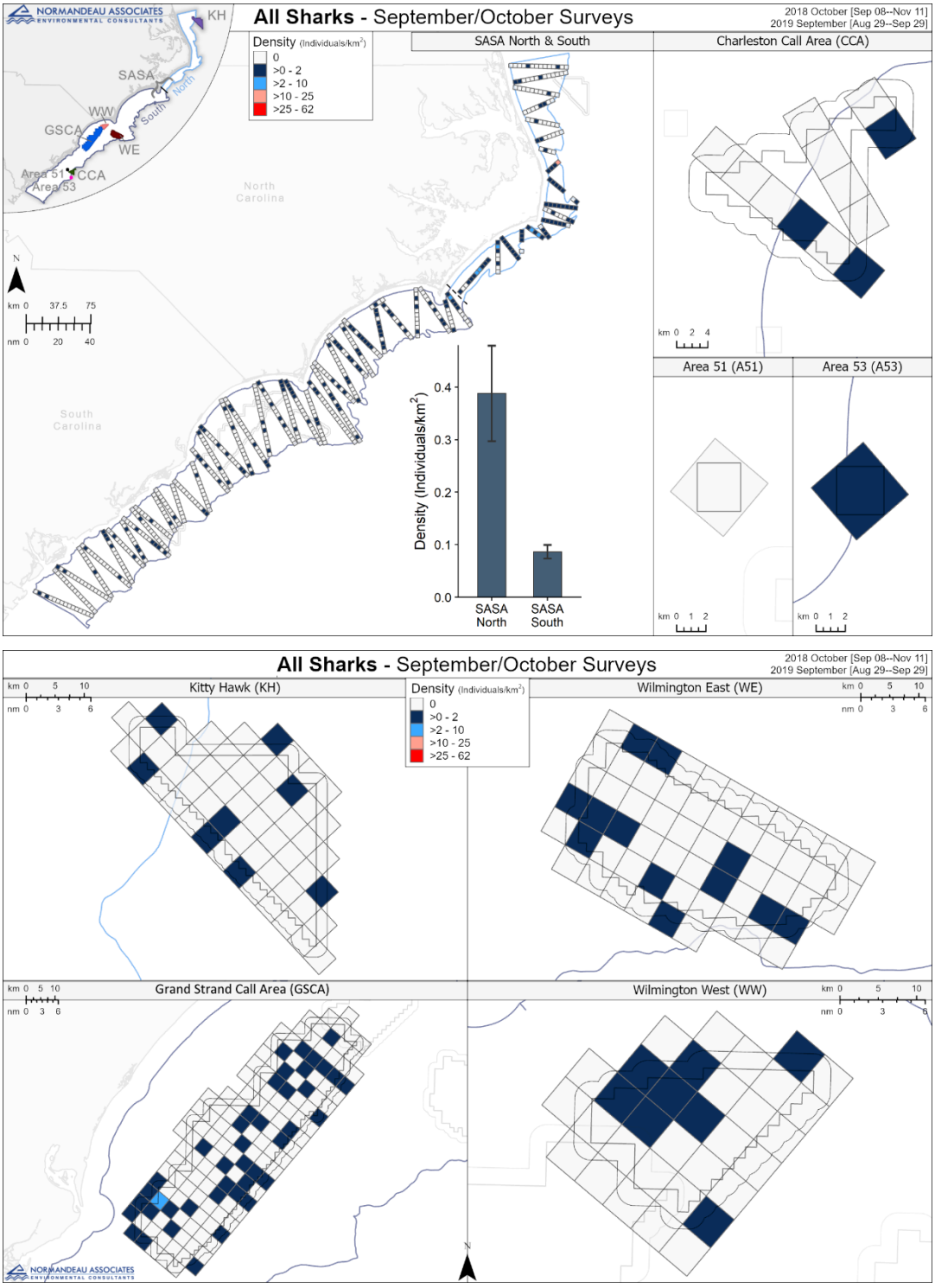

Figure 4–59. Spatial distribution of all shark species during the September/October surveys for all areas

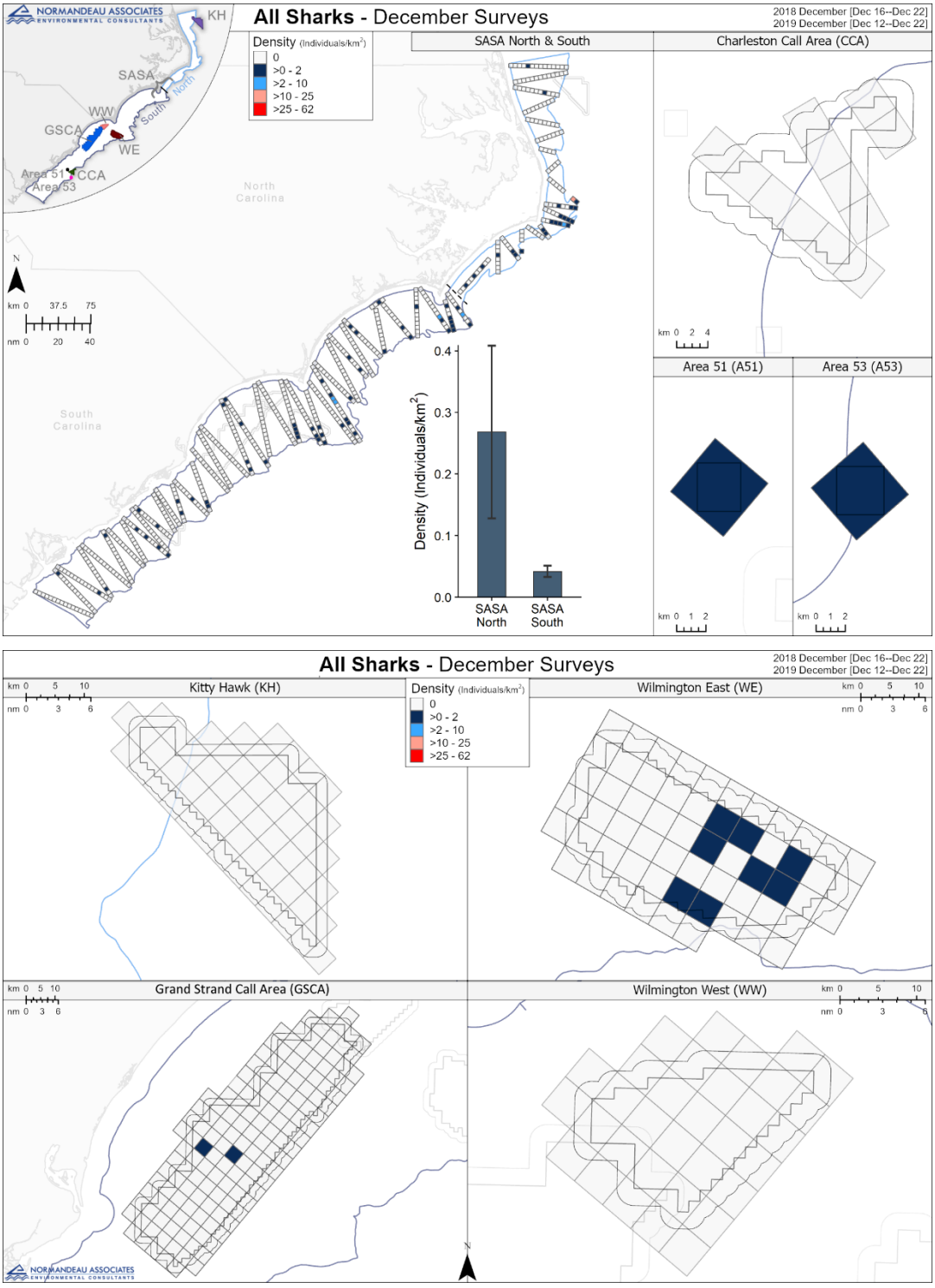

Figure 4–60. Spatial distribution of all shark species during the December surveys for all areas

4.8.4 Direction of Travel

Direction of travel for rays and sharks during the February 2018 through February 2020 surveys is presented in Figure 4–61 and Figure 4–62, respectively. Travel direction for rays was primarily to the West during October/September surveys and highly variable during May/June surveys (Figure 4–61). Too few rays were observed during February and December to discern any patterns. Travel direction for sharks was highly variable with no clear pattern during February, May/June, and October/September surveys (Figure 4–62). In December surveys sharks showed a predominant SSW direction of travel (Figure 4–62).

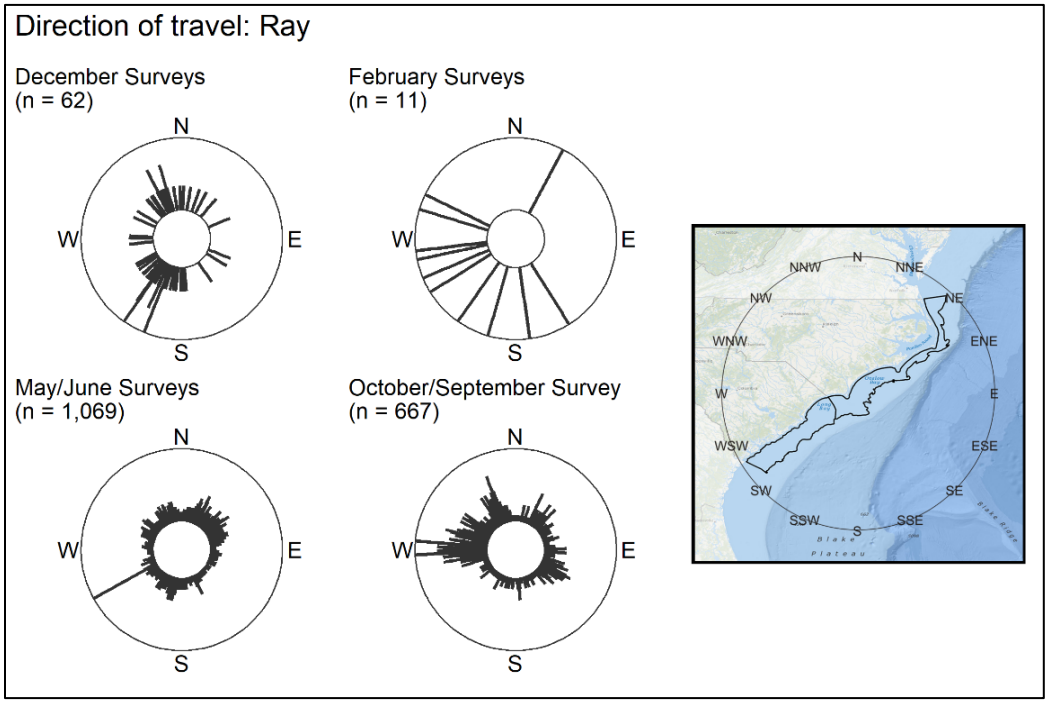

Figure 4–61. Direction of travel for rays observed during each survey in the South Atlantic Survey Area (SASA)

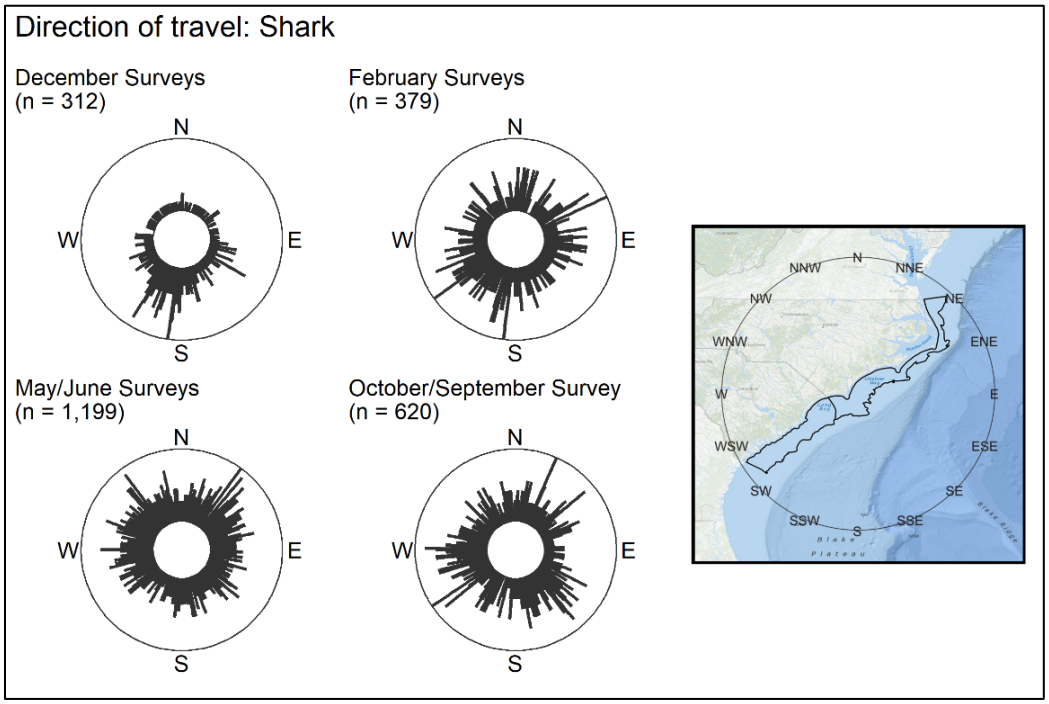

Figure 4–62. Direction of travel for sharks observed during each survey in the South Atlantic Survey Area (SASA)

4.9 Large Bony Fishes

4.9.1 Species Identification

Raw counts of large bony fishes identified in the February 2018 through February 2020 surveys are presented in Appendix G.1 (Table G–1). Large bony fish species identified in imagery for each area by survey are presented in Appendix G.1 (Table G–2 through Table G–9). There were 4,255 large bony fishes found in the imagery across all areas and surveys (Table G–1). Across all surveys, 60% of fish (n=2,556) were ascribed to species (Table G–1). The most abundant species for all surveys was mahi-mahi (n=1,803; 42%); although, the number of individuals found during May/June 2018 (n=3), December 2019 (n=5), and December 2018 (n=23) was low. Of the 6 species of fish identified, mahi-mahi and ocean sunfish were the only species found in all surveys.

Of the 526 individuals recorded during the February 2018 survey, 459 (87%) were identified to species with mahi-mahi representing 90% of the identified species. During the February 2020 survey, 180 of the 395 individuals were identified to species (46%) For the May/June 2018 survey, 7 (4%) of the 192 individuals were identified to species. During the May 2019 survey, 717 of the 1,227 (58%) individuals were identified to species. Of the 989 individuals found during October 2018, 559 (57%) were identified to species. For the September 2019 survey, 469 (69%) individuals of the 682 observed where identified to species. During the December 2018 survey, 66 (75%) of the 88 individuals were identified to species, 30 of which were ocean sunfish (Table G–1). Of the 156 individuals observed during December 2019, 97 (62%) were identified to species, with ocean sunfish comprising 52%. For the individuals not identified to species (n=1,699; 40%), only 5% (n=80) were significantly submerged (Table G–1).

Identification accuracy was 100% for fish species groups (Table 4–33) and individual species (Table 4–34).

Table 4–33. Initial identification accuracy and QC ID accuracy for fish species groups

Species Group	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Mahi-Mahi	100.0%	100.0%	2	2
Tuna	100.0%	100.0%	241	241
Sunfish	100.0%	100.0%	3	3
Remora	100.0%	100.0%	7	7

Table 4–34. Initial identification accuracy and QC ID accuracy for fish species

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Mahi-Mahi	100.0%	100.0%	2	2
Atlantic bluefin tuna	100.0%	100.0%	241	241
Ocean Sunfish	100.0%	100.0%	1	1
Sunfish-species unknown	100.0%	100.0%	2	2
Remora unid.	100.0%	100.0%	7	7

4.9.2 Species Composition and Density

Large bony fishes identified and the density of large bony fishes per km^2 for each survey across all areas is shown in Table 4–35 and Figure 4–63. Density for large bony fishes for each area by survey can be found in Appendix G.2 (Table G–10 through Table G–17; Figure G–1). When counted by area, SASA counts include all of A51, part of A53, and part of CCA; GSCA counts include part of WW. This causes double counting of some targets when added together, but these have been eliminated in Table 4–35. Values in Table G–10 through Table G–17 will allow assessment of individual survey areas for each survey period.

The February 2018 survey had an overall density of 0.23 large bony fishes/km^2 (12% of the total) and was dominated by mahi-mahi (0.18 per km^2; 79%). Diversity was low with just 4 species identified (Table 4–35, Figure 4–63).

Density in the February 2020 survey was 9% (0.17 per km^2) and was dominated by ocean sunfish (0.04 per km^2; 22%) and mahi-mahi (0.03 per km^2; 20%) (Table 4–35, Figure 4–63). Similar to February 2018, diversity was low with 4 species identified.

The May/June 2018 survey had a density of 0.09 large bony fishes/km^2 (5% of the total) and was dominated by tuna-species unknown (0.05 per km^2; 56%). This survey had a low diversity with only 3 species identified (Table 4–35, Figure 4–63) and was only one of two surveys (December 2019) with no Atlantic bluefin tuna observed (Table 4–35, Figure 4–63).

The May 2019 survey had the highest density of all surveys with 0.52 large bony fishes/km^2 (29%) and was dominated by mahi-mahi (0.30 per km^2; 57%) and tuna-species unknown (0.22 per km^2; 41%) (Table 4–35, Figure 4–63). Diversity during this survey was low with 4 species identified.

The October 2018 survey had the second highest density with 0.44 large bony fishes/km^2 (23%) and the greatest diversity with 6 species identified (Table 4–35, Figure 4–63). The dominant species were Atlantic bluefin tuna (0.09 per km^2; 21%) and ocean sunfish (0.09 per km^2; 20%). This was the only survey where flying fish (unid.) and blue marlin were observed (Table 4–35, Figure 4–63).

The September 2019 survey had an overall density of 0.29 large bony fishes/km^2 (16%) and a low diversity of 4 species (Table 4–35, Figure 4–63). The survey was dominated by mahi-mahi (0.19 per km^2; 66%).

December 2018 had the lowest density of all surveys (0.04 per km^2; 2%), which also had low diversity (n=3) (Table 4–35, Figure 4–63). The dominant species during this survey was ocean sunfish with 0.01 large bony fishes/km^2 (34%).

The December 2019 survey had the second lowest density with 0.07 large bony fishes/km^2 (4%) and the lowest diversity of all surveys with 2 species identified (Table 4–35, Figure 4–63). The dominant species was ocean sunfish (0.04 per km^2; 59%) and was one of two surveys (May/June 2018) where no Atlantic bluefin tuna were observed (Table 4–35, Figure 4–63).

Overall, large bony fishes were observed in all surveys with highly variable densities among surveys (Table 4–35, Figure 4–63). Density was greatest in the May 2019 survey (0.30 large bony fishes/km^2; 57%), and the lowest density occurred during December 2018 (0.04 per km^2; 2%). Diversity was greatest in the October 2018 survey and the lowest in December 2019 (Table 4–35, Figure 4–63).

Table 4–35. Density per km^2 of all large bony fishes observed by survey for all areas

Species	Density per km^2																
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Other Fish																	
Flying Fish unid.	—	—	—	—	—	—	—	—	0.0018	100.00	—	—	—	—	—	—	0.0018
Cobia																	
Cobia	—	—	0.0004	4.17	0.0014	12.50	0.0030	29.17	0.0053	50.00	0.0004	4.17	—	—	—	—	0.0105
Mahi-Mahi																	
Mahi-Mahi	0.1776	23.02	0.0340	4.38	0.0014	0.17	0.2950	38.44	0.0597	7.49	0.1926	24.96	0.0098	1.28	0.0023	0.28	0.7722
Tuna																	
Atlantic bluefin tuna	0.0030	2.85	0.0056	5.28	—	—	0.0009	0.81	0.0928	85.37	0.0004	0.41	0.0055	5.28	—	—	0.1082
species unknown	0.0013	0.25	0.0795	15.38	0.0496	8.89	0.2128	41.56	0.0791	14.88	0.0757	14.71	0.0009	0.17	0.0226	4.16	0.5215
Billfish																	
Blue marlin	—	—	—	—	—	—	—	—	0.0004	100.00	—	—	—	—	—	—	0.0004
species unknown	—	—	—	—	—	—	—	—	0.0004	50.00	0.0004	50.00	—	—	—	—	0.0009
Sunfish																	
Ocean Sunfish	0.0150	7.31	0.0374	18.16	0.0005	0.21	0.0064	3.13	0.0893	42.17	0.0073	3.55	0.0128	6.26	0.0415	19.21	0.2101
Sharptail Sunfish	0.0009	66.67	—	—	—	—	—	—	0.0004	33.33	—	—	—	—	—	—	0.0013
species unknown	0.0009	3.17	0.0060	22.22	—	—	—	—	0.0159	57.14	—	—	0.0034	12.70	0.0014	4.76	0.0276
Remora																	
Remora unid.	—	—	0.0004	1.18	—	—	0.0030	8.24	0.0208	55.29	0.0124	34.12	0.0004	1.18	—	—	0.0370
Unid. Fish																	
species unknown	0.0265	18.13	0.0064	4.39	0.0361	22.81	0.0013	0.88	0.0712	47.08	0.0026	1.75	0.0047	3.22	0.0027	1.75	0.1515
Total	**0.2250**	**12.36**	**0.1698**	**9.28**	**0.0889**	**4.51**	**0.5223**	**28.84**	**0.4372**	**23.24**	**0.2919**	**16.03**	**0.0375**	**2.07**	**0.0704**	**3.67**	**1.8431**

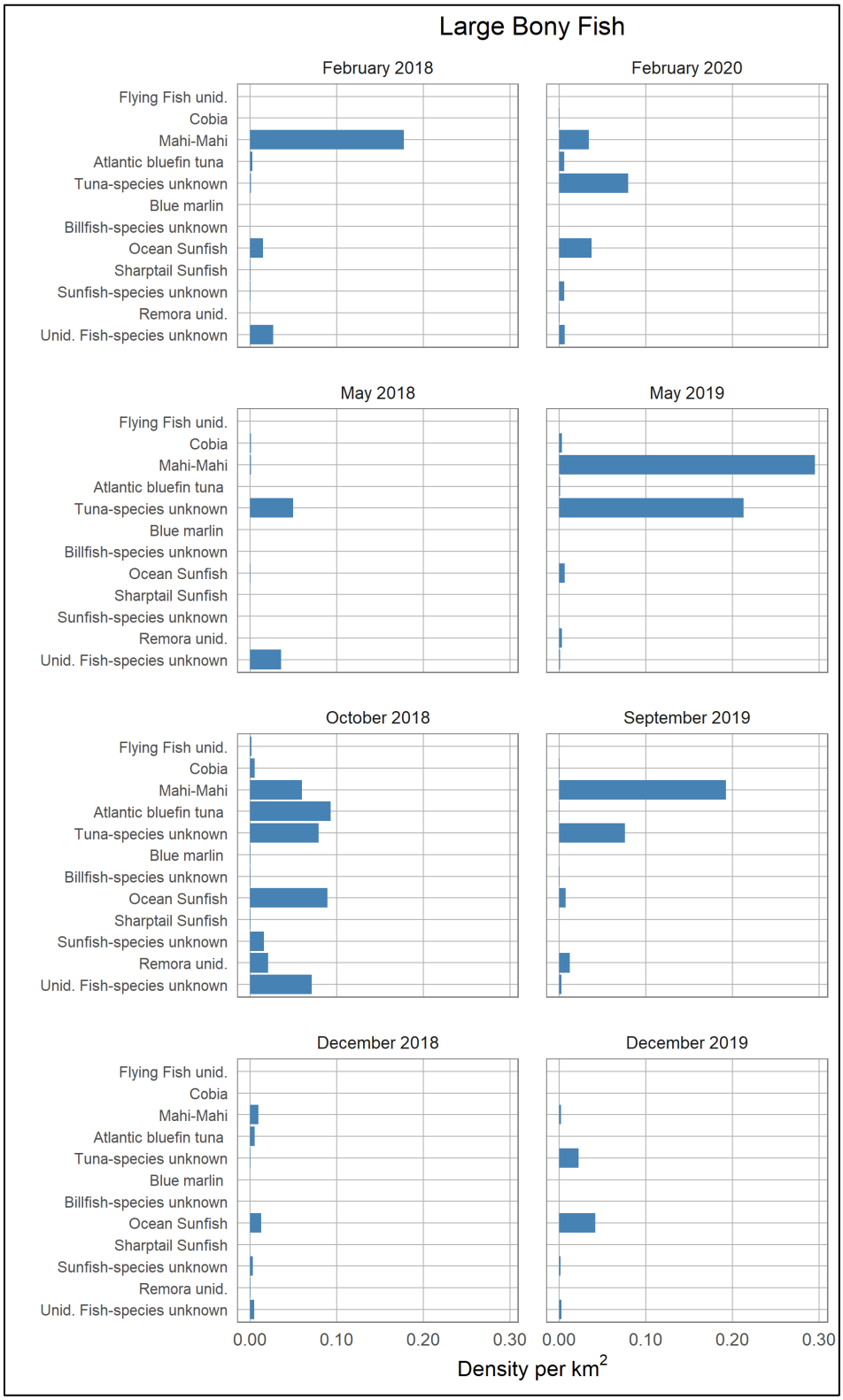

Figure 4–63. Density (per km^2) of large bony fishes encountered during the February 2018 through February 2020 surveys for all areas by survey

4.9.3 Spatial Distribution

The spatial distribution of all large bony fishes encountered during the February 2018 through February 2020 surveys is shown in Figure 4–64 through Figure 4–67. The spatial distribution of individual species is shown in Appendix G.3 Figure G–2 through Figure G–36.

Cobia were observed only in SASA and GSCA (Figure G–2 through Figure G–4). Mahi-mahi were observed throughout SASA with SASA south having the highest densities during February and SASA north having the highest densities in May/June and September/October. During February mahi-mahi occurred in all call areas during at least one period of the year (Figure G–5 through Figure G–8). Atlantic bluefin tuna were most abundant in SASA north during September/October and much more infrequent among other areas (Figure G–9 through Figure G–12). There were too few observations of billfish to understand any spatial trends in the data (Figure G–17 and Figure G–18). Ocean sunfish were most abundant in SASA south and WE in February, SASA north and KH in May/June, September/October, and December. There were too few remora observations to draw any conclusions about spatial trends in the data (Figure G–28 through Figure G–31).

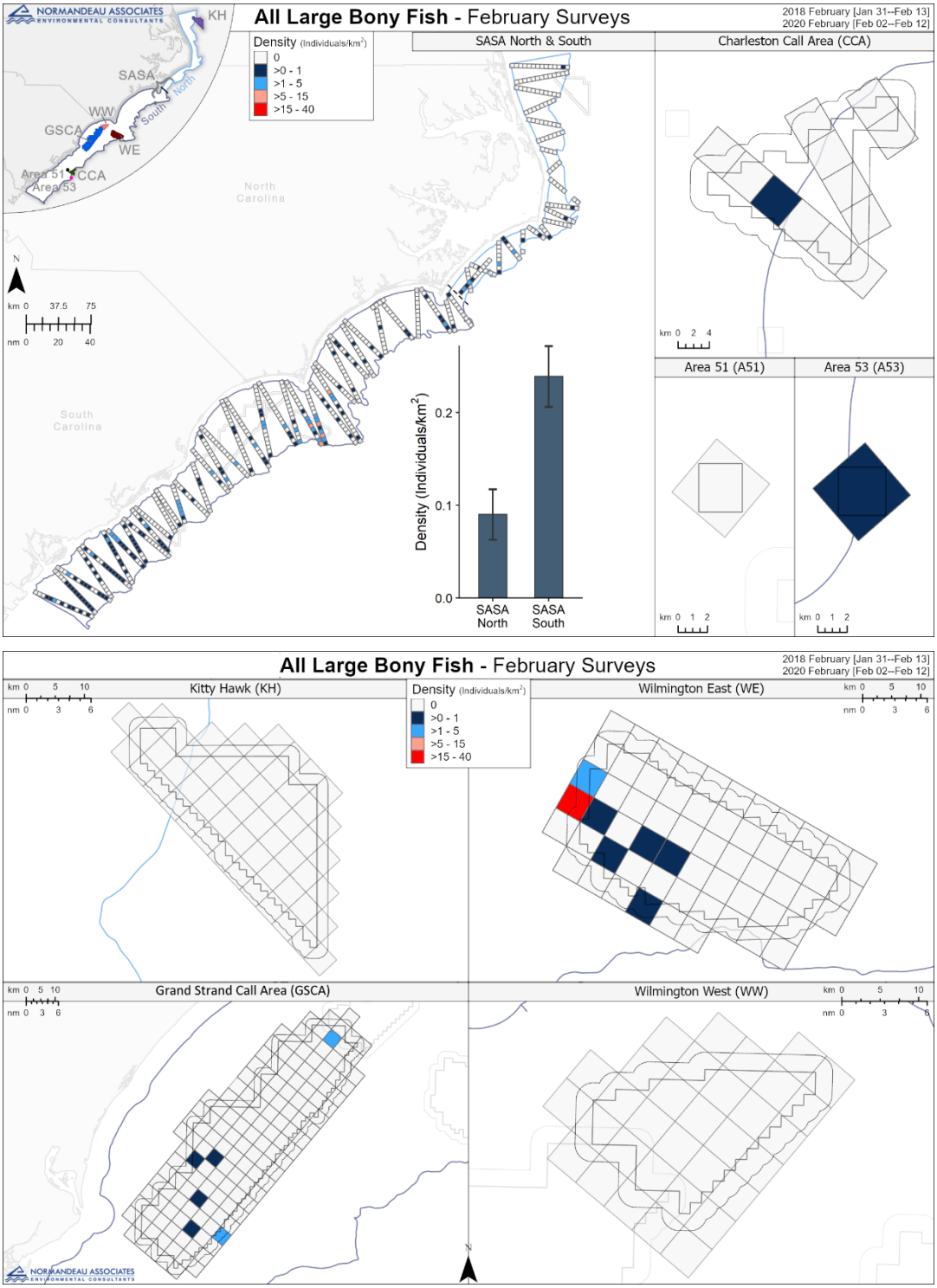

Figure 4–64. Spatial distribution of all large bony fishes during the February surveys for all areas

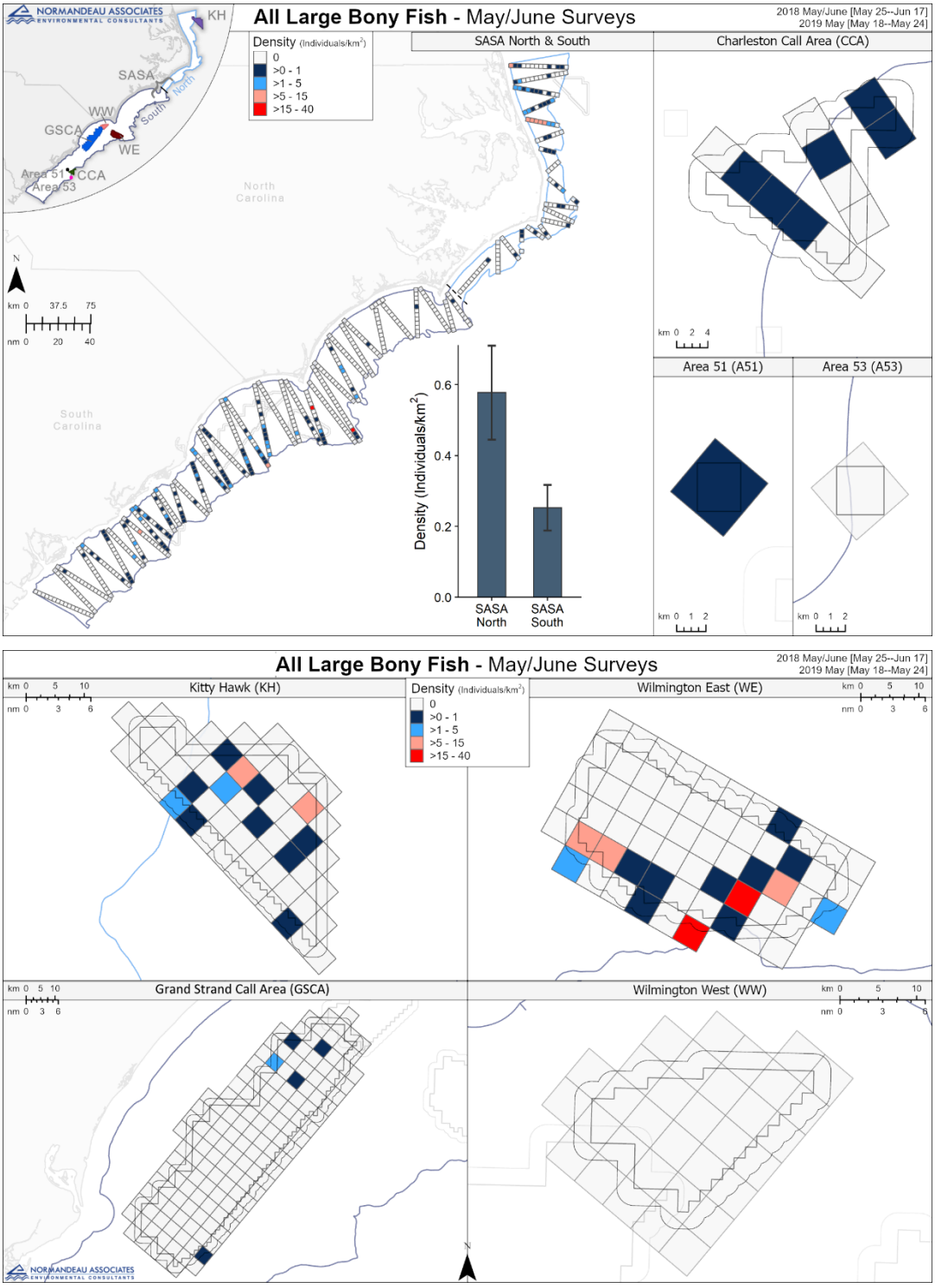

Figure 4–65. Spatial distribution of all large bony fishes during the May/June surveys for all areas

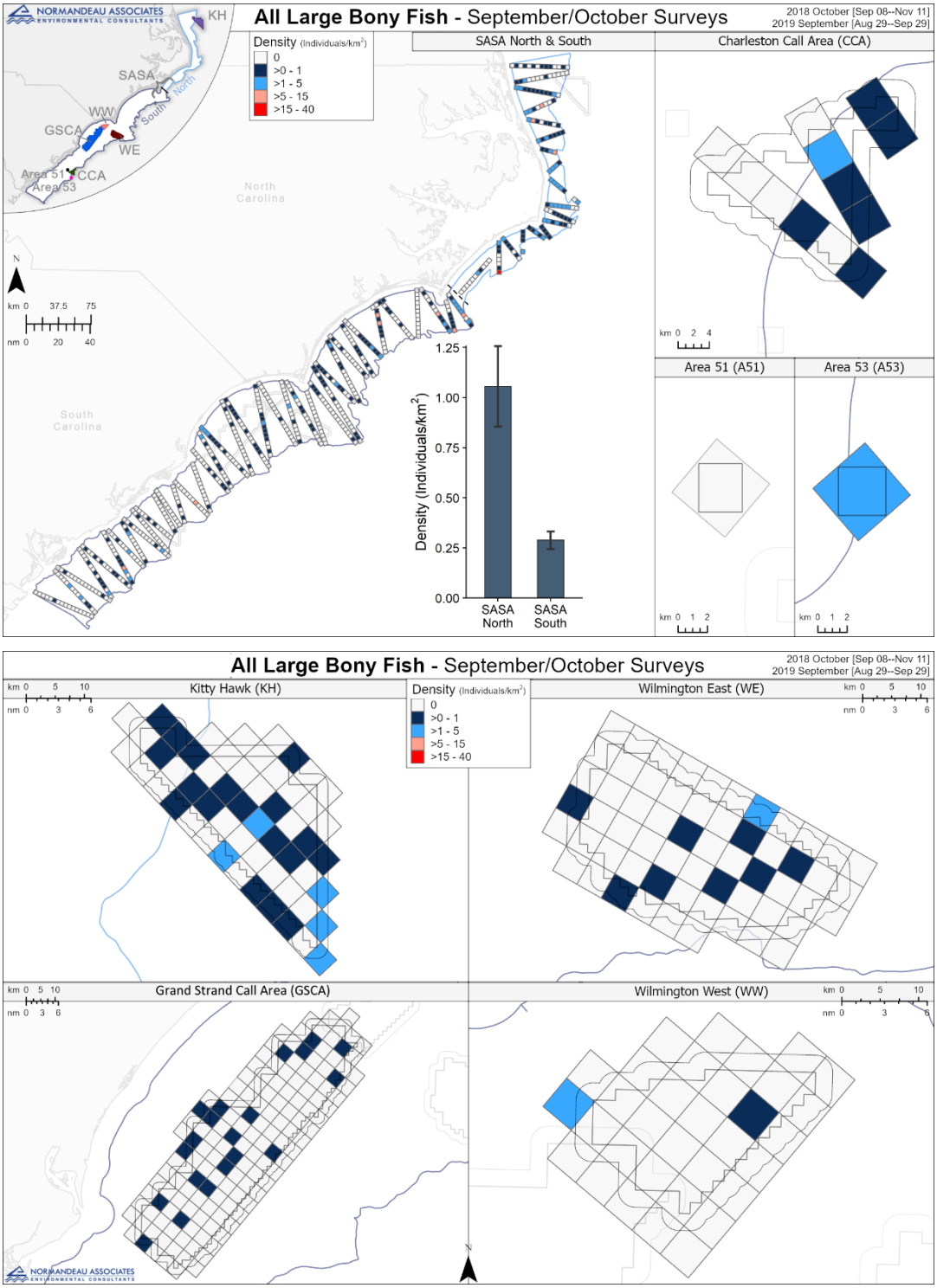

Figure 4–66. Spatial distribution of all large bony fishes during the September/ October surveys for all areas

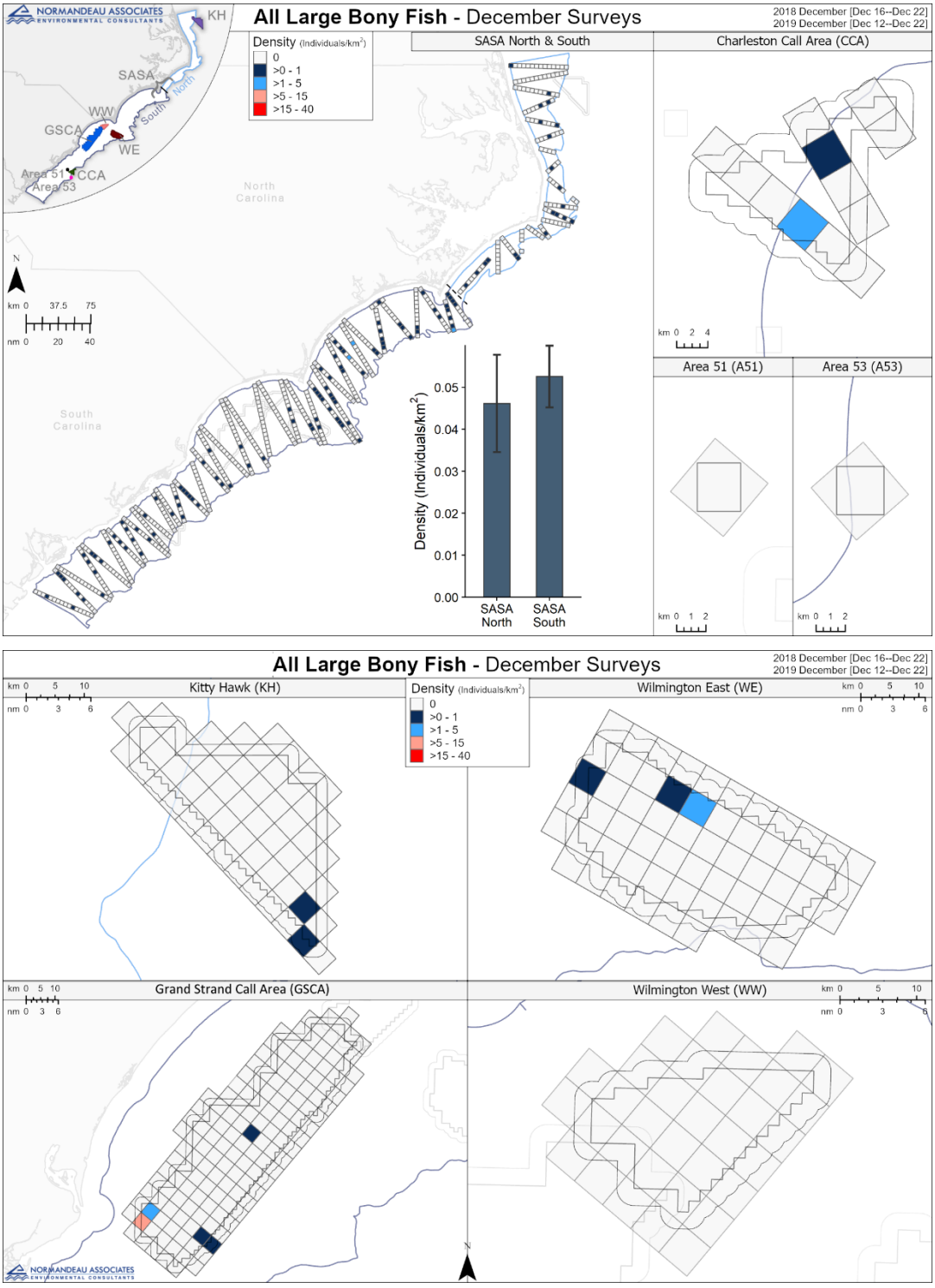

Figure 4–67. Spatial distribution of all large bony fishes during the December surveys for all areas

4.10 Threatened and Endangered Species

4.10.1 Species Identification

The categorization of ESA or State-listed species was conservative, incorporating "*Sterna* tern" (possibly representing roseate tern), "hammerhead (unid.)" (possibly representing scalloped hammerhead), and "turtle species unknown" (possibly representing all endangered turtles). Raw counts of ESA or State-listed species identified in the February 2018 through February 2020 surveys are presented in Appendix H.1 (Table H–1). ESA species identified in imagery for each area by survey are presented in Appendix H.2 (Table H–2 through Table H–9).

There were 3,973 ESA or State-listed species found in the imagery across all areas and surveys (Appendix H.1 Table H–1). Turtles accounted for 77% of the encounters with 3,049 observations (Appendix H.1 Table H–1) with a fairly even distribution over each survey (ranging from n=236 to n=421) except during December 2019 (n=680) when almost double the occurrences were observed (Appendix H.1 Table H–1). Of the 3,049 turtles, 39% (n=1,185) were identified as loggerhead turtles and 22% (n=669) were identified as Kemp's ridley turtles (Appendix H.1 Table H–1). All turtle species identified were observed in all surveys except for 6 green turtles, which were only observed in February 2018 (n=2), February 2019 (n=1), October 2018 (n=1), and December 2019 (n=2) (Appendix H.1 Table H–1).

Eight whales (0.2% of the total ESA species) were observed over all surveys with one north Atlantic right whale observed in February 2018 and seven humpback whales observed over several surveys (Appendix H.1 Table H–1).

Shark species represented 14% (n=540) of the ESA and State-listed species observed in all surveys. This group was dominated by hammerhead (unid.) with 85% (n=457) of the total and were observed in all surveys. Scalloped hammerhead sharks represented 15% (n=81) and were observed in all surveys except February 2019. Whale sharks (>1%; n=2) were only observed in May 2019 and December 2018 (Appendix H.1 Table H–1)

Twenty-four giant manta rays (>1% of the total) were observed with 96% (n=23) of the occurrences during the May/June 2018 (n=5), May 2019 (n=6), October 2018 (2), and September 2019 (n=10) surveys; one giant manta ray was observed in the February 2018 survey (Appendix H.1 Table H–1).

Of the 246 Atlantic bluefin tuna observed (6% of the total), 85% (n=210) were recorded during the October 2018 survey. Other observations included February 2018 (n=7), February 2020 (n=13), May 2019 (n=6), September 2019 (n=1), and December 2018 (n=13). No observations were made during the May/June 2018 or December 2019 surveys (Appendix H.1 Table H–1).

Sterna terns consisted of 3% (n=106) of the observations of listed species, but there were no roseate terns identified to species during the surveys (see Table 4–17). Of the 106 observations, 76% (n=81) were made during the May/June 2018 (n=41) and October 2018 (n=40) surveys. There were no observations during the February 2018, May 2019, or December 2018 surveys (Appendix H.1 Table H–1).

4.10.2 Species Composition and Density

ESA and State-listed species identified in the February 2018 through February 2020 surveys are presented in Table 4–36 and Figure 4–68. The density per km^2 of ESA and State-listed species for each area for each survey is listed in Appendix H.2 (Table H–2 through Table H–9; Figure H–1).

The overall density of ESA and State-listed species was 1.74 individuals/km^2 (Table 4–36, Figure 4–68). Across all areas, 20% (0.35 individuals/km^2) of the observations of listed species occurred during the December 2019 survey with October 2018 being the next highest period representing 17% (0.30 per km^2) of observations (Table 4–36, Figure 4–68). These numbers are mainly driven by the most frequently observed species (identified to species): loggerhead turtle, which consisted of 30% (0.52 per km^2) of the total number of observations of listed species and was observed in all surveys. The highest observations of loggerhead turtles were in May 2019 (18%) and October 2018 (16%) (Table 4–36, Figure 4–68). Kemp's ridley turtle accounted for another 17% (0.29 per km^2) of the total and was also observed in all surveys. Atlantic bluefin tuna represented 6% (0.11 per km^2) of observations of listed species but was not observed during the May/June 2018 or December 2019 surveys (Table 4–36, Figure 4–68). Hammerhead (unid.) sharks comprised 11% (0.20 per km^2) of the total observations of listed species and were observed in each survey (Table 4–36, Figure 4–68).

Table 4–36. Density per km^2 of all ESA and State-listed species observed by survey for all areas

Subtype/Species	Density per km^2																
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Total
***Sterna* Tern**																	
species unknown	—	—	0.0009	1.89	0.0190	38.68	—	—	0.0177	37.74	0.0030	6.60	—	—	0.0072	15.09	0.0478
Whale																	
North Atlantic Right Whale	0.0004	100.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0004
Humpback Whale	0.0004	14.29	0.0009	28.57	—	—	—	—	0.0004	14.29	—	—	0.0004	14.29	0.0009	28.57	0.0031
Turtle																	
Leatherback Turtle	0.0098	30.67	0.0009	2.67	0.0009	2.67	0.0081	25.33	0.0066	20.00	0.0047	14.67	0.0004	1.33	0.0009	2.67	0.0324
Loggerhead Turtle	0.0633	12.49	0.0473	9.28	0.0797	14.51	0.0881	17.47	0.0849	16.20	0.0479	9.45	0.0486	9.62	0.0587	10.97	0.5185
Loggerhead/Kemp's Turtle	0.0171	11.36	0.0232	15.34	0.0111	6.82	0.0302	20.17	0.0199	12.78	0.0146	9.66	0.0098	6.53	0.0275	17.33	0.1535
Green Turtle	0.0009	33.33	0.0004	16.67	—	—	—	—	0.0004	16.67	—	—	—	—	0.0009	33.33	0.0026
Kemp's Ridley Turtle	0.0569	19.88	0.0387	13.45	0.0046	1.49	0.0111	3.89	0.0270	9.12	0.0047	1.64	0.0601	21.08	0.0890	29.45	0.2920
species unknown	0.0141	4.33	0.0413	12.60	0.0153	4.33	0.0417	12.86	0.0354	10.50	0.0291	8.92	0.0281	8.66	0.1300	37.80	0.3350
Shark																	
Whale Shark	—	—	—	—	—	—	0.0004	50.00	—	—	0.0004	50.00	—	—	—	—	0.0009
Scalloped Hammerhead	0.0026	7.41	—	—	0.0028	7.41	0.0153	44.44	0.0031	8.64	0.0013	3.70	0.0009	2.47	0.0095	25.93	0.0354
Hammerhead (unid.)	0.0774	39.61	0.0013	0.66	0.0208	9.85	0.0502	25.82	0.0133	6.56	0.0103	5.25	0.0038	1.97	0.0212	10.28	0.1984
Ray																	
Giant Manta Ray	0.0004	4.17	—	—	0.0023	20.83	0.0026	25.00	0.0009	8.33	0.0043	41.67	—	—	—	—	0.0105
Tuna																	
Atlantic bluefin tuna	0.0030	2.85	0.0056	5.28	—	—	0.0009	0.81	0.0928	85.37	0.0004	0.41	0.0055	5.28	—	—	0.1082
Total	**0.2464**	**14.50**	**0.1603**	**9.39**	**0.1566**	**8.51**	**0.2486**	**14.70**	**0.3024**	**17.22**	**0.1207**	**7.10**	**0.1576**	**9.31**	**0.3459**	**19.28**	**1.7385**

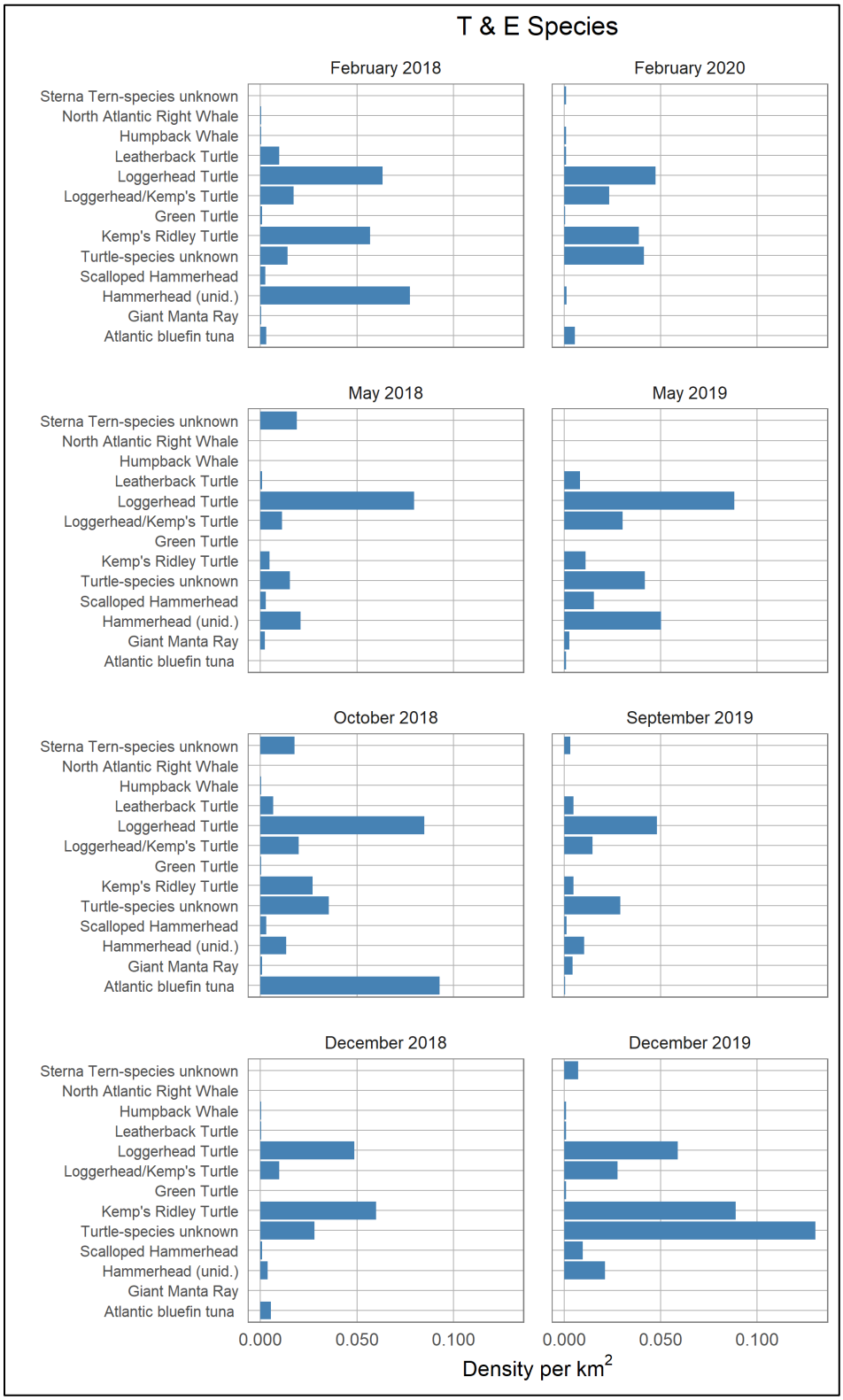

Figure 4–68. Density (per km^2) of threatened and endangered species encountered during the February 2018 through February 2020 surveys for all areas by survey

5 Discussion

Overall, SASA North had increased animal abundance relative to the SASA South; a pattern driven by the reduced width of SASA North (thereby increasing the overall proximity of any region in the area to the coast) as well as the presence of Pamlico Sound, which was associated with increased species activity. Considering all bird species, increased density estimates were observed in SASA North compared to SASA South, a pattern also predicted by Marine-life Data and Analysis Team (MDAT) models (Curtice et al. 2019). Bird density was positively related to the outermost rim of Pamlico Sound, which acts as a natural convergence point for individuals making coastal movements and individuals using Pamlico Sound.

During the February surveys, loon density was greater within SASA North with density hotspots surrounding the outermost rim of Pamlico Sound farther south within the Frying Pan Shoal region, a pattern predicted by MDAT models. Northern gannet exhibited similar patterns of distribution during February surveys having increased density in SASA North.

Phalarope were present within SASA South during the February surveys. During seasons when MDAT model predictions were available, phalarope abundance is predicted to be relatively low throughout the SASA; a prediction in line with survey data results. No winter season MDAT model predictions were available for comparison. These surveys fill this data gap and the data will be used to update MDAT data and create a winter distribution map for this species.

Overall auk abundance was driven by the presence of razorbill. During February surveys, razorbill were prevalent along the outermost rim of Pamlico Sound driving increased density in SASA North relative to South, a pattern that aligns with MDAT model predictions.

Gulls were most abundant during February surveys. The most abundant gull species during February surveys was Bonaparte's gull comprising 89% (n=23,983) of the total (n=26,978). Herring gull were the next most abundant gull species during February surveys with 1,824 observations. During December surveys, gull abundance was driven by herring gull (n=2,722) and Bonaparte's gull (n=1,744).

Winter MDAT model predictions suggest that gull will be distributed south of Pamlico Sound and into the portion of SASA South that stretches into the western portion of Wilmington East Wind Energy Area. The aerial digital data support an increased abundance in the western portion of the Wilmington East Wind Energy Area but suggest distributions in the North are more closely associated with the outer rim of Pamlico Sound rather than the area south of the Sound. Spring MDAT models predict increased gull density north of Pamlico Sound (the northernmost portion of the SASA). We were unable to test this prediction based on the mismatched timing of surveys. In December, black-legged Kittiwake were observed within the northeastern portion of the SASA and within the Kitty Hawk Lease Area; a pattern weakly predicted by the MDAT models.

Royal tern were the most abundant tern species (n=533) followed by black tern (n=427) and were observed most frequently during the September/October surveys. During May/June surveys, tern were more abundant within SASA South but had relatively low overall estimated densities, a pattern weakly predicted by MDAT models. September/October surveys showed similar patterns but with less distinct differences between SASA North and SASA South densities.

Survey data for turtles reflect seasonal movements. December and February survey data suggest turtles are most abundant between Frying Pan Shoal and Pamlico Sound. In May/June density was greatest between the midpoint of Pamlico Sound and the northernmost portion of SASA. During September/October surveys, when abundance was greatest, observations shifted back to the midpoint of

Pamlico Sound suggesting year-round residence but seasonal movements north in the spring through Summer and back south to be more evenly distributed throughout the whole of SASA in winter. This same pattern has been observed in SASA by tagged loggerhead turtles (NROC 2009)

Atlantic spotted dolphin were the most abundant dolphin species, and their distribution aligns with the MDAT data in that they occur throughout SASA across all survey seasons. Bottlenose dolphins were the second most abundant species and align with MDAT predictions of relatively high densities at the outermost rim of Pamlico Sound.

Overall, sharks exhibited patterns of seasonal movement. During December surveys, sharks were associated with Pamlico Sound and then were observed in higher densities at the southern edge of Pamlico Sound during February surveys. During the May/June surveys, sharks were observed in the highest densities within the southernmost portion of SASA and finally back at Pamlico Sound during September/October surveys.

During May/June surveys, rays were observed in relatively high densities in SASA South but extended into SASA North with groups of cownose rays observed with the Kitty Hawk Lease Area. During the September/October surveys, ray density was highest in SASA North suggesting annual movements along the coast.

These eight surveys were the largest and most complex surveys ever performed in the world. Using multiple survey designs coupled with targeted surveys of smaller areas with assumed biological activity, these surveys made it possible to characterize the seasonal spatial and temporal distributions of marine wildlife in federal waters off the coast of North Carolina and South Carolina. Data from these surveys can inform siting decisions at a high level and site level through better understanding of species composition, relative abundance, and animal movements. This information can also be used in developing project-specific environmental documents such as Environmental Assessments and Environmental Impact Statements when the need arises.

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Appendix A: Common and Scientific Names for Taxa Identified in the February 2018 through February 2020 Surveys

List of Tables

Table A–1. List of species found in imagery during February 2018 through February 2020 surveys in taxonomic order for each area.....A-2

Table A–1. List of species found in imagery during February 2018 through February 2020 surveys in taxonomic order for each area

Common Name	Scientific Name	Class	Family	SASA	A51	A53	CCA	KH	WW	WE	GSCA
Gadwall	*Mareca strepera*	Aves	Anatidae	X							
American Black Duck	*Anas rubripes*	Aves	Anatidae	X							
Redhead	*Aythya americana*	Aves	Anatidae	X							
Greater Scaup	*Aythya marila*	Aves	Anatidae	X							
Lesser Scaup	*Aythya affinis*	Aves	Anatidae								X
Surf Scoter	*Melanitta perspicillata*	Aves	Anatidae	X							
White-winged Scoter	*Melanitta fusca*	Aves	Anatidae	X							X
Black Scoter	*Melanitta americana*	Aves	Anatidae	X					X		X
Long-tailed Duck	*Clangula hyemalis*	Aves	Anatidae						X		
Red-breasted Merganser	*Mergus serrator*	Aves	Anatidae	X							
Red-throated Loon	*Gavia stellata*	Aves	Gaviidae	X		X	X	X	X	X	X
Common Loon	*Gavia immer*	Aves	Gaviidae	X	X	X	X	X	X	X	X
Horned Grebe	*Podiceps auritus*	Aves	Podicipedidae	X							
Northern Fulmar	*Fulmarus glacialis*	Aves	Procellariidae	X				X			
Trindade Petrel	*Pterodroma arminjoniana*	Aves	Procellariidae					X			
Black-capped Petrel	*Pterodroma hasitata*	Aves	Procellariidae	X				X		X	
Cory's Shearwater	*Calonectris diomedea*	Aves	Procellariidae	X		X	X	X		X	X
Great Shearwater	*Ardenna gravis*	Aves	Procellariidae	X	X		X	X		X	X
Sooty Shearwater	*Ardenna grisea*	Aves	Procellariidae	X				X			
Manx Shearwater	*Puffinus puffinus*	Aves	Procellariidae	X			X	X	X	X	
Audubon's Shearwater	*Puffinus lherminieri*	Aves	Procellariidae	X		X		X		X	
Northern Gannet	*Morus bassanus*	Aves	Sulidae	X	X	X	X	X	X	X	X
Double-crested Cormorant	*Phalacrocorax auritus*	Aves	Phalacrocoracidae	X							

(continued)

Table A–1. (Continued)

Common Name	Scientific Name	Class	Family	SASA	A51	A53	CCA	KH	WW	WE	GSCA
Brown Pelican	*Pelecanus occidentalis*	Aves	Pelecanidae	X							
American White Pelican	*Pelecanus erythrorhynchos*	Aves	Pelecanidae	X							
Great Blue Heron	*Ardea herodias*	Aves	Ardeidae	X							
Great Egret	*Ardea alba*	Aves	Ardeidae	X							
Snowy Egret	*Egretta thula*	Aves	Ardeidae	X							
Green Heron	*Butorides virescens*	Aves	Ardeidae	X							
Peregrine Falcon	*Falco peregrinus*	Aves	Falconidae	X							
Black-bellied Plover	*Pluvialis squatarola*	Aves	Charadriidae	X							
Ruddy Turnstone	*Arenaria interpres*	Aves	Scolopacidae	X							
Dunlin	*Calidris alpina*	Aves	Scolopacidae	X							
Red-necked Phalarope	*Phalaropus lobatus*	Aves	Scolopacidae	X				X	X	X	X
Red Phalarope	*Phalaropus fulicarius*	Aves	Scolopacidae	X	X	X	X	X	X	X	X
Great Skua	*Stercorarius skua*	Aves	Stercorariidae	X				X			
Pomarine Jaeger	*Stercorarius pomarinus*	Aves	Stercorariidae	X							X
Parasitic Jaeger	*Stercorarius parasiticus*	Aves	Stercorariidae	X							X
Long-tailed Jaeger	*Stercorarius longicaudus*	Aves	Stercorariidae	X							
Dovekie	*Alle alle*	Aves	Alcidae	X			X				X
Razorbill	*Alca torda*	Aves	Alcidae	X				X	X	X	X
Atlantic Puffin	*Fratercula arctica*	Aves	Alcidae	X				X			
Black-legged Kittiwake	*Rissa tridactyla*	Aves	Laridae	X				X	X		X
Bonaparte's Gull	*Chroicocephalus philadelphia*	Aves	Laridae	X	X	X	X	X	X	X	X
Little Gull	*Hydrocoloeus minutus*	Aves	Laridae	X							
Laughing Gull	*Leucophaeus atricilla*	Aves	Laridae	X				X	X	X	X
Ring-billed Gull	*Larus delawarensis*	Aves	Laridae	X				X		X	X
Herring Gull	*Larus argentatus*	Aves	Laridae	X	X			X	X	X	X
Iceland Gull	*Larus glaucoides*	Aves	Laridae	X							
Lesser Black-backed Gull	*Larus fuscus*	Aves	Laridae	X			X	X		X	X

(continued)

Table A–1. (Continued)

Common Name	Scientific Name	Class	Family	SASA	A51	A53	CCA	KH	WW	WE	GSCA
Glaucous Gull	*Larus hyperboreus*	Aves	Laridae	X							
Great Black-backed Gull	*Larus marinus*	Aves	Laridae	X				X	X		X
Sooty Tern	*Onychoprion fuscatus*	Aves	Laridae	X			X			X	
Bridled Tern	*Onychoprion anaethetus*	Aves	Laridae	X		X				X	X
Sooty/Bridled Tern	*Onychoprion unid.*	Aves	Laridae	X				X		X	
Least Tern	*Sternula antillarum*	Aves	Laridae	X							
Gull-billed Tern	*Gelochelidon nilotica*	Aves	Laridae	X						X	
Caspian Tern	*Hydroprogne caspia*	Aves	Laridae	X							X
Black Tern	*Chlidonias niger*	Aves	Laridae	X			X	X		X	
Royal Tern	*Thalasseus maximus*	Aves	Laridae	X			X		X	X	X
Sandwich Tern	*Thalasseus sandvicensis*	Aves	Laridae	X			X		X		X
Thalasseus Tern unid.		Aves	Laridae	X					X		X
Common Tern	*Sterna hirundo*	Aves	Laridae	X		X	X			X	X
Forster's Tern	*Sterna forsteri*	Aves	Laridae	X					X	X	X
North Atlantic Right Whale	*Eubalaena glacialis*	Mammalia	Balaenidae					X			
Common Minke Whale	*Balaenoptera acutorostrata*	Mammalia	Balaenopteridae					X			
Humpback Whale	*Megaptera novaeangliae*	Mammalia	Balaenopteridae	X							X
Common Dolphin	*Delphinus delphis*	Mammalia	Delphinidae	X				X			
Risso's Dolphin	*Grampus griseus*	Mammalia	Delphinidae	X				X			
Atlantic White-sided Dolphin	*Lagenorhynchus acutus*	Mammalia	Delphinidae	X							
Rough-toothed dolphin	*Steno bredanensis*	Mammalia	Delphinidae	X							
Atlantic Spotted Dolphin	*Stenella frontalis*	Mammalia	Delphinidae	X			X	X	X	X	X
Clymene Dolphin	*Stenella clymene*	Mammalia	Delphinidae	X							
Pantropical Spotted Dolphin	*Stenella attenuata*	Mammalia	Delphinidae	X							
Bottlenose Dolphin	*Tursiops truncatus*	Mammalia	Delphinidae	X			X		X	X	X
Harbor Porpoise	*Phocoena phocoena*	Mammalia	Phocoenidae	X			X				
Leatherback Turtle	*Dermochelys coriacea*	Reptilia	Dermochelyidae	X		X		X		X	X

(continued)

Table A–1. (Continued)

Common Name	Scientific Name	Class	Family	SASA	A51	A53	CCA	KH	WW	WE	GSCA
Loggerhead Turtle	*Caretta caretta*	Reptilia	Cheloniidae	X	X	X	X	X	X	X	X
Green Turtle	*Chelonia mydas*	Reptilia	Cheloniidae	X							
Kemp's Ridley Turtle	*Lepidochelys kempii*	Reptilia	Cheloniidae	X	X		X	X		X	X
Whale Shark	*Rhincodon typus*	Chondrichthyes	Rhincodontidae	X							
Thresher Shark	*Alopias vulpinus*	Chondrichthyes	Alopiidae	X							
Basking Shark	*Cetorhinus maximus*	Chondrichthyes	Cetorhinidae	X							
White Shark	*Carcharodon carcharias*	Chondrichthyes	Lamnidae	X				X		X	X
Blacktip Shark	*Carcharhinus limbatus*	Chondrichthyes	Carcharhinidae	X							
Blue Shark	*Prionace glauca*	Chondrichthyes	Carcharhinidae	X				X			
Dusky Shark	*Carcharhinus obscurus*	Chondrichthyes	Carcharhinidae								X
Silky Shark	*Carcharhinus falciformis*	Chondrichthyes	Carcharhinidae	X							
Tiger Shark	*Galeocerdo cuvier*	Chondrichthyes	Carcharhinidae	X							
Bonnethead Shark	*Sphyrna tiburo*	Chondrichthyes	Sphyrnidae	X							
Great Hammerhead	*Sphyrna mokarran*	Chondrichthyes	Sphyrnidae	X							X
Smooth Hammerhead	*Sphyrna zygaena*	Chondrichthyes	Sphyrnidae	X	X				X		X
Scalloped Hammerhead	*Sphyrna lewini*	Chondrichthyes	Sphyrnidae	X			X		X	X	X
Spurdog	*Squalus* sp.	Chondrichthyes	Squalidae	X	X	X	X	X	X	X	X
Atlantic Stingray	*Dasyatis sabina*	Chondrichthyes	Dasyatidae	X							
Giant Manta Ray	*Manta birostris*	Chondrichthyes	Mobulidae	X							X
Giant Devil Ray	*Mobula mobula*	Chondrichthyes	Mobulidae	X			X				X
Chilean Devil Ray	*Mobula tarapacana*	Chondrichthyes	Mobulidae	X				X			X
Atlantic Devil Ray	*Mobula hypostoma*	Chondrichthyes	Mobulidae					X			
Spotted Eagle Ray	*Aetobatus narinari*	Chondrichthyes	Myliobatidae	X					X		
Bullnose Ray	*Myliobatis freminvillii*	Chondrichthyes	Myliobatidae	X							
Cownose Ray	*Rhinoptera bonasus*	Chondrichthyes	Rhinopteridae	X				X		X	X
Cobia	*Rachycentron canadum*	Actinopterygii	Rachycentridae	X							X
Mahi-Mahi	*Coryphaena hippurus*	Actinopterygii	Coryphaenidae	X	X	X	X	X	X	X	X

(continued)

Table A–1. (Continued)

Common Name	Scientific Name	Class	Family	SASA	A51	A53	CCA	KH	WW	WE	GSCA
Atlantic bluefin tuna	*Thunnus thynnus*	Actinopterygii	Scombridae	X				X			
Blue marlin	*Makaira nigricans*	Actinopterygii	Istiophoridae	X							
Ocean Sunfish	*Mola Mola*	Actinopterygii	Molidae	X		X		X		X	X
Sharptail Sunfish	*Masturus lanceolatus*	Actinopterygii	Molidae	X							
Remora unid.	*Echeneidae*	Actinopterygii	Echeneidae	X			X				X

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B.1 Animals Found During the Quality Control Process in Each Area

Table B–1. Number of individuals within reported taxonomic groups found during the QC process for each area for each survey

Survey	Taxonomic Group						Total
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)							
2018 February	80	3	3	8	—	1	95
2020 February	51	1	4	1	2	2	61
2018 May/June	8	1	10	14	13	4	50
2019 May	5	3	2	16	4	24	54
2018 October	12	—	7	2	6	25	52
2019 September	19	—	3	7	1	52	82
2018 December	106	7	18	—	3	5	139
2019 December	64	3	7	1	3	7	85
Totals	**345**	**18**	**54**	**49**	**32**	**120**	**618**
A51 (34%)							
2018 February	—	—	—	—	—	—	—
2020 February	—	—	—	—	—	—	—
2018 May/June	—	—	—	—	—	—	—
2019 May	—	—	—	—	—	—	—
2018 October	—	—	—	—	—	—	—
2019 September	—	—	—	—	—	—	—
2018 December	—	—	—	—	—	—	—
2019 December	—	—	—	—	—	—	—
Totals	**—**	**—**	**—**	**—**	**—**	**—**	**—**
A53 (34%)							
2018 February	—	—	—	—	—	1	1
2020 February	—	—	—	—	—	—	—
2018 May/June	—	—	—	—	—	—	—
2019 May	—	—	—	—	—	—	—
2018 October	—	—	—	—	—	—	—
2019 September	—	—	—	—	—	—	—
2018 December	—	—	—	—	—	—	—
2019 December	—	—	—	—	—	—	—
Totals	**—**	**—**	**—**	**—**	**—**	**1**	**1**

(continued)

Table B–1. (Continued)

Survey	Taxonomic Group						Total
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
CCA (11%)							
2018 February	2	—	—	—	—	—	2
2020 February	2	—	—	—	—	—	2
2018 May/June	—	—	—	—	—	—	—
2019 May	—	—	—	—	—	—	—
2018 October	—	—	—	—	—	—	—
2019 September	1	—	—	—	—	1	2
2018 December	—	—	—	—	—	1	1
2019 December	—	—	—	—	—	—	—
Totals	**5**	**—**	**—**	**—**	**—**	**2**	**7**
TOTAL TRANSECT							
2018 February	82	3	3	8	—	2	98
2020 February	52	1	4	1	2	2	62
2018 May/June	8	1	10	14	13	4	50
2019 May	5	3	2	16	4	24	54
2018 October	12	—	7	2	6	25	52
2019 September	20	—	3	7	1	52	83
2018 December	106	7	18	—	3	6	140
2019 December	64	3	7	1	3	7	85
Totals	**349**	**18**	**54**	**49**	**32**	**122**	**624**
GRID (≈10%)							
KH							
2018 February	3	—	—	—	—	—	3
2020 February	—	—	—	—	—	—	—
2018 May/June	—	—	5	2	—	1	8
2019 May	1	—	2	—	—	2	5
2018 October	—	—	—	—	—	—	—
2019 September	—	—	—	—	—	—	—
2018 December	16	—	—	—	—	1	17
2019 December	2	—	—	—	—	—	2
Totals	**22**	**—**	**7**	**2**	**—**	**4**	**35**
WW							
2018 February	3	1	—	—	—	—	4
2020 February	2	—	—	—	—	1	3
2018 May/June	—	—	—	—	—	—	—
2019 May	—	—	—	1	—	—	1
2018 October	—	—	—	1	—	—	1
2019 September	—	—	—	—	—	—	—
2018 December	1	—	—	—	—	—	1
2019 December	—	—	—	—	—	—	—
Totals	**6**	**1**	**—**	**2**	**—**	**1**	**10**

(continued)

Table B–1. (Continued)

Survey	Taxonomic Group						Total
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
WE							
2018 February	—	—	—	—	—	—	—
2020 February	—	—	—	—	1	—	1
2018 May/June	—	—	—	1	—	—	1
2019 May	—	—	—	—	—	—	—
2018 October	1	—	—	—	—	—	1
2019 September	—	—	—	—	—	1	1
2018 December	11	—	1	—	—	—	12
2019 December	4	—	—	—	—	—	4
Totals	**16**	**—**	**1**	**1**	**1**	**1**	**20**
GSCA							
2018 February	5	—	—	—	—	—	5
2020 February	7	—	—	—	—	—	7
2018 May/June	—	—	—	—	—	—	—
2019 May	2	1	—	—	2	3	8
2018 October	4	—	4	—	7	2	17
2019 September	—	1	—	2	—	6	9
2018 December	24	—	2	—	—	—	26
2019 December	5	—	6	—	—	1	12
Totals	**47**	**2**	**12**	**2**	**9**	**12**	**84**
TOTAL GRID							
2018 February	10	1	—	—	—	—	11
2020 February	9	—	—	—	1	1	11
2018 May/June	—	—	5	3	—	1	9
2019 May	3	1	2	1	2	5	14
2018 October	5	—	4	1	7	2	19
2019 September	—	1	—	2	—	7	10
2018 December	51	—	3	—	—	1	55
2019 December	11	—	6	—	—	1	18
Totals	**89**	**3**	**20**	**7**	**10**	**18**	**147**
TOTAL SURVEY AREA							
2018 February	92	4	3	8	—	2	109
2020 February	61	1	4	1	3	3	73
2018 May/June	8	1	15	17	13	5	59
2019 May	8	4	4	17	6	29	68
2018 October	17	—	11	3	13	27	71
2019 September	20	1	3	9	1	59	93
2018 December	157	7	21	—	3	7	195
2019 December	75	3	13	1	3	8	103
Totals	**438**	**21**	**74**	**56**	**42**	**140**	**771**

B.2 Animals Found During Image Review in Each Area

Table B–2. Number of individuals within taxonomic groups found during image review and sent for identification by survey area and survey type for each survey

Survey	Taxonomic Group						Total
	Avian	Marine Mammals	Turtles	Sharks	Rays	Large Bony Fish	
TRANSECT SURVEYS (Coverage Varies)							
SASA (6%)							
Feb 2018	56,538	456	343	278	3	509	**58,127**
Feb 2020	36,525	899	309	36	4	312	**38,085**
May/Jun 2018	252	87	189	598	499	144	**1,769**
May 2019	694	360	317	958	14,480	1,008	**17,817**
Oct 2018	1,562	323	356	247	812	951	**4,251**
Sep 2019	1,999	482	186	262	3,527	586	**7,042**
Dec 2018	12,566	583	326	40	603	85	**14,203**
Dec 2019	9,558	501	591	259	141	130	**11,180**
Total	**119,694**	**3,691**	**2,617**	**2,678**	**20,069**	**3,725**	**152,474**
A51 (34%)							
Feb 2018	3	—	1	—	—	—	**4**
Feb 2020	—	—	—	—	—	—	**—**
May/Jun 2018	—	—	1	—	—	—	**1**
May 2019	—	—	—	3	—	3	**6**
Oct 2018	—	—	—	—	—	—	**—**
Sep 2019	2	—	1	—	—	—	**3**
Dec 2018	5	—	—	—	—	—	**5**
Dec 2019	3	—	—	1	—	—	**4**
Total	**13**	**—**	**3**	**4**	**—**	**3**	**23**
A53 (34%)							
Feb 2018	453	—	1	—	—	3	**457**
Feb 2020	22	—	1	1	—	—	**24**
May/Jun 2018	—	—	—	—	—	—	**—**
May 2019	—	—	—	—	—	—	**—**
Oct 2018	—	—	2	—	—	—	**2**
Sep 2019	43	—	—	5	—	6	**54**
Dec 2018	2	—	—	1	—	—	**3**
Dec 2019	2	—	1	—	—	—	**3**
Total	**522**	**—**	**5**	**7**	**—**	**9**	**543**

(continued)

Table B–2. (Continued)

Survey	Taxonomic Group						Total
	Avian	Marine Mammals	Turtles	Sharks	Rays	Large Bony Fish	
CCA (11%)							
Feb 2018	303	—	4	—	—	—	**307**
Feb 2020	787	—	6	—	—	1	**794**
May/Jun 2018	1	—	1	3	—	—	**5**
May 2019	5	21	3	3	1	11	**44**
Oct 2018	6	—	—	—	—	—	**6**
Sep 2019	86	7	3	4	—	19	**119**
Dec 2018	13	1	4	—	—	1	**19**
Dec 2019	147	7	2	—	—	6	**162**
Total	**1,348**	**36**	**23**	**10**	**1**	**38**	**1,456**
TOTAL TRANSECT							
Feb 2018	56,940	456	346	278	3	512	58,535
Feb 2020	37,172	899	312	37	4	312	38,736
May/Jun 2018	253	87	189	598	499	144	1,770
May 2019	696	370	319	960	14,480	1,015	17,840
Oct 2018	1,565	323	356	247	812	951	4,254
Sep 2019	2,110	489	188	271	3,527	610	7,195
Dec 2018	12,572	583	330	41	603	86	14,215
Dec 2019	9,622	508	594	260	141	136	11,261
Total	**120,930**	**3,715**	**2,634**	**2,692**	**20,069**	**3,766**	**153,806**
GRID SURVEYS (≈10%)							
KH							
Feb 2018	148	15	3	—	—	—	**166**
Feb 2020	268	92	1	32	—	—	**393**
May/Jun 2018	—	—	43	—	3,292	1	**3,336**
May 2019	9	—	86	5	1	78	**179**
Oct 2018	4	2	19	4	—	19	**48**
Sep 2019	7	16	34	10	2	42	**111**
Dec 2018	3,368	56	3	—	—	—	**3,427**
Dec 2019	179	4	4	—	—	2	**189**
Total	**3,983**	**185**	**193**	**51**	**3,295**	**142**	**7,849**
WW							
Feb 2018	633	—	—	—	—	—	**633**
Feb 2020	2,672	19	2	—	—	—	**2,693**
May/Jun 2018	—	2	—	—	—	—	**2**
May 2019	24	—	2	18	2	—	**46**
Oct 2018	8	1	2	1	—	1	**13**
Sep 2019	21	—	1	7	1	3	**33**
Dec 2018	393	11	—	—	—	—	**404**
Dec 2019	774	18	1	—	—	—	**793**
Total	**4,525**	**51**	**8**	**26**	**3**	**4**	**4,617**

(continued)

Table B–2. (Continued)

Survey	Taxonomic Group						Total
	Avian	Marine Mammals	Turtles	Sharks	Rays	Large Bony Fish	
WE							
Feb 2018	1,734	8	25	—	—	3	**1,770**
Feb 2020	6,554	6	9	29	4	71	**6,673**
May/Jun 2018	—	13	4	9	—	46	**72**
May 2019	7	8	2	55	—	125	**197**
Oct 2018	18	11	4	2	—	13	**48**
Sep 2019	144	23	2	17	2	5	**193**
Dec 2018	265	4	6	—	—	—	**275**
Dec 2019	1,214	5	25	9	—	6	**1,259**
Total	**9,936**	**78**	**77**	**121**	**6**	**269**	**10,487**
GSCA							
Feb 2018	2,130	22	5	—	—	11	**2,168**
Feb 2020	2,510	48	29	3	—	12	**2,602**
May/Jun 2018	4	2	5	1	4	1	**17**
May 2019	43	8	13	84	3	9	**160**
Oct 2018	586	21	13	15	—	5	**640**
Sep 2019	73	36	11	46	—	22	**188**
Dec 2018	1,087	14	6	—	—	2	**1,109**
Dec 2019	2,682	12	56	2	—	12	**2,764**
Total	**9,115**	**163**	**138**	**151**	**7**	**74**	**9,648**
TOTAL GRID							
Feb 2018	4,626	45	33	—	—	14	**4,718**
Feb 2020	11,833	165	41	64	4	83	**12,190**
May/Jun 2018	4	17	52	10	3,296	48	**3,427**
May 2019	59	16	102	155	6	212	**550**
Oct 2018	616	35	38	22	—	38	**749**
Sep 2019	242	75	48	80	5	72	**522**
Dec 2018	5,067	84	15	—	—	2	**5,168**
Dec 2019	4,697	39	86	11	—	20	**4,853**
Total	**27,144**	**476**	**415**	**342**	**3,311**	**489**	**32,177**

B.3 Identification Success of Animals within Taxonomic Groups for Each Area and Survey

Table B–3. Number of individuals within each taxonomic order, number of individuals QC'd, and percent agreement for the February 2018 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	56,538	12,175	100	3	1	100	453	61	100	303	43	100
Marine Mammals	456	100	100	—	—	—	—	—	—	—	—	—
Turtles	343	343	100	1	1	100	1	1	100	4	4	100
Sharks	278	55	98	—	—	—	—	—	—	—	—	—
Rays	3	1	100	—	—	—	—	—	—	—	—	—
Large Bony Fish	509	3	100	—	—	—	3	—	—	—	—	—
Total	**58,127**	**12,677**	**100**	**4**	**2**	**100**	**457**	**62**	**100**	**307**	**47**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	148	—	—	633	12	100	1,734	30	100	2,130	42	100
Marine Mammals	15	1	100	—	—	—	8	—	—	22	—	—
Turtles	3	3	100	—	—	—	25	25	100	5	5	100
Sharks	—	—	—	—	—	—	—	—	—	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	3	—	—	11	—	—
Total	**166**	**4**	**100**	**633**	**12**	**100**	**1,770**	**55**	**100**	**2,168**	**47**	**100**

Table B–4. Number of individuals within each taxonomic order, number of individuals QC'd, and percent agreement for the February 2020 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	36,525	9,147	100	—	—	—	22	2	100	787	78	100
Marine Mammals	899	210	100	—	—	—	—	—	—	—	—	—
Turtles	309	309	100	—	—	—	1	1	100	6	6	83
Sharks	36	13	100	—	—	—	1	1	100	—	—	—
Rays	4	1	100	—	—	—	—	—	—	—	—	—
Large Bony Fish	312	14	100	—	—	—	—	—	—	1	—	—
Total	**38,085**	**9,694**	**100**	**—**	**—**	**—**	**24**	**4**	**100**	**794**	**84**	**99**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	268	17	100	2,672	166	99	6,554	386	100	2,510	33	100
Marine Mammals	92	3	100	19	—	—	6	—	—	48	—	—
Turtles	1	1	100	2	2	100	9	9	100	29	29	100
Sharks	32	4	100	—	—	—	29	3	100	3	—	—
Rays	—	—	—	—	—	—	4	1	100	—	—	—
Large Bony Fish	—	—	—	—	—	—	71	—	—	12	—	—
Total	**393**	**25**	**100**	**2,693**	**168**	**99**	**6,673**	**399**	**100**	**2,602**	**62**	**100**

Table B–5. Number of individuals within each taxonomic order, number of individuals QC'd, and percent agreement for the May/June 2018 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	252	51	100	—	—	—	—	—	—	1	1	100
Marine Mammals	87	19	100	—	—	—	—	—	—	—	—	—
Turtles	189	189	100	1	1	100	—	—	—	1	1	100
Sharks	598	157	99	—	—	—	—	—	—	3	1	100
Rays	499	178	99	—	—	—	—	—	—	—	—	—
Large Bony Fish	144	—	—	—	—	—	—	—	—	—	—	—
Total	**1,769**	**594**	**99**	**1**	**1**	**100**	**—**	**—**	**—**	**5**	**3**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	4	1	100
Marine Mammals	—	—	—	2	—	—	13	1	100	2	1	100
Turtles	43	43	98	—	—	—	4	4	100	5	5	100
Sharks	—	—	—	—	—	—	9	7	100	1	—	—
Rays	3,292	580	100	—	—	—	—	—	—	4	2	100
Large Bony Fish	1	—	—	—	—	—	46	—	—	1	—	—
Total	**3,336**	**623**	**100**	**2**	**—**	**—**	**72**	**12**	**100**	**17**	**9**	**100**

Table B–6. Number of individuals within each taxonomic order, number of individuals QC'd, and percent agreement for the May 2019 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	694	150	99	—	—	—	—	—	—	5	1	100
Marine Mammals	360	78	100	—	—	—	—	—	—	21	2	100
Turtles	317	317	100	—	—	—	—	—	—	3	3	100
Sharks	958	312	100	3	1	100	—	—	—	3	2	100
Rays	14,480	2,904	100	—	—	—	—	—	—	1	—	—
Large Bony Fish	1,008	11	100	3	—	—	—	—	—	11	—	—
Total	**17,817**	**3,772**	**100**	**6**	**1**	**100**	**—**	**—**	**—**	**44**	**8**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	9	—	—	24	1	100	7	—	—	43	2	100
Marine Mammals	—	—	—	—	—	—	8	—	—	8	—	—
Turtles	86	86	100	2	2	100	2	2	100	13	13	100
Sharks	5	4	100	18	2	100	55	7	100	84	12	100
Rays	1	—	—	2	—	—	—	—	—	3	—	—
Large Bony Fish	78	—	—	—	—	—	125	—	—	9	—	—
Total	**179**	**90**	**100**	**46**	**5**	**100**	**197**	**9**	**100**	**160**	**27**	**100**

Table B–7. Number of individuals within each taxonomic order, number of individuals QC'd, and percent agreement for the October 2018 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	1,562	554	85	—	—	—	—	—	—	6	2	100
Marine Mammals	323	71	100	—	—	—	—	—	—	—	—	—
Turtles	356	356	100	—	—	—	2	2	100	—	—	—
Sharks	247	75	100	—	—	—	—	—	—	—	—	—
Rays	813	165	100	—	—	—	—	—	—	—	—	—
Large Bony Fish	950	210	100	—	—	—	—	—	—	—	—	—
Total	**4,251**	**1,431**	**94**	**—**	**—**	**—**	**2**	**2**	**100**	**6**	**2**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	4	—	—	8	4	75	18	5	100	586	479	86
Marine Mammals	2	—	—	1	—	—	11	—	—	21	1	100
Turtles	19	19	100	2	2	100	4	4	100	13	13	100
Sharks	4	2	100	1	1	100	2	1	100	15	1	100
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	19	1	100	1	—	—	13	—	—	5	—	—
Total	**48**	**22**	**100**	**13**	**7**	**86**	**48**	**10**	**100**	**640**	**494**	**87**

Table B–8. Number of individuals within each taxonomic order, number of individuals QC'd, and percent agreement for the September 2019 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	1,999	464	97	2	—	—	43	2	100	86	—	—
Marine Mammals	482	111	99	—	—	—	—	—	—	7	—	—
Turtles	186	186	99	1	1	100	—	—	—	3	3	100
Sharks	262	74	100	—	—	—	5	—	—	4	3	100
Rays	3,527	715	100	—	—	—	—	—	—	—	—	—
Large Bony Fish	586	1	100	—	—	—	6	—	—	19	—	—
Total	**7,042**	**1,551**	**99**	**3**	**1**	**100**	**54**	**2**	**100**	**119**	**6**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	7	—	—	21	—	—	144	4	100	73	1	100
Marine Mammals	16	—	—	—	—	—	23	2	100	36	—	—
Turtles	34	34	100	1	1	100	2	2	100	11	11	100
Sharks	10	2	100	7	3	100	17	1	100	46	6	100
Rays	2	—	—	1	—	—	2	—	—	—	—	—
Large Bony Fish	42	—	—	3	—	—	5	—	—	22	—	—
Total	**111**	**36**	**100**	**33**	**4**	**100**	**193**	**9**	**100**	**188**	**18**	**100**

Table B–9. Number of individuals within each taxonomic order, number of individuals QC'd, and percent agreement for the December 2018 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	12,566	2,966	99	5	3	100	2	1	100	13	8	100
Marine Mammals	583	126	100	—	—	—	—	—	—	1	—	—
Turtles	326	326	100	—	—	—	—	—	—	4	4	100
Sharks	40	16	100	—	—	—	1	1	100	—	—	—
Rays	603	121	100	—	—	—	—	—	—	—	—	—
Large Bony Fish	85	13	100	—	—	—	—	—	—	1	—	—
Total	**14,203**	**3,568**	**99**	**5**	**3**	**100**	**3**	**2**	**100**	**19**	**12**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	3,368	317	99	393	31	100	265	23	100	1,087	191	100
Marine Mammals	56	7	100	11	—	—	4	—	—	14	1	100
Turtles	3	3	100	—	—	—	6	6	100	6	6	100
Sharks	—	—	—	—	—	—	—	—	—	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	2	—	—
Total	**3,427**	**327**	**99**	**404**	**31**	**100**	**275**	**29**	**100**	**1,109**	**198**	**100**

Table B–10. Number of individuals within each taxonomic order, number of individuals QC'd, and percent agreement for the December 2019 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	9,558	2,456	98	3	2	100	2	0	—	147	15	100
Marine Mammals	501	106	100	0	0	—	0	0	—	7	1	100
Turtles	591	591	100	0	0	—	1	1	100	2	2	100
Sharks	259	102	100	1	0	—	0	0	—	0	0	—
Rays	141	28	100	0	0	—	0	0	—	0	0	—
Large Bony Fish	130	0	—	0	0	—	0	0	—	6	0	—
Total	**11,180**	**3,283**	**99**	**4**	**2**	**100**	**3**	**1**	**100**	**162**	**18**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	179	33	100	774	91	100	1,214	171	100	2,682	125	100
Marine Mammals	4	—	—	18	2	100	5	—	—	12	1	100
Turtles	4	4	100	1	1	100	25	25	100	56	56	100
Sharks	—	—	—	—	—	—	9	3	100	2	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	2	—	—	—	—	—	6	—	—	12	—	—
Total	**189**	**37**	**100**	**793**	**94**	**100**	**1,259**	**199**	**100**	**2,764**	**182**	**100**

Table B–11. Number of threatened and endangered individuals within each taxonomic order and percent agreement during QC for the February 2018 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	1	—	—	—	—	—	—	—	—	—	—	—
Turtles	343	343	100	1	1	100	1	1	100	4	4	100
Sharks	187	37	100	—	—	—	—	—	—	—	—	—
Rays	1	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	7	2	100	—	—	—	—	—	—	—	—	—
Total	**539**	**382**	**100**	**1**	**1**	**100**	**1**	**1**	**100**	**4**	**4**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	1	1	100	—	—	—	—	—	—	—	—	—
Turtles	3	3	100	—	—	—	25	25	100	5	5	100
Sharks	—	—	—	—	—	—	—	—	—	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**4**	**4**	**100**	**—**	**—**	**—**	**25**	**25**	**100**	**5**	**5**	**100**

Table B–12. Number of threatened and endangered individuals within each taxonomic order and percent agreement during QC for the February 2020 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	2	2	100	—	—	—	—	—	—	—	—	—
Turtles	309	309	100	—	—	—	1	1	100	6	6	100
Sharks	2	2	100	—	—	—	—	—	—	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	13	13	100	—	—	—	—	—	—	—	—	—
Total	**326**	**326**	**100**	**—**	**—**	**—**	**1**	**1**	**100**	**6**	**6**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	1	1	100	1	1	100
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	1	1	100	2	2	100	9	9	100	29	29	100
Sharks	—	—	—	—	—	—	1	1	100	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**1**	**1**	**100**	**2**	**2**	**100**	**11**	**11**	**100**	**30**	**30**	**100**

Table B–13. Number of threatened and endangered individuals within each taxonomic order and percent agreement during QC for the May/June 2018 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	39	39	100	—	—	—	—	—	—	1	1	100
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	189	189	100	1	1	100	—	—	—	1	1	100
Sharks	44	44	100	—	—	—	—	—	—	1	1	100
Rays	3	3	100	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**275**	**275**	**100**	**1**	**1**	**100**	**—**	**—**	**—**	**3**	**3**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	1	1	100
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	43	43	100	—	—	—	4	4	100	5	5	100
Sharks	—	—	—	—	—	—	7	7	100	—	—	—
Rays	—	—	—	—	—	—	—	—	—	2	2	100
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**43**	**43**	**100**	**—**	**—**	**—**	**11**	**11**	**100**	**8**	**8**	**100**

Table B–14. Number of threatened and endangered individuals within each taxonomic order and percent agreement during QC for the May 2019 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	317	317	100	—	—	—	—	—	—	3	3	100
Sharks	132	132	100	—	—	—	—	—	—	2	2	100
Rays	6	6	67	—	—	—	—	—	—	—	—	—
Large Bony Fish	2	2	100	—	—	—	—	—	—	—	—	—
Total	**457**	**457**	**100**	**—**	**—**	**—**	**—**	**—**	**—**	**5**	**5**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	86	86	100	2	2	100	2	2	100	13	13	100
Sharks	3	3	100	1	1	100	7	7	100	10	10	100
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**89**	**89**	**100**	**3**	**3**	**100**	**9**	**9**	**100**	**23**	**23**	**100**

Table B–15. Number of threatened and endangered individuals within each taxonomic order and percent agreement during QC for the October 2018 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	36	36	100	—	—	—	—	—	—	—	—	—
Marine Mammals	1	1	100	—	—	—	—	—	—	—	—	—
Turtles	356	356	100	—	—	—	2	2	100	—	—	—
Sharks	35	35	100	—	—	—	—	—	—	—	—	—
Rays	2	2	100	—	—	—	—	—	—	—	—	—
Large Bony Fish	209	209	100	—	—	—	—	—	—	—	—	—
Total	**639**	**639**	**100**	**—**	**—**	**—**	**2**	**2**	**100**	**—**	**—**	**—**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	4	4	100
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	19	19	100	2	2	100	4	4	100	13	13	100
Sharks	—	—	—	1	1	100	1	1	100	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	1	1	100	—	—	—	—	—	—	—	—	—
Total	**20**	**20**	**100**	**3**	**3**	**100**	**5**	**5**	**100**	**17**	**17**	**100**

Table B–16. Number of threatened and endangered individuals within each taxonomic order and percent agreement during QC for the September 2019 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	7	7	100	—	—	—	—	—	—	—	—	—
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	186	186	99	1	1	100	—	—	—	3	3	100
Sharks	17	17	100	—	—	—	—	—	—	3	3	100
Rays	10	10	100	—	—	—	—	—	—	—	—	—
Large Bony Fish	1	1	100	—	—	—	—	—	—	—	—	—
Total	**221**	**221**	**100**	**1**	**1**	**100**	**—**	**—**	**—**	**6**	**6**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	34	34	100	1	1	100	2	2	100	11	11	100
Sharks	1	1	100	1	1	100	1	1	100	5	5	100
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**35**	**35**	**100**	**2**	**2**	**100**	**3**	**3**	**100**	**16**	**16**	**100**

Table B–17. Number of threatened and endangered individuals within each taxonomic order and percent agreement during QC for the December 2018 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	1	1	100	—	—	—	—	—	—	—	—	—
Turtles	326	326	100	—	—	—	—	—	—	4	4	100
Sharks	10	10	100	—	—	—	1	1	100	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	13	13	100	—	—	—	—	—	—	—	—	—
Total	**350**	**350**	**100**	**—**	**—**	**—**	**1**	**1**	**100**	**4**	**4**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	—	—	—	—	—	—	—	—	—	—	—	—
Turtles	3	3	100	—	—	—	6	6	100	6	6	100
Sharks	—	—	—	—	—	—	—	—	—	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**3**	**3**	**100**	**—**	**—**	**—**	**6**	**6**	**100**	**6**	**6**	**100**

Table B–18. Number of threatened and endangered individuals within each taxonomic order and percent agreement during QC for the December 2019 survey by survey area

Taxonomic Order	Survey Area Transect (Coverage Varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	—	—	—	—	—	—
Marine Mammals	1	1	100	—	—	—	—	—	—	—	—	—
Turtles	591	591	100	—	—	—	1	1	100	2	2	100
Sharks	65	65	100	—	—	—	—	—	—	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**657**	**657**	**100**	**—**	**—**	**—**	**1**	**1**	**100**	**2**	**2**	**100**

Taxonomic Order	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree	N	# QC	% Agree
Avian	—	—	—	—	—	—	15	15	100	1	1	100
Marine Mammals	—	—	—	—	—	—	—	—	—	1	1	100
Turtles	4	4	100	1	1	100	25	25	100	56	56	100
Sharks	—	—	—	—	—	—	3	3	100	—	—	—
Rays	—	—	—	—	—	—	—	—	—	—	—	—
Large Bony Fish	—	—	—	—	—	—	—	—	—	—	—	—
Total	**4**	**4**	**100**	**1**	**1**	**100**	**43**	**43**	**100**	**58**	**58**	**100**

B.4 Total Density (per km^2) of Individuals in Taxonomic Group by Survey Area and Survey

Table B–19. Total Density per km^2 of Individuals in Taxonomic Group by Area for the February 2018 Survey

Survey Area	Taxonomic Group						Total Density (km^2)
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)	29.5073	0.2380	0.1790	0.1451	0.0016	0.2656	30.3366
A51 (34%)	1.2712	—	0.4237	—	—	—	1.6949
A53 (34%)	174.2308	—	0.3846	—	—	1.1538	175.7692
CCA (11%)	10.0066	—	0.1321	—	—	—	10.1387
TOTAL TRANSECT	**29.1804**	**0.2337**	**0.1773**	**0.1425**	**0.0015**	**0.2624**	**29.9978**
GRID (≈10%)							
KH	2.0109	0.2038	0.0408	—	—	—	2.2555
WW	17.9219	—	—	—	—	—	17.9219
WE	22.1315	0.1021	0.3191	—	—	0.0383	22.5910
GSCA	10.7170	0.1107	0.0252	—	—	0.0553	10.9082
TOTAL GRID	**11.9838**	**0.1166**	**0.0855**	**—**	**—**	**0.0363**	**12.2222**
TOTAL	**26.3403**	**0.2143**	**0.1622**	**0.1189**	**0.0013**	**0.2250**	**27.0620**

Table B–20. Total Density per km^2 of Individuals in Taxonomic Group by Area for the February 2020 Survey

Survey Area	Taxonomic Group						Total Density (km^2)
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)	19.1651	0.4717	0.1621	0.0189	0.0021	0.1637	19.9836
A51 (34%)	—	—	—	—	—	—	—
A53 (34%)	8.4615	—	0.3846	0.3846	—	—	9.2307
CCA (11%)	25.9908	—	0.1982	—	—	0.0330	26.2220
TOTAL TRANSECT	**19.1505**	**0.4632**	**0.1607**	**0.0191**	**0.0021**	**0.1607**	**19.9563**
GRID (≈10%)							
KH	3.6512	1.2534	0.0136	0.4360	—	—	5.3542
WW	75.8445	0.5393	0.0568	—	—	—	76.4406
WE	83.8751	0.0768	0.1152	0.3711	0.0512	0.9086	85.3980
GSCA	12.6455	0.2418	0.1461	0.0151	—	0.0605	13.1090
TOTAL GRID	**30.7143**	**0.4283**	**0.1064**	**0.1661**	**0.0104**	**0.2154**	**31.6409**
TOTAL	**21.0655**	**0.4574**	**0.1517**	**0.0434**	**0.0034**	**0.1698**	**21.8912**

Table B–21. Total Density per km^2 of Individuals in Taxonomic Group by Area for the May/June 2018 Survey

Survey Area	Taxonomic Group						Total Density (km^2)
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)	0.1453	0.0502	0.1090	0.3448	0.2878	0.0830	1.0201
A51 (34%)	—	—	0.4237	—	—	—	0.4237
A53 (34%)	—	—	—	—	—	—	—
CCA (11%)	0.0330	—	0.0330	0.0991	—	—	0.1651
TOTAL TRANSECT	**0.1430**	**0.0492**	**0.1068**	**0.3380**	**0.2820**	**0.0814**	**1.0004**
GRID (10%)							
KH	—	—	0.5842	—	44.7283	0.0136	45.3261
WW	—	0.0568	—	—	—	—	0.0568
WE	—	0.1659	0.0511	0.1149	—	0.5871	0.9190
GSCA	0.0198	0.0099	0.0247	0.0049	0.0198	0.0049	0.0840
TOTAL GRID	**0.0103**	**0.0436**	**0.1335**	**0.0257**	**8.4621**	**0.1232**	**8.7984**
TOTAL	**0.1190**	**0.0482**	**0.1116**	**0.2816**	**1.7579**	**0.0889**	**2.4072**

Table B–22. Total Density per km^2 of Individuals in Taxonomic Group by Area for the May 2019 Survey

Survey Area	Taxonomic Group						Total Density (km^2)
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)	0.3641	0.1889	0.1663	0.5026	7.5962	0.5288	9.3469
A51 (34%)	—	—	—	1.2712	—	1.2712	2.5424
A53 (34%)	—	—	—	—	—	—	—
CCA (11%)	0.1651	0.6935	0.0991	0.0991	0.0330	0.3633	1.4531
TOTAL TRANSECT	**0.3585**	**0.1906**	**0.1643**	**0.4945**	**7.4583**	**0.5228**	**9.1890**
GRID (10%)							
KH	0.1226	—	1.1715	0.0681	0.0136	1.0625	2.4383
WW	0.6812	—	0.0568	0.5109	0.0568	—	1.3057
WE	0.0896	0.1024	0.0256	0.7039	—	1.5997	2.5212
GSCA	0.1947	0.0362	0.0589	0.3803	0.0136	0.0407	0.7244
TOTAL GRID	**0.1447**	**0.0392**	**0.2502**	**0.3802**	**0.0147**	**0.5201**	**1.3491**
TOTAL	**0.3214**	**0.1643**	**0.1792**	**0.4746**	**6.1666**	**0.5223**	**7.8284**

Table B–23. Total Density per km^2 of Individuals in Taxonomic Group by Area for the October 2018 survey

Survey Area	Taxonomic Group						Total Density (km^2)
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)	0.8639	0.1786	0.1969	0.1366	0.4496	0.5254	2.3510
A51 (34%)	—	—	—	—	—	—	—
A53 (34%)	—	—	0.7692	—	—	—	0.7692
CCA (11%)	0.1982	—	—	—	—	—	0.1982
TOTAL TRANSECT	**0.8491**	**0.1752**	**0.1931**	**0.1340**	**0.4411**	**0.5154**	**2.3079**
GRID (10%)							
KH	0.0543	0.0272	0.2582	0.0543	—	0.2582	0.6522
WW	0.1923	0.0240	0.0481	0.0240	—	0.0240	0.3124
WE	0.2297	0.1404	0.0511	0.0255	—	0.1659	0.6126
GSCA	2.6024	0.0933	0.0577	0.0666	—	0.0222	2.8422
TOTAL GRID	**1.4711**	**0.0836**	**0.0908**	**0.0525**	**—**	**0.0908**	**1.7888**
TOTAL	**0.9642**	**0.1583**	**0.1742**	**0.1189**	**0.3594**	**0.4368**	**2.2118**

Table B–24. Total Density per km^2 of Individuals in Taxonomic Group by Area for the September 2019 survey

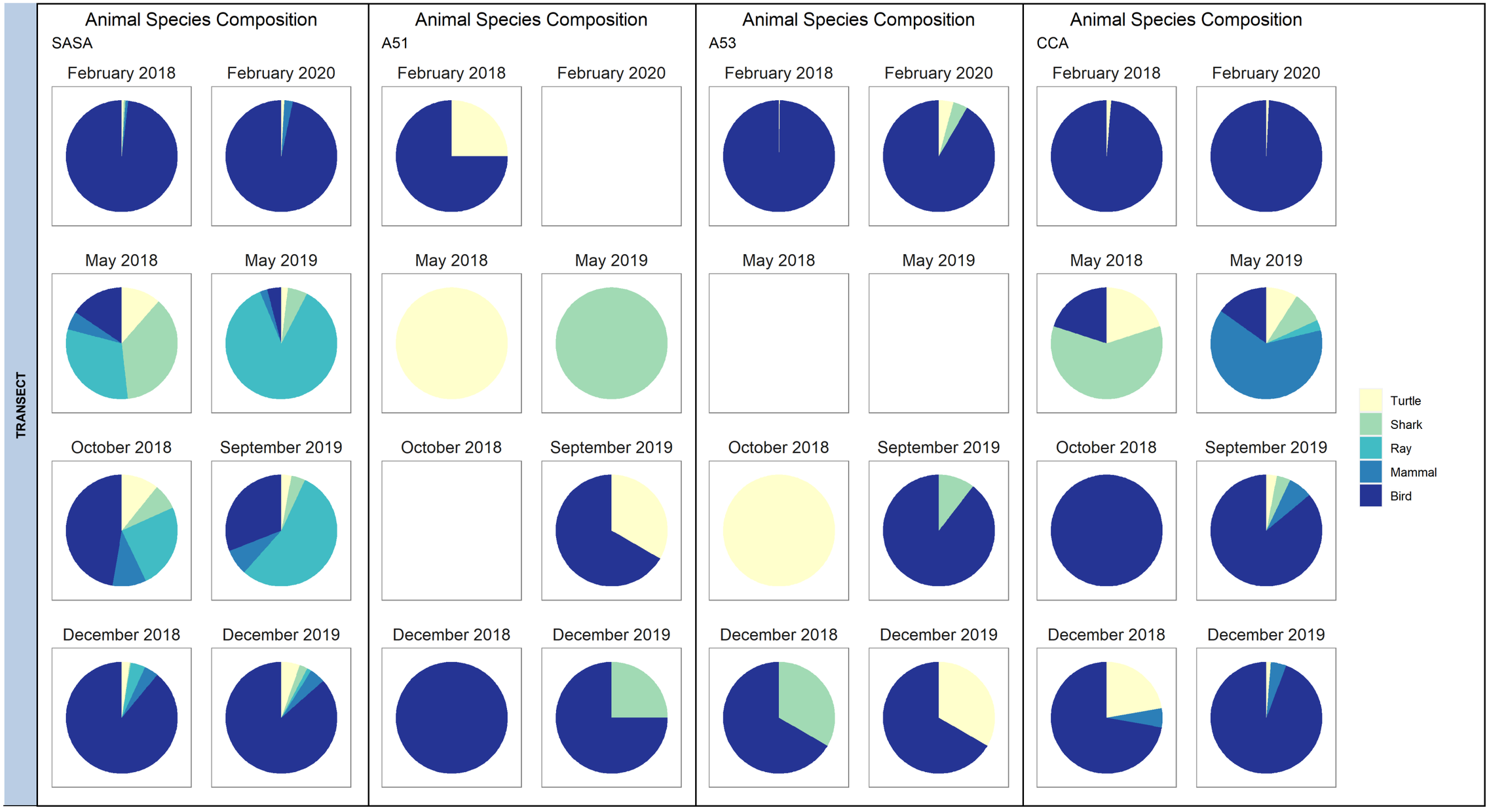
Survey Area	Taxonomic Group						Total Density (km^2)
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)	1.0429	0.2515	0.0970	0.1367	1.8401	0.3057	3.6739
A51 (34%)	0.8475	—	0.4237	—	—	—	1.2712
A53 (34%)	16.5385	—	—	1.9231	—	2.3077	20.7693
CCA (11%)	2.8402	0.2312	0.0991	0.1321	—	0.6275	3.9301
TOTAL TRANSECT	**1.0810**	**0.2505**	**0.0963**	**0.1388**	**1.8069**	**0.3125**	**3.6860**
GRID (10%)							
KH	0.0954	0.2180	0.4632	0.1362	0.0272	0.5721	1.5121
WW	0.5961	—	0.0284	0.1987	0.0284	0.0852	0.9368
WE	1.8443	0.2946	0.0256	0.2177	0.0256	0.0640	2.4718
GSCA	0.3687	0.1818	0.0556	0.2323	—	0.1111	0.9495
TOTAL GRID	**0.6290**	**0.1949**	**0.1248**	**0.2079**	**0.0130**	**0.1871**	**1.3567**
TOTAL	**1.0066**	**0.2414**	**0.1010**	**0.1502**	**1.5115**	**0.2919**	**3.3026**

Table B–25. Total Density per km^2 of Individuals in Taxonomic Group by Area for the December 2018 survey

Survey Area	Taxonomic Group						Total Density (km^2)
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)	6.5614	0.3044	0.1702	0.0209	0.3149	0.0444	7.4162
A51 (34%)	2.1930	—	—	—	—	—	2.1930
A53 (34%)	0.7722	—	—	0.3861	—	—	1.1583
CCA (11%)	0.4275	0.0329	0.1315	—	—	0.0329	0.6248
TOTAL TRANSECT	**6.4455**	**0.2989**	**0.1692**	**0.0210**	**0.3091**	**0.0441**	**7.2878**
GRID (10%)							
KH	45.7733	0.7611	0.0408	—	—	—	46.5752
WW	10.6302	0.2975	—	—	—	—	10.9277
WE	3.3823	0.0511	0.0766	—	—	—	3.5100
GSCA	5.2159	0.0672	0.0288	—	—	0.0096	5.3215
TOTAL GRID	**12.7536**	**0.2114**	**0.0378**	**—**	**—**	**0.0050**	**13.0078**
TOTAL	**7.5129**	**0.2841**	**0.1469**	**0.0175**	**0.2568**	**0.0375**	**8.2557**

Table B–26. Total Density per km^2 of Individuals in Taxonomic Group by Area for the December 2019 survey

Survey Area	Taxonomic Group						Total Density (km^2)
	Avian	Mammal	Turtle	Shark	Ray	Large Bony Fish	
TRANSECT (Coverage Varies)							
SASA (6%)	5.0090	0.2626	0.3097	0.1357	0.0739	0.0681	5.8590
A51 (34%)	1.2712	—	—	0.4237	—	—	1.6949
A53 (34%)	0.7692	—	0.3846	—	—	—	1.1538
CCA (11%)	4.8547	0.2312	0.0661	—	—	0.1982	5.3502
TOTAL TRANSECT	**4.9511**	**0.2614**	**0.3057**	**0.1338**	**0.0726**	**0.0700**	**5.7946**
GRID (10%)							
KH	2.4370	0.0545	0.0545	—	—	0.0272	2.5732
WW	49.8069	1.1583	0.0644	—	—	—	51.0296
WE	15.5382	0.0640	0.3200	0.1152	—	0.0768	16.1142
GSCA	25.7686	0.1153	0.5380	0.0192	—	0.1153	26.5564
TOTAL GRID	**17.3193**	**0.1438**	**0.3171**	**0.0406**	**—**	**0.0737**	**17.8945**
TOTAL	**6.4658**	**0.2470**	**0.3071**	**0.1224**	**0.0637**	**0.0704**	**7.2764**



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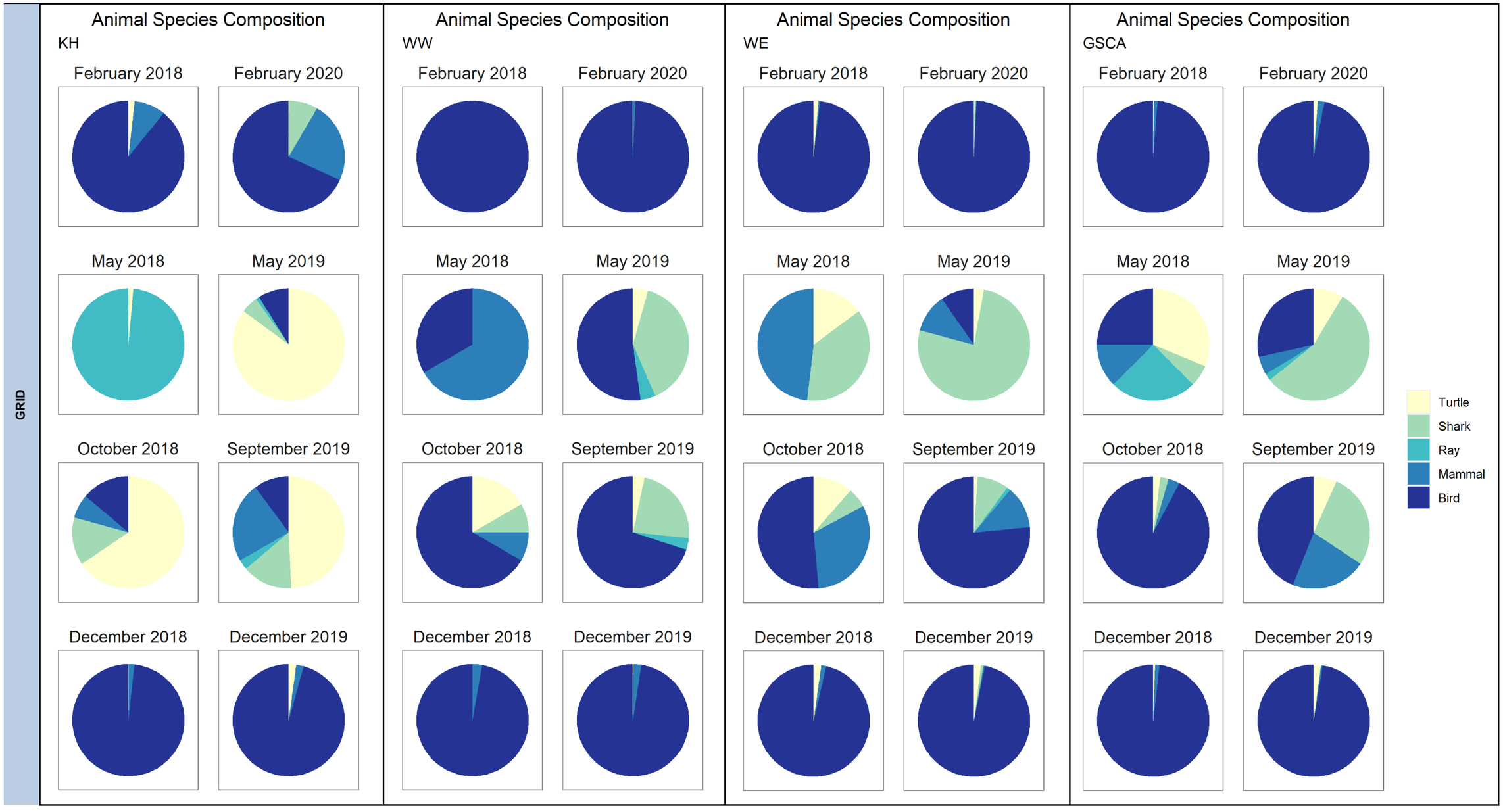

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Figure C–296. Spatial distribution of loons flying within the rotor swept zone during the February surveys for all areas C–455

Figure C–297. Spatial distribution of sitting loons during the February surveys for all areas C–456

Figure C–298. Spatial distribution of sitting loons during the May/June surveys for all areas C–457

Figure C–299. Spatial distribution of loons flying below the rotor swept zone during the September/October surveys for all areas C–458

Figure C–300. Spatial distribution of loons flying within the rotor swept zone during the September/October surveys for all areas C–458

Figure C–301. Spatial distribution of loons flying below the rotor swept zone during the December surveys for all areas C–459

Figure C–302. Spatial distribution of loons flying within the rotor swept zone during the December surveys for all areas C–460

Figure C–303. Spatial distribution of sitting loons during the December surveys for all areas C–461

Figure C–304. Spatial distribution of gannets flying below the rotor swept zone during the February surveys for all areas C–462

Figure C–305. Spatial distribution of gannets flying within the rotor swept zone during the February surveys for all areas C–463

Figure C–306. Spatial distribution of sitting gannets during the February surveys for all areas C–464

Figure C–307. Spatial distribution of sitting gannets during the May/June surveys for all areas C–465

Figure C–308. Spatial distribution of sitting gannets during the September/October surveys for all areas C–465

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Figure C–310. Spatial distribution of gannets flying within the rotor swept zone during the December surveys for all areas C–467

Figure C–311. Spatial distribution of sitting gannets during the December surveys for all areas C–468
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Figure C–314. Spatial distribution of sitting gulls during the February surveys for all areas C–471
Figure C–315. Spatial distribution of gulls flying below the rotor swept zone during the May/June surveys for all areas C–472
Figure C–316. Spatial distribution of gulls flying within the rotor swept zone during the May/June surveys for all areas C–472
Figure C–317. Spatial distribution of sitting gulls during the May/June surveys for all areas C–473
Figure C–318. Spatial distribution of gulls flying below the rotor swept zone during the September/October surveys for all areas C–473
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Figure C–320. Spatial distribution of sitting gulls during the September/October surveys for all areas C–475
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C.1 Avian Species Identification for Each Area by Survey

Table C–1. Number of individuals identified in avian groups, percent identification success, and percent of individuals sitting for each area during February 2018

Avian Group	Survey Area Transect (coverage varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	90	98	69	—	—	—	—	—	—	—	—	—
Loon	15,275	99	99	—	—	—	—	—	—	7	100	100
Grebe	2	100	100	—	—	—	—	—	—	—	—	—
Fulmar	45	100	9	—	—	—	—	—	—	—	—	—
Shearwater	22	95	55	—	—	—	—	—	—	—	—	—
Storm-petrel	1	—	—	—	—	—	—	—	—	—	—	—
Gannet	5,881	100	78	—	—	—	1	100	100	1	100	100
Cormorant	19	—	95	—	—	—	—	—	—	—	—	—
Phalarope	11,152	73	78	2	100	100	451	100	73	293	100	83
Skua	1	100	—	—	—	—	—	—	—	—	—	—
Auk	11,037	99	94	—	—	—	—	—	—	—	—	—
Gull	12,504	99	45	1	100	—	1	100	—	2	50	100
Sterna Tern	509	100	2	—	—	—	—	—	—	—	—	—
TOTAL	**56,538**			**3**			**453**			**303**		

Avian Group	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	—	—	—	5	100	60	—	—	—	—	—	—
Loon	66	100	100	84	100	100	85	99	100	317	99	100
Grebe	—	—	—	—	—	—	—	—	—	—	—	—
Fulmar	3	100	33	—	—	—	—	—	—	—	—	—
Shearwater	—	—	—	1	100	100	7	100	100	—	—	—
Storm-petrel	—	—	—	—	—	—	—	—	—	—	—	—
Gannet	49	100	6	128	100	99	33	100	82	287	100	81
Cormorant	—	—	—	—	—	—	—	—	—	—	—	—
Phalarope	—	—	—	24	100	96	511	100	76	1,320	99	96
Skua	1	100	—	—	—	—	—	—	—	—	—	—
Auk	17	94	100	156	96	90	258	100	100	55	98	89
Gull	12	100	58	228	100	86	794	100	44	131	99	48
Sterna Tern	—	—	—	7	100	43	46	100	24	20	100	—
Total	**148**			**633**			**1,734**			**2,130**		

Table C–2. Number of individuals identified in avian groups, percent identification success, and percent of individuals sitting for each area during February 2020

Avian Group	Survey Area Transect (coverage varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	28	100	—	—	—	—	—	—	—	—	—	—
Loon	3,671	96	99	—	—	—	—	—	—	27	85	100
Fulmar	—	—	—	—	—	—	—	—	—	—	—	—
Petrel	2	100	50	—	—	—	—	—	—	—	—	—
Shearwater	72	99	25	—	—	—	—	—	—	1	100	—
Gannet	4,646	100	80	—	—	—	—	—	—	—	—	—
Cormorant	1,156	99	100	—	—	—	—	—	—	—	—	—
Pelican	49	100	78	—	—	—	—	—	—	—	—	—
Phalarope	8,456	100	80	—	—	—	22	100	95	744	100	87
Skua	1	100	—	—	—	—	—	—	—	—	—	—
Auk	7,207	96	91	—	—	—	—	—	—	—	—	—
Gull	10,609	94	48	—	—	—	—	—	—	15	73	13
Tern	4	—	—	—	—	—	—	—	—	—	—	—
Sterna Tern	624	70	4	—	—	—	—	—	—	—	—	—
Total	**36,525**			**—**			**22**			**787**		

Avian Group	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	—	—	—	2	100	—	—	—	—	8	38	88
Loon	41	98	98	240	100	100	35	100	97	303	100	100
Fulmar	1	100	—	—	—	—	—	—	—	—	—	—
Petrel	—	—	—	1	—	100	—	—	—	—	—	—
Shearwater	1	100	—	—	—	—	—	—	—	3	100	100
Gannet	11	100	55	47	100	77	8	100	25	586	100	82
Cormorant	—	—	—	2	—	100	—	—	—	—	—	—
Pelican	—	—	—	—	—	—	—	—	—	—	—	—
Phalarope	3	100	100	912	100	75	6047	100	61	206	100	45
Skua	—	—	—	—	—	—	—	—	—	—	—	—
Auk	177	99	99	318	99	92	7	100	43	282	99	76
Gull	34	53	65	1126	99	66	449	98	21	1113	97	37
Tern	—	—	—	2	—	—	—	—	—	—	—	—
Sterna Tern	—	—	—	22	100	—	8	88	—	9	89	—
Total	**268**			**2672**			**6554**			**2510**		

Table C–3. Number of individuals identified in avian groups, percent identification success, and percent of individuals sitting for each area during May/June 2018

Avian Group	Survey Area Transect (coverage varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Loon	10	100	100	—	—	—	—	—	—	—	—	—
Petrel	2	50	—	—	—	—	—	—	—	—	—	—
Shearwater	9	89	11	—	—	—	—	—	—	—	—	—
Gannet	3	100	67	—	—	—	—	—	—	—	—	—
Ardeidae	1	100	—	—	—	—	—	—	—	—	—	—
Phalarope	2	—	50	—	—	—	—	—	—	—	—	—
Gull	38	100	13	—	—	—	—	—	—	—	—	—
Tern	148	98	—	—	—	—	—	—	—	—	—	—
Sterna Tern	39	—	—	—	—	—	—	—	—	1	—	—
Total	**252**			**—**			**—**			**1**		

Avian Group	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Loon	—	—	—	—	—	—	—	—	—	—	—	—
Petrel	—	—	—	—	—	—	—	—	—	—	—	—
Shearwater	—	—	—	—	—	—	—	—	—	2	50	50
Gannet	—	—	—	—	—	—	—	—	—	—	—	—
Ardeidae	—	—	—	—	—	—	—	—	—	—	—	—
Phalarope	—	—	—	—	—	—	—	—	—	—	—	—
Gull	—	—	—	—	—	—	—	—	—	—	—	—
Tern	—	—	—	—	—	—	—	—	—	1	100	—
Sterna Tern	—	—	—	—	—	—	—	—	—	1	—	—
Total	**—**			**—**			**—**			**4**		

Table C–4. Number of individuals identified in avian groups, percent identification success, and percent of individuals sitting for each area during May 2019

Avian Group	Survey Area Transect (coverage varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Loon	47	94	98	—	—	—	—	—	—	—	—	—
Petrel	—	—	—	—	—	—	—	—	—	—	—	—
Shearwater	3	100	33	—	—	—	—	—	—	—	—	—
Storm-petrel	5	—	—	—	—	—	—	—	—	—	—	—
Gannet	6	100	100	—	—	—	—	—	—	—	—	—
Cormorant	2	—	—	—	—	—	—	—	—	—	—	—
Pelican	11	100	73	—	—	—	—	—	—	—	—	—
Ardeidae	1	100	—	—	—	—	—	—	—	—	—	—
Shorebird	322	6	—	—	—	—	—	—	—	—	—	—
Phalarope	32	—	—	—	—	—	—	—	—	—	—	—
Skua	1	100	—	—	—	—	—	—	—	—	—	—
Auk	2	—	100	—	—	—	—	—	—	1	100	100
Gull	63	92	49	—	—	—	—	—	—	—	—	—
Tern	115	84	3	—	—	—	—	—	—	1	100	—
Sterna Tern	84	49	—	—	—	—	—	—	—	3	—	—
Passerine	—	—	—	—	—	—	—	—	—	—	—	—
Total	**694**			**—**			**—**			**5**		

Avian Group	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Loon	8	100	100	—	—	—	—	—	—	1	100	100
Petrel	1	100	—	—	—	—	—	—	—	—	—	—
Shearwater	—	—	—	—	—	—	—	—	—	—	—	—
Storm-petrel	—	—	—	—	—	—	—	—	—	—	—	—
Gannet	—	—	—	—	—	—	—	—	—	—	—	—
Cormorant	—	—	—	—	—	—	—	—	—	—	—	—
Pelican	—	—	—	—	—	—	—	—	—	—	—	—
Ardeidae	—	—	—	—	—	—	—	—	—	—	—	—
Shorebird	—	—	—	—	—	—	—	—	—	2	—	—
Phalarope	—	—	—	—	—	—	—	—	—	—	—	—
Skua	—	—	—	—	—	—	—	—	—	—	—	—
Auk	—	—	—	—	—	—	—	—	—	7	100	100
Gull	—	—	—	—	—	—	—	—	—	—	—	—
Tern	—	—	—	—	—	—	—	—	—	8	100	—
Sterna Tern	—	—	—	—	—	—	7	14	29	1	—	—
Passerine	—	—	—	24	—	—	—	—	—	24	—	—
Total	**9**			**24**			**7**			**43**		

Table C–5. Number of individuals identified in avian groups, percent identification success, and percent of individuals sitting for each area during October 2018

Avian Group	Survey Area Transect (coverage varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Loon	75	100	80	—	—	—	—	—	—	—	—	—
Fulmar	1	100	100	—	—	—	—	—	—	—	—	—
Petrel	5	40	60	—	—	—	—	—	—	—	—	—
Shearwater	52	71	23	—	—	—	—	—	—	1	100	—
Storm-petrel	2	—	—	—	—	—	—	—	—	—	—	—
Gannet	62	100	50	—	—	—	—	—	—	—	—	—
Cormorant	8	100	—	—	—	—	—	—	—	—	—	—
Pelican	21	100	33	—	—	—	—	—	—	—	—	—
Ardeidae	15	100	—	—	—	—	—	—	—	—	—	—
Raptor	1	100	—	—	—	—	—	—	—	—	—	—
Shorebird	16	25	—	—	—	—	—	—	—	—	—	—
Phalarope	29	79	66	—	—	—	—	—	—	—	—	—
Skua	1	100	—	—	—	—	—	—	—	—	—	—
Auk	2	—	100	—	—	—	—	—	—	—	—	—
Gull	470	95	56	—	—	—	—	—	—	—	—	—
Tern	446	38	—	—	—	—	—	—	—	3	100	—
Sterna Tern	355	20	6	—	—	—	—	—	—	2	—	—
Passerine	1	—	—	—	—	—	—	—	—	—	—	—
Total	**1,562**			**—**			**—**			**6**		

(continued)

Table C–5. (Continued).

Avian Group	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Loon	—	—	—	—	—	—	—	—	—	36	100	100
Fulmar	—	—	—	—	—	—	—	—	—	—	—	—
Petrel	—	—	—	—	—	—	—	—	—	—	—	—
Shearwater	1	100	—	—	—	—	1	100	—	3	100	33
Storm-petrel	—	—	—	—	—	—	—	—	—	—	—	—
Gannet	3	100	67	—	—	—	—	—	—	—	—	—
Cormorant	—	—	—	—	—	—	—	—	—	—	—	—
Pelican	—	—	—	—	—	—	—	—	—	—	—	—
Ardeidae	—	—	—	—	—	—	—	—	—	—	—	—
Raptor	—	—	—	—	—	—	—	—	—	—	—	—
Shorebird	—	—	—	—	—	—	—	—	—	—	—	—
Phalarope	—	—	—	—	—	—	—	—	—	5	100	100
Skua	—	—	—	—	—	—	—	—	—	1	100	—
Auk	—	—	—	—	—	—	—	—	—	—	—	—
Gull	—	—	—	—	—	—	—	—	—	6	17	83
Tern	—	—	—	4	100	—	12	83	42	115	25	37
Sterna Tern	—	—	—	4	—	—	5	80	—	420	32	12
Passerine	—	—	—	—	—	—	—	—	—	—	—	—
Total	**4**			**8**			**18**			**586**		

Table C–6. Number of individuals identified in avian groups, percent identification success, and percent of individuals sitting for each area during September 2019

Avian Group	Survey Area Transect (coverage varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	8	13	88	—	—	—	—	—	—	—	—	—
Petrel	1	100	—	—	—	—	—	—	—	—	—	—
Shearwater	118	76	31	1	100	—	11	73	55	36	8	61
Pelican	1	100	—	—	—	—	—	—	—	—	—	—
Ardeidae	1	100	—	—	—	—	—	—	—	—	—	—
Shorebird	2	—	—	—	—	—	—	—	—	—	—	—
Phalarope	31	48	58	—	—	—	—	—	—	—	—	—
Skua	2	—	—	—	—	—	—	—	—	—	—	—
Gull	45	93	47	—	—	—	—	—	—	—	—	—
Tern	721	93	5	1	—	—	1	100	—	3	100	—
Sterna Tern	1,068	59	2	—	—	—	31	19	—	47	57	—
Passerine	1	—	—	—	—	—	—	—	—	—	—	—
Total	**1,999**			**2**			**43**			**86**		

Avian Group	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	—	—	—	—	—	—	—	—	—	—	—	—
Petrel	1	100	100	—	—	—	1	100	—	—	—	—
Shearwater	3	100	—	—	—	—	77	95	23	—	—	—
Pelican	—	—	—	—	—	—	—	—	—	—	—	—
Ardeidae	—	—	—	—	—	—	—	—	—	—	—	—
Shorebird	—	—	—	—	—	—	—	—	—	—	—	—
Phalarope	—	—	—	—	—	—	—	—	—	—	—	—
Skua	—	—	—	—	—	—	—	—	—	—	—	—
Gull	1	100	—	1	—	100	—	—	—	—	—	—
Tern	2	50	—	20	65	5	40	83	8	61	89	—
Sterna Tern	—	—	—	—	—	—	25	80	—	12	17	—
Passerine	—	—	—	—	—	—	1	—	—	—	—	—
Total	**7**			**21**			**144**			**73**		

Table C–7. Number of individuals identified in avian groups, percent identification success, and percent of individuals sitting for each area during December 2018

Avian Group	Survey Area Transect (coverage varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	00	98	89	—	—	—	—	—	—	—	—	—
Loon	2,077	99	97	3	100	100	2	100	100	10	100	100
Fulmar	1	100	100	—	—	—	—	—	—	—	—	—
Shearwater	4	25	75	—	—	—	—	—	—	—	—	—
Gannet	4,581	100	75	1	100	100	—	—	—	3	100	100
Cormorant	4	50	—	—	—	—	—	—	—	—	—	—
Pelican	44	100	95	—	—	—	—	—	—	—	—	—
Phalarope	288	94	95	—	—	—	—	—	—	—	—	—
Skua	4	50	75	—	—	—	—	—	—	—	—	—
Auk	464	82	90	—	—	—	—	—	—	—	—	—
Gull	3,956	88	72	1	100	—	—	—	—	—	—	—
Tern	31	3	19	—	—	—	—	—	—	—	—	—
Sterna Tern	512	83	6	—	—	—	—	—	—	—	—	—
Total	**12,566**			**5**			**2**			**13**		

Avian Group	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	—	—	—	2	—	—	—	—	—	11	82	18
Loon	73	100	100	77	100	96	26	100	88	188	99	99
Fulmar	—	—	—	—	—	—	—	—	—	—	—	—
Shearwater	294	100	49	—	—	—	—	—	—	—	—	—
Gannet	9	100	78	161	100	60	228	100	23	583	100	72
Cormorant	—	—	—	—	—	—	—	—	—	—	—	—
Pelican	—	—	—	—	—	—	—	—	—	—	—	—
Phalarope	238	73	92	100	100	92	—	—	—	212	100	89
Skua	—	—	—	1	—	—	—	—	—	1	100	—
Auk	20	80	85	—	—	—	—	—	—	1	—	100
Gull	2,733	62	47	14	93	7	11	100	—	45	98	60
Tern	—	—	—	—	—	—	—	—	—	3	—	—
Sterna Tern	1	—	—	38	53	—	—	—	—	43	88	—
Total	**3,368**			**393**			**265**			**1,087**		

Table C–8. Number of individuals identified in avian groups, percent identification success, and percent of individuals sitting for each area during December 2019

Avian Group	Survey Area Transect (coverage varies)											
	SASA (6%)			A51 (34%)			A53 (34%)			CCA (11%)		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	243	99	87	—	—	—	—	—	—	—	—	—
Loon	2,148	97	97	2	100	100	2	100	100	24	88	96
Shearwater	90	100	86	—	—	—	—	—	—	—	—	—
Gannet	3,278	100	62	1	100	100	—	—	—	1	100	—
Cormorant	4	—	—	—	—	—	—	—	—	—	—	—
Shorebird	4	—	—	—	—	—	—	—	—	—	—	—
Phalarope	2,008	58	74	—	—	—	—	—	—	122	87	58
Skua	3	67	33	—	—	—	—	—	—	—	—	—
Auk	22	18	95	—	—	—	—	—	—	—	—	—
Gull	936	88	37	—	—	—	—	—	—	—	—	—
Tern	8	—	—	—	—	—	—	—	—	—	—	—
Sterna Tern	814	86	8	—	—	—	—	—	—	—	—	—
Total	**9,558**			**3**			**2**			**147**		

Avian Group	Survey Area Grid (≈10% coverage)											
	KH			WW			WE			GSCA		
	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting	N	% ID Success	% Sitting
Duck	—	—	—	—	—	—	—	—	—	—	—	—
Loon	5	100	60	34	100	100	13	100	100	164	100	98
Shearwater	—	—	—	—	—	—	1	100	—	—	—	—
Gannet	3	100	67	127	100	48	45	100	31	17	100	24
Cormorant	—	—	—	—	—	—	—	—	—	—	—	—
Shorebird	—	—	—	—	—	—	—	—	—	—	—	—
Phalarope	7	—	71	532	59	77	1,055	99	75	2,377	100	60
Skua	—	—	—	—	—	—	—	—	—	—	—	—
Auk	—	—	—	3	—	100	—	—	—	—	—	—
Gull	164	95	64	34	100	47	45	93	60	20	90	40
Tern	—	—	—	1	—	—	1	—	—	—	—	—
Sterna Tern	—	—	—	43	100	—	54	72	15	104	99	31
Total	**179**			**774**			**1,214**			**2,682**		

C.2 Raw Counts of Avian Species Identified in the February 2018 through February 2020 Surveys by Area

Table C–9. Avian species identified in the February 2018 through February 2020 surveys in all areas combined

Species	Raw Counts								Species Total
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Duck	**95**	**38**	**—**	**—**	**—**	**8**	**611**	**243**	**995**
Gadwall	—	—	—	—	—	—	—	5	5
American Black Duck	—	—	—	—	—	—	1	—	1
Redhead	—	—	—	—	—	1	—	—	1
Greater Scaup	—	24	—	—	—	—	10	3	37
Lesser Scaup	—	—	—	—	—	—	4	—	4
Surf Scoter	—	1	—	—	—	—	3	—	4
White-winged Scoter	—	—	—	—	—	—	8	1	9
Black Scoter	89	8	—	—	—	—	559	226	882
Scoter unid.	—	4	—	—	—	—	2	—	6
Long-tailed Duck	1	—	—	—	—	—	—	—	1
Red-breasted Merganser	3	—	—	—	—	—	11	5	19
species unknown	2	1	—	—	—	7	13	3	26
Loon	**15,826**	**4,271**	**10**	**56**	**111**	**—**	**2,426**	**2,374**	**25,074**
Red-throated Loon	11,978	910	—	2	3	—	489	400	13,782
Common Loon	3,751	3,214	10	51	108	—	1,910	1,909	10,953
species unknown	97	147	—	3	—	—	27	65	339
Grebe	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**
Horned Grebe	2	—	—	—	—	—	—	—	2
Fulmar	**48**	**1**	**—**	**—**	**1**	**—**	**1**	**—**	**51**
Northern Fulmar	48	1	—	—	1	—	1	—	51

(continued)

Table C–9. (Continued)

Species	Raw Counts								Species Total
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Petrel	**—**	**3**	**2**	**1**	**5**	**3**	**—**	**—**	**14**
Trindade Petrel	—	—	—	1	—	—	—	—	1
Black-capped Petrel	—	2	1	—	2	3	—	—	8
species unknown	—	1	1	—	3	—	—	—	5
Shearwater	**30**	**77**	**11**	**3**	**58**	**241**	**298**	**91**	**809**
Cory's Shearwater	—	—	6	2	39	114	1	—	162
Great Shearwater	1	—	3	1	4	16	—	—	25
Sooty Shearwater	—	—	—	—	—	1	4	—	5
Manx Shearwater	28	76	—	—	—	—	290	91	485
Audubon's Shearwater	—	—	—	—	—	43	—	—	43
species unknown-Large	1	—	1	—	13	11	3	—	29
species unknown-Small	—	1	1	—	2	48	—	—	52
species unknown	—	—	—	—	—	8	—	—	8
Storm-petrel	**1**	**—**	**—**	**5**	**2**	**—**	**—**	**—**	**8**
species unknown	1	—	—	5	2	—	—	—	8
Gannet	**6,380**	**5,293**	**3**	**6**	**65**	**—**	**5,546**	**3,467**	**20,760**
Northern Gannet	6,380	5,293	3	6	65	—	5,546	3,467	20,760
Cormorant	**19**	**1,158**	**—**	**2**	**8**	**—**	**4**	**4**	**1,195**
Double-crested Cormorant	—	1,143	—	—	8	—	2	—	1,153
species unknown	19	15	—	2	—	—	2	4	42
Pelican	**—**	**49**	**—**	**11**	**21**	**1**	**44**	**—**	**126**
Brown Pelican	—	49	—	11	19	1	44	—	124
American White Pelican	—	—	—	—	2	—	—	—	2
Ardeidae	**—**	**—**	**1**	**1**	**15**	**1**	**—**	**—**	**18**
Great Blue Heron	—	—	—	—	13	1	—	—	14
Great Egret	—	—	—	—	1	—	—	—	1
Snowy Egret	—	—	1	1	—	—	—	—	2
Green Heron	—	—	—	—	1	—	—	—	1

(continued)

Table C–9. (Continued)

Species	Raw Counts								Species Total
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Raptor	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**1**
Peregrine Falcon	—	—	—	—	1	—	—	—	1
Shorebird	**—**	**—**	**—**	**324**	**16**	**2**	**—**	**4**	**346**
Black-bellied Plover	—	—	—	17	—	—	—	—	17
Ruddy Turnstone	—	—	—	2	—	—	—	—	2
Dunlin	—	—	—	—	4	—	—	—	4
species unknown	—	—	—	305	12	2	—	4	323
Phalarope	**13,401**	**16,160**	**2**	**32**	**34**	**31**	**834**	**5,916**	**36,410**
Red-necked Phalarope	11	—	—	—	—	5	10	6	32
Red Phalarope	10,379	16,160	—	—	28	10	743	4,816	32,136
Red/Red-necked Phalarope	3,011	—	2	32	6	16	81	1,094	4,242
Skua	**2**	**1**	**—**	**1**	**2**	**2**	**6**	**3**	**17**
Great Skua	1	—	—	—	—	—	—	1	2
Pomarine Jaeger	—	—	—	—	1	—	1	1	3
Parasitic Jaeger	1	1	—	—	1	—	2	—	5
Long-tailed Jaeger	—	—	—	1	—	—	—	—	1
species unknown	—	—	—	—	—	2	3	1	6
Auk	**11,510**	**7,977**	**—**	**10**	**2**	**—**	**485**	**25**	**20,009**
Dovekie	3	—	—	8	—	—	—	—	11
Common/Thick-billed Murre	—	4	—	—	—	—	4	1	9
Razorbill	11,347	7,666	—	—	—	—	390	3	19,406
Murre/Razorbill	84	263	—	—	—	—	86	19	452
Atlantic Puffin	21	23	—	—	—	—	5	1	50
species unknown	55	21	—	2	2	—	—	1	81

(continued)

Table C–9. (Continued)

Species	Raw Counts								Species Total
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Gull	**13,670**	**13,308**	**38**	**63**	**476**	**47**	**6,757**	**1,197**	**35,556**
Black-legged Kittiwake	12	53	—	—	2	1	563	3	634
Bonaparte's Gull	12,887	11,096	—	—	6	—	1,575	169	25,733
Little Gull	2	1	—	—	—	1	1	—	5
Laughing Gull	35	4	38	53	211	39	337	409	1,126
Ring-billed Gull	11	4	—	—	3	—	95	7	120
Herring Gull	487	1,337	—	3	165	1	2,309	413	4,715
Iceland Gull	—	—	—	—	—	—	3	—	3
Lesser Black-backed Gull	19	66	—	—	35	—	51	2	173
Glaucous Gull	2	—	—	—	—	—	—	—	2
Great Black-backed Gull	72	91	—	2	27	1	295	67	555
species unknown - Large	10	40	—	—	3	1	142	1	197
species unknown - Small	129	606	—	3	23	3	1,381	116	2,261
species unknown	4	10	—	2	1	—	5	10	32
Tern	**—**	**6**	**149**	**123**	**579**	**845**	**34**	**10**	**1,746**
Sooty Tern	—	—	—	—	—	7	—	—	7
Bridled Tern	—	—	—	—	3	24	—	—	27
Sooty/Bridled Tern	—	—	—	—	—	8	—	—	8
Least Tern	—	—	—	—	—	14	—	—	14
Gull-billed Tern	—	—	—	4	14	1	—	—	19
Caspian Tern	—	—	13	4	8	1	—	—	26
Black Tern	—	—	29	2	—	396	—	—	427
Royal Tern	—	—	73	91	122	248	1	—	535
Royal/Caspian Tern	—	—	—	11	87	9	—	—	107
Sandwich Tern	—	—	31	4	66	82	—	—	183
Thalasseus Tern unid.	—	—	—	—	—	23	—	—	23
species unknown	—	6	3	7	279	32	33	10	370

(continued)

Table C–9. (Continued)

Species	Raw Counts								Species Total
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
***Sterna* Tern**	**582**	**663**	**41**	**93**	**784**	**1,169**	**593**	**985**	**4,910**
Common Tern	—	—	—	41	118	660	1	—	820
Commic Tern	—	—	—	—	1	—	—	—	1
Forster's Tern	582	471	—	1	92	11	479	852	2,488
Commic/Forster's Tern	—	190	—	51	533	491	113	117	1,495
species unknown	—	2	41	—	40	7	—	16	106
Passerine	**—**	**—**	**—**	**24**	**1**	**2**	**—**	**—**	**27**
species unknown	—	—	—	24	1	2	—	—	27
Total	**61,566**	**49,005**	**257**	**755**	**2,181**	**2,352**	**17,639**	**14,319**	**148,074**

Table C–10. Avian species identified in the February 2018 through February 2020 surveys in the South Atlantic Survey Area (SASA; counts include all of A51, part of A53, and part of CCA)

Species	Raw Counts								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Duck	**90**	**28**	**—**	**—**	**—**	**8**	**600**	**243**	**969**
Gadwall	—	—	—	—	—	—	—	5	5
American Black Duck	—	—	—	—	—	—	1	—	1
Redhead	—	—	—	—	—	1	—	—	1
Greater Scaup	—	24	—	—	—	—	10	3	37
Surf Scoter	—	1	—	—	—	—	3	—	4
White-winged Scoter	—	—	—	—	—	—	7	1	8
Black Scoter	85	3	—	—	—	—	555	226	869
Scoter unid.	—	—	—	—	—	—	2	—	2
Red-breasted Merganser	3	—	—	—	—	—	11	5	19
species unknown	2	—	—	—	—	7	11	3	23
Loon	**15,275**	**3,671**	**10**	**47**	**75**	**—**	**2,077**	**2,148**	**23,303**
Red-throated Loon	11,953	882	—	2	3	—	468	394	13,702
Common Loon	3,230	2,643	10	42	72	—	1,584	1,691	9,272
species unknown	92	146	—	3	—	—	25	63	329
Grebe	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**
Horned Grebe	2	—	—	—	—	—	—	—	2
Fulmar	**45**	**—**	**—**	**—**	**1**	**—**	**1**	**—**	**47**
Northern Fulmar	45	—	—	—	1	—	1	—	47
Petrel	**—**	**2**	**2**	**—**	**5**	**1**	**—**	**—**	**10**
Black-capped Petrel	—	2	1	—	2	1	—	—	6
species unknown	—	—	1	—	3	—	—	—	4
Shearwater	**22**	**72**	**9**	**3**	**52**	**118**	**4**	**90**	**370**
Cory's Shearwater	—	—	5	2	35	65	—	—	107
Great Shearwater	1	—	3	1	2	3	—	—	10
Sooty Shearwater	—	—	—	—	—	1	—	—	1
Manx Shearwater	20	71	—	—	—	—	1	90	182
Audubon's Shearwater	—	—	—	—	—	21	—	—	21

(continued)

Table C–10. (Continued)

Species	Raw Counts								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
species unknown-Large	1	—	—	—	13	7	3	—	24
species unknown-Small	—	1	1	—	2	16	—	—	20
species unknown	—	—	—	—	—	5	—	—	5
Storm-petrel	**1**	**—**	**—**	**5**	**2**	**—**	**—**	**—**	**8**
species unknown	1	—	—	5	2	—	—	—	8
Gannet	**5,881**	**4,646**	**3**	**6**	**62**	**—**	**4,581**	**3,278**	**18,457**
Northern Gannet	5,881	4,646	3	6	62	—	4,581	3,278	18,457
Cormorant	**19**	**1,156**	**—**	**2**	**8**	**—**	**4**	**4**	**1,193**
Double-crested Cormorant	—	1,143	—	—	8	—	2	—	1,153
species unknown	19	13	—	2	—	—	2	4	40
Pelican	**—**	**49**	**—**	**11**	**21**	**1**	**44**	**—**	**126**
Brown Pelican	—	49	—	11	19	1	44	—	124
American White Pelican	—	—	—	—	2	—	—	—	2
Ardeidae	**—**	**—**	**1**	**1**	**15**	**1**	**—**	**—**	**18**
Great Blue Heron	—	—	—	—	13	1	—	—	14
Great Egret	—	—	—	—	1	—	—	—	1
Snowy Egret	—	—	1	1	—	—	—	—	2
Green Heron	—	—	—	—	1	—	—	—	1
Raptor	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**1**
Peregrine Falcon	—	—	—	—	1	—	—	—	1
Shorebird	**—**	**—**	**—**	**322**	**16**	**2**	**—**	**4**	**344**
Black-bellied Plover	—	—	—	17	—	—	—	—	17
Ruddy Turnstone	—	—	—	2	—	—	—	—	2
Dunlin	—	—	—	—	4	—	—	—	4
species unknown	—	—	—	303	12	2	—	4	321
Phalarope	**11,152**	**8,456**	**2**	**32**	**29**	**31**	**288**	**2,008**	**21,998**
Red-necked Phalarope	11	—	—	—	—	5	3	1	20
Red Phalarope	8,140	8,456	—	—	23	10	269	1,169	18,067
Red/Red-necked Phalarope	3,001	—	2	32	6	16	16	838	3,911

(continued)

Table C–10. (Continued)

Species	Raw Counts								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Skua	**1**	**1**	**—**	**1**	**1**	**2**	**4**	**3**	**13**
Great Skua	—	—	—	—	—	—	—	1	1
Pomarine Jaeger	—	—	—	—	1	—	—	1	2
Parasitic Jaeger	1	1	—	—	—	—	2	—	4
Long-tailed Jaeger	—	—	—	1	—	—	—	—	1
species unknown	—	—	—	—	—	2	2	1	5
Auk	**11,037**	**7,207**	**—**	**2**	**2**	**—**	**464**	**22**	**18,734**
Dovekie	3	—	—	—	—	—	—	—	3
Common/Thick-billed Murre	—	3	—	—	—	—	4	1	8
Razorbill	10,888	6,925	—	—	—	—	374	3	18,190
Murre/Razorbill	75	259	—	—	—	—	81	16	431
Atlantic Puffin	16	1	—	—	—	—	5	1	23
species unknown	55	19	—	2	2	—	—	1	79
Gull	**12,504**	**10,609**	**38**	**63**	**470**	**45**	**3,956**	**936**	**28,621**
Black-legged Kittiwake	7	49	—	—	1	1	14	—	72
Bonaparte's Gull	11,756	8,525	—	—	6	—	481	43	20,811
Little Gull	2	—	—	—	—	1	1	—	4
Laughing Gull	35	4	38	53	211	39	307	408	1,095
Ring-billed Gull	10	4	—	—	3	—	77	7	101
Herring Gull	468	1,284	—	3	165	—	2,268	320	4,508
Iceland Gull	—	—	—	—	—	—	3	—	3
Lesser Black-backed Gull	17	64	—	—	35	—	50	1	167
Glaucous Gull	2	—	—	—	—	—	—	—	2
Great Black-backed Gull	66	89	—	2	27	1	271	43	499
species unknown - Large	9	40	—	—	3	1	139	—	192
species unknown - Small	128	543	—	3	18	2	340	104	1,138
species unknown	4	7	—	2	1	—	5	10	29
Tern	**—**	**4**	**148**	**115**	**448**	**721**	**31**	**8**	**1,475**
Sooty Tern	—	—	—	—	—	5	—	—	5
Bridled Tern	—	—	—	—	—	16	—	—	16

(continued)

Table C–10. (Continued)

Species	Raw Counts								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Sooty/Bridled Tern	—	—	—	—	—	1	—	—	1
Least Tern	—	—	—	—	—	14	—	—	14
Gull-billed Tern	—	—	—	4	14	—	—	—	18
Caspian Tern	—	—	13	4	7	1	—	—	25
Black Tern	—	—	29	2	—	389	—	—	420
Royal Tern	—	—	72	83	87	167	1	—	410
Royal/Caspian Tern	—	—	—	11	65	2	—	—	78
Sandwich Tern	—	—	31	4	62	77	—	—	174
Thalasseus Tern unid.	—	—	—	—	—	22	—	—	22
species unknown	—	4	3	7	213	27	30	8	292
***Sterna* Tern**	**509**	**624**	**39**	**84**	**353**	**1,068**	**512**	**814**	**4,003**
Common Tern	—	—	—	40	57	616	1	—	714
Commic Tern	—	—	—	—	1	—	—	—	1
Forster's Tern	509	434	—	1	15	10	422	697	2,088
Commic/Forster's Tern	—	190	—	43	244	435	89	117	1,118
species unknown	—	—	39	—	36	7	—	—	82
Passerine	**—**	**—**	**—**	**—**	**1**	**1**	**—**	**—**	**2**
species unknown	—	—	—	—	1	1	—	—	2
Total	**56,538**	**36,525**	**252**	**694**	**1,562**	**1,999**	**12,566**	**9,558**	**119,694**

Table C–11. Avian species identified in the February 2018 through February 2020 surveys in Areas A51 and A53

Species	Raw Counts								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Loon	**—**	**—**	**—**	**—**	**—**	**—**	**5**	**4**	**9**
Red-throated Loon	—	—	—	—	—	—	—	2	2
Common Loon	—	—	—	—	—	—	5	2	7
Shearwater	**—**	**—**	**—**	**—**	**—**	**12**	**—**	**—**	**12**
Cory's Shearwater	—	—	—	—	—	2	—	—	2
Great Shearwater	—	—	—	—	—	1	—	—	1
Audubon's Shearwater	—	—	—	—	—	6	—	—	6
species unknown-Large	—	—	—	—	—	2	—	—	2
species unknown-Small	—	—	—	—	—	1	—	—	1
Gannet	**1**	**—**	**—**	**—**	**—**	**—**	**1**	**1**	**3**
Northern Gannet	1	—	—	—	—	—	1	1	3
Phalarope	**453**	**22**	**—**	**—**	**—**	**—**	**—**	**—**	**475**
Red Phalarope	453	22	—	—	—	—	—	—	475
Gull	**2**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**3**
Bonaparte's Gull	2	—	—	—	—	—	—	—	2
Herring Gull	—	—	—	—	—	—	1	—	1
Tern	**—**	**—**	**—**	**—**	**—**	**2**	**—**	**—**	**2**
Bridled Tern	—	—	—	—	—	1	—	—	1
Royal/Caspian Tern	—	—	—	—	—	1	—	—	1
***Sterna* Tern**	**—**	**—**	**—**	**—**	**—**	**31**	**—**	**—**	**31**
Common Tern	—	—	—	—	—	6	—	—	6
Commic/Forster's Tern	—	—	—	—	—	25	—	—	25
Total	**456**	**22**	**—**	**—**	**—**	**45**	**7**	**5**	**535**

Table C–12. Avian species identified in the February 2018 through February 2020 surveys in the Charleston Call Area (CCA)

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Loon	**7**	**27**	**—**	**—**	**—**	**—**	**10**	**24**	**68**
Red-throated Loon	1	6	—	—	—	—	—	1	8
Common Loon	6	17	—	—	—	—	10	20	53
species unknown	—	4	—	—	—	—	—	3	7
Shearwater	**—**	**1**	**—**	**—**	**1**	**36**	**—**	**—**	**38**
Cory's Shearwater	—	—	—	—	—	3	—	—	3
Great Shearwater	—	—	—	—	1	—	—	—	1
Manx Shearwater	—	1	—	—	—	—	—	—	1
species unknown-Large	—	—	—	—	—	2	—	—	2
species unknown-Small	—	—	—	—	—	31	—	—	31
Gannet	**1**	**—**	**—**	**—**	**—**	**—**	**3**	**1**	**5**
Northern Gannet	1	—	—	—	—	—	3	1	5
Phalarope	**293**	**744**	**—**	**—**	**—**	**—**	**—**	**122**	**1,159**
Red Phalarope	293	744	—	—	—	—	—	106	1,143
Red/Red-necked Phalarope	—	—	—	—	—	—	—	16	16
Auk	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**—**	**1**
Dovekie	—	—	—	1	—	—	—	—	1
Gull	**2**	**15**	**—**	**—**	**—**	**—**	**—**	**—**	**17**
Bonaparte's Gull	—	11	—	—	—	—	—	—	11
Lesser Black-backed Gull	1	—	—	—	—	—	—	—	1
species unknown - Small	1	4	—	—	—	—	—	—	5
Tern	**—**	**—**	**—**	**1**	**3**	**3**	**—**	**—**	**7**
Sooty Tern	—	—	—	—	—	1	—	—	1
Black Tern	—	—	—	—	—	2	—	—	2
Royal Tern	—	—	—	—	1	—	—	—	1
Sandwich Tern	—	—	—	1	2	—	—	—	3
***Sterna* Tern**	**—**	**—**	**1**	**3**	**2**	**47**	**—**	**—**	**53**
Common Tern	—	—	—	—	—	27	—	—	27
Commic/Forster's Tern	—	—	—	3	2	20	—	—	25
species unknown	—	—	1	—	—	—	—	—	1
Total	**303**	**787**	**1**	**5**	**6**	**86**	**13**	**147**	**1,348**

Table C–13. Avian species identified in the February 2018 through February 2020 surveys in the Kitty Hawk (KH) Area

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Loon	**66**	**41**	**—**	**8**	**—**	**—**	**73**	**5**	**193**
Red-throated Loon	4	1	—	—	—	—	4	1	10
Common Loon	62	39	—	8	—	—	69	4	182
species unknown	—	1	—	—	—	—	—	—	1
Fulmar	**3**	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**4**
Northern Fulmar	3	1	—	—	—	—	—	—	4
Petrel	**—**	**—**	**—**	**1**	**—**	**1**	**—**	**—**	**2**
Trindade Petrel	—	—	—	1	—	—	—	—	1
Black-capped Petrel	—	—	—	—	—	1	—	—	1
Shearwater	**—**	**1**	**—**	**—**	**1**	**3**	**294**	**—**	**299**
Cory's Shearwater	—	—	—	—	1	1	1	—	3
Great Shearwater	—	—	—	—	—	1	—	—	1
Sooty Shearwater	—	—	—	—	—	—	4	—	4
Manx Shearwater	—	1	—	—	—	—	289	—	290
Audubon's Shearwater	—	—	—	—	—	1	—	—	1
Gannet	**49**	**11**	**—**	**—**	**3**	**—**	**9**	**3**	**75**
Northern Gannet	49	11	—	—	3	—	9	3	75
Phalarope	**—**	**3**	**—**	**—**	**—**	**—**	**238**	**7**	**248**
Red-necked Phalarope	—	—	—	—	—	—	5	—	5
Red Phalarope	—	3	—	—	—	—	168	—	171
Red/Red-necked Phalarope	—	—	—	—	—	—	65	7	72
Skua	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**
Great Skua	1	—	—	—	—	—	—	—	1
Auk	**17**	**177**	**—**	**—**	**—**	**—**	**20**	**—**	**214**
Razorbill	11	153	—	—	—	—	16	—	180
Murre/Razorbill	1	—	—	—	—	—	4	—	5
Atlantic Puffin	5	22	—	—	—	—	—	—	27
species unknown	—	2	—	—	—	—	—	—	2

(continued)

Table C–13. (Continued)

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Gull	**12**	**34**	**—**	**—**	**—**	**1**	**2,733**	**164**	**2,944**
Black-legged Kittiwake	5	4	—	—	—	—	549	1	559
Bonaparte's Gull	1	6	—	—	—	—	1,081	109	1,197
Laughing Gull	—	—	—	—	—	—	7	—	7
Ring-billed Gull	—	—	—	—	—	—	15	—	15
Herring Gull	—	7	—	—	—	1	14	23	45
Lesser Black-backed Gull	—	1	—	—	—	—	—	—	1
Great Black-backed Gull	6	—	—	—	—	—	24	23	53
species unknown - Large	—	—	—	—	—	—	3	1	4
species unknown - Small	—	16	—	—	—	—	1,040	7	1,063
Tern	**—**	**—**	**—**	**—**	**—**	**2**	**—**	**—**	**2**
Sooty/Bridled Tern	—	—	—	—	—	1	—	—	1
Black Tern	—	—	—	—	—	1	—	—	1
***Sterna* Tern**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**1**
Commic/Forster's Tern	—	—	—	—	—	—	1	—	1
Total	**148**	**268**	**—**	**9**	**4**	**7**	**3,368**	**179**	**3,983**

Table C–14. Avian species identified in the February 2018 through December 2018 surveys in the Wilmington West (WW) Area

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Duck	**5**	**2**	**—**	**—**	**—**	**—**	**2**	**—**	**9**
Black Scoter	4	2	—	—	—	—	—	—	6
Long-tailed Duck	1	—	—	—	—	—	—	—	1
species unknown	—	—	—	—	—	—	2	—	2
Loon	**84**	**240**	**—**	**—**	**—**	**—**	**77**	**34**	**435**
Red-throated Loon	3	4	—	—	—	—	1	—	8
Common Loon	81	236	—	—	—	—	76	34	427
Petrel	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**1**
species unknown	—	1	—	—	—	—	—	—	1
Shearwater	**1**	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**2**
Manx Shearwater	1	—	—	—	—	—	—	—	1
Species unknown-Large	—	—	1	—	—	—	—	—	1
Gannet	**128**	**47**	**—**	**—**	**—**	**—**	**161**	**127**	**463**
Northern Gannet	128	47	—	—	—	—	161	127	463
Cormorant	**—**	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**2**
species unknown	—	2	—	—	—	—	—	—	2
Phalarope	**24**	**912**	**—**	**—**	**—**	**—**	**100**	**532**	**1,568**
Red-necked Phalarope	—	—	—	—	—	—	—	2	2
Red Phalarope	24	912	—	—	—	—	100	311	1,347
Red/Red-necked Phalarope	—	—	—	—	—	—	—	219	219
Skua	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**1**
species unknown	—	—	—	—	—	—	1	—	1
Auk	**156**	**318**	**—**	**—**	**—**	**—**	**—**	**3**	**477**
Razorbill	149	315	—	—	—	—	—	—	464
Murre/Razorbill	7	3	—	—	—	—	—	3	13
Gull	**228**	**1,126**	**—**	**—**	**—**	**1**	**14**	**34**	**1,403**
Black-legged Kittiwake	—	—	—	—	—	—	—	1	1
Bonaparte's Gull	226	1,103	—	—	—	—	3	5	1,337
Laughing Gull	—	—	—	—	—	—	8	1	9
Herring Gull	1	15	—	—	—	—	2	27	45

(continued)

Table C–14. (Continued)

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Great Black-backed Gull	—	1	—	—	—	—	—	—	1
species unknown - Large	1	—	—	—	—	—	—	—	1
species unknown - Small	—	5	—	—	—	1	1	—	7
species unknown	—	2	—	—	—	—	—	—	2
Tern	**—**	**2**	**—**	**—**	**4**	**20**	**—**	**1**	**27**
Royal Tern	—	—	—	—	4	12	—	—	16
Royal/Caspian Tern	—	—	—	—	—	5	—	—	5
Sandwich Tern	—	—	—	—	—	1	—	—	1
Thalasseus Tern unid.	—	—	—	—	—	1	—	—	1
species unknown	—	2	—	—	—	1	—	1	4
***Sterna* Tern**	**7**	**22**	**—**	**—**	**4**	**—**	**38**	**43**	**114**
Forster's Tern	7	22	—	—	—	—	20	43	92
Commic/Forster's Tern	—	—	—	—	4	—	18	—	22
Passerine	**—**	**—**	**—**	**24**	**—**	**—**	**—**	**—**	**24**
species unknown	—	—	—	24	—	—	—	—	24
Total	**633**	**2,672**	**1**	**24**	**8**	**21**	**393**	**774**	**4,526**

Table C–15. Avian species identified in the February 2018 through February 2020 surveys in the Wilmington East (WE) Area

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Loon	**85**	**35**	**—**	**—**	**—**	**—**	**26**	**13**	**159**
Red-throated Loon	6	3	—	—	—	—	—	—	9
Common Loon	78	32	—	—	—	—	26	13	149
species unknown	1	—	—	—	—	—	—	—	1
Petrel	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**1**
Black-capped Petrel	—	—	—	—	—	1	—	—	1
Shearwater	**7**	**—**	**—**	**—**	**1**	**77**	**—**	**1**	**86**
Cory's Shearwater	—	—	—	—	1	44	—	—	45
Great Shearwater	—	—	—	—	—	12	—	—	12
Manx Shearwater	7	—	—	—	—	—	—	1	8
Audubon's Shearwater	—	—	—	—	—	17	—	—	17
species unknown-Large	—	—	—	—	—	1	—	—	1
species unknown	—	—	—	—	—	3	—	—	3
Gannet	**33**	**8**	**—**	**—**	**—**	**—**	**228**	**45**	**314**
Northern Gannet	33	8	—	—	—	—	228	45	314
Phalarope	**511**	**6,047**	**—**	**—**	**—**	**—**	**—**	**1,055**	**7,613**
Red-necked Phalarope	—	—	—	—	—	—	—	3	3
Red Phalarope	511	6,047	—	—	—	—	—	1,038	7,596
Red/Red-necked Phalarope	—	—	—	—	—	—	—	14	14
Auk	**258**	**7**	**—**	**—**	**—**	**—**	**—**	**—**	**265**
Razorbill	258	7	—	—	—	—	—	—	265
Gull	**794**	**449**	**—**	**—**	**—**	**—**	**11**	**45**	**1,299**
Bonaparte's Gull	776	438	—	—	—	—	—	1	1,215
Laughing Gull	—	—	—	—	—	—	8	—	8
Ring-billed Gull	1	—	—	—	—	—	1	—	2
Herring Gull	16	—	—	—	—	—	1	41	58
Lesser Black-backed Gull	1	—	—	—	—	—	1	—	2
species unknown - Small	—	11	—	—	—	—	—	3	14

(continued)

Table C–15. (Continued)

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Tern	**—**	**—**	**—**	**—**	**12**	**40**	**—**	**1**	**53**
Sooty Tern	—	—	—	—	—	1	—	—	1
Bridled Tern	—	—	—	—	2	7	—	—	9
Sooty/Bridled Tern	—	—	—	—	—	6	—	—	6
Gull-billed Tern	—	—	—	—	—	1	—	—	1
Black Tern	—	—	—	—	—	4	—	—	4
Royal Tern	—	—	—	—	8	20	—	—	28
species unknown	—	—	—	—	2	1	—	1	4
***Sterna* Tern**	**46**	**8**	**—**	**7**	**5**	**25**	**—**	**54**	**145**
Common Tern	—	—	—	1	4	20	—	—	25
Forster's Tern	46	7	—	—	—	—	—	39	92
Commic/Forster's Tern	—	—	—	6	1	5	—	—	12
species unknown	—	1	—	—	—	—	—	15	16
Passerine	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**1**
species unknown	—	—	—	—	—	1	—	—	1
Total	**1,734**	**6,554**	**—**	**7**	**18**	**144**	**265**	**1,214**	**9,936**

Table C–16. Avian species identified in the February 2018 through February 2020 surveys in the Grand Strand Call Area (GSCA; counts include part of WW)

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Duck	**—**	**8**	**—**	**—**	**—**	**—**	**11**	**—**	**19**
Lesser Scaup	—	—	—	—	—	—	4	—	4
White-winged Scoter	—	—	—	—	—	—	1	—	1
Black Scoter	—	3	—	—	—	—	4	—	7
Scoter unid.	—	4	—	—	—	—	—	—	4
species unknown	—	1	—	—	—	—	2	—	3
Loon	**317**	**303**	**—**	**1**	**36**	**—**	**188**	**164**	**1,009**
Red-throated Loon	11	18	—	—	—	—	16	2	47
Common Loon	302	285	—	1	36	—	170	162	956
species unknown	4	—	—	—	—	—	2	—	6
Shearwater	**—**	**3**	**2**	**—**	**3**	**—**	**—**	**—**	**8**
Cory's Shearwater	—	—	1	—	2	—	—	—	3
Great Shearwater	—	—	—	—	1	—	—	—	1
Manx Shearwater	—	3	—	—	—	—	—	—	3
species unknown-Large	—	—	1	—	—	—	—	—	1
Gannet	**287**	**586**	**—**	**—**	**—**	**—**	**583**	**17**	**1,473**
Northern Gannet	287	586	—	—	—	—	583	17	1,473
Shorebird	**—**	**—**	**—**	**2**	**—**	**—**	**—**	**—**	**2**
species unknown	—	—	—	2	—	—	—	—	2
Phalarope	**1,320**	**206**	**—**	**—**	**5**	**—**	**212**	**2,377**	**4,120**
Red-necked Phalarope	—	—	—	—	—	—	2	—	2
Red Phalarope	1,310	206	—	—	5	—	210	2,377	4,108
Red/Red-necked Phalarope	10	—	—	—	—	—	—	—	10
Skua	**—**	**—**	**—**	**—**	**1**	**—**	**1**	**—**	**2**
Pomarine Jaeger	—	—	—	—	—	—	1	—	1
Parasitic Jaeger	—	—	—	—	1	—	—	—	1
Auk	**55**	**282**	**—**	**7**	**—**	**—**	**1**	**—**	**345**
Dovekie	—	—	—	7	—	—	—	—	7
Common/Thick-billed Murre	—	1	—	—	—	—	—	—	1
Razorbill	54	280	—	—	—	—	—	—	334
Murre/Razorbill	1	1	—	—	—	—	1	—	3

(continued)

Table C–16. (Continued)

Species	Raw Count								Total Species
	2018 February	2020 February	2018 May/June	2019 May	2018 October	2019 September	2018 December	2019 December	
Gull	**131**	**1,113**	**—**	**—**	**6**	**—**	**45**	**20**	**1,315**
Black-legged Kittiwake	—	—	—	—	1	—	—	1	2
Bonaparte's Gull	128	1,048	—	—	—	—	10	11	1,197
Little Gull	—	1	—	—	—	—	—	—	1
Laughing Gull	—	—	—	—	—	—	8	—	8
Ring-billed Gull	—	—	—	—	—	—	2	—	2
Herring Gull	2	31	—	—	—	—	24	4	61
Lesser Black-backed Gull	—	1	—	—	—	—	—	1	2
Great Black-backed Gull	—	1	—	—	—	—	—	1	2
species unknown - Small	1	29	—	—	5	—	1	2	38
species unknown	—	2	—	—	—	—	—	—	2
Tern	**—**	**—**	**1**	**8**	**115**	**61**	**3**	**—**	**188**
Bridled Tern	—	—	—	—	1	—	—	—	1
Caspian Tern	—	—	—	—	1	—	—	—	1
Royal Tern	—	—	1	8	23	50	—	—	82
Royal/Caspian Tern	—	—	—	—	22	3	—	—	25
Sandwich Tern	—	—	—	—	4	4	—	—	8
Thalasseus Tern unid.	—	—	—	—	—	1	—	—	1
species unknown	—	—	—	—	64	3	3	—	70
***Sterna* Tern**	**20**	**9**	**1**	**1**	**420**	**12**	**43**	**104**	**610**
Common Tern	—	—	—	—	57	1	—	—	58
Forster's Tern	20	8	—	—	77	1	38	103	247
Commic/Forster's Tern	—	—	—	1	282	10	5	—	298
species unknown	—	1	1	—	4	—	—	1	7
Passerine	**—**	**—**	**—**	**24**	**—**	**—**	**—**	**—**	**24**
species unknown	—	—	—	24	—	—	—	—	24
Total	**2,130**	**2,510**	**4**	**43**	**586**	**73**	**1,087**	**2,682**	**9,115**

C.3 Species Composition and Percent Relative Abundance by Survey Area for Each Survey

Table C–17. Percent relative abundance of each avian species group for each area for the February 2018 survey

Species Group	Percent Relative Abundance										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY TOTAL (%)
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Duck	0.16				**0.16**		0.79			**0.11**	**0.15**
Loon	27.02			2.31	**26.84**	44.59	13.27	4.90	14.88	**11.80**	**25.71**
Grebe											
Fulmar	0.08				**0.08**	2.03				**0.06**	**0.08**
Shearwater	0.04				**0.04**		0.16	0.40		**0.17**	**0.05**
Storm-petrel											
Gannet	10.40		0.22	0.33	**10.33**	33.11	20.22	1.90	13.47	**10.74**	**10.36**
Cormorant	0.03				**0.03**						**0.03**
Phalarope	19.72	66.67	99.56	96.70	**20.28**		3.79	29.47	61.97	**40.10**	**21.77**
Skua						0.68				**0.02**	
Auk	19.52				**19.38**	11.49	24.64	14.88	2.58	**10.22**	**18.70**
Gull	22.12	33.33	0.22	0.66	**21.96**	8.11	36.02	45.79	6.15	**25.18**	**22.20**
Sterna Tern	0.90				**0.89**		1.11	2.65	0.94	**1.58**	**0.95**
Totals	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table C–18. Percent relative abundance of each avian species group for each area for the February 2020 survey

Species Group	Percent Relative Abundance										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY TOTAL (%)
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Duck	0.08				**0.08**		0.07		0.32	**0.08**	**0.08**
Loon	10.05			3.43	**9.90**	15.30	8.98	0.53	12.07	**4.99**	**8.72**
Fulmar						0.37				**0.01**	**>0.01**
Petrel	0.01				**0.01**		0.04			**0.01**	**0.01**
Shearwater	0.20			0.13	**0.20**	0.37			0.12	**0.03**	**0.16**
Gannet	12.72				**12.50**	4.10	1.76	0.12	23.35	**5.47**	**10.80**
Cormorant	3.16				**3.11**		0.07			**0.02**	**2.36**
Pelican	0.13				**0.13**						**0.10**
Phalarope	23.15		100.00	94.54	**24.43**	1.12	34.13	92.26	8.21	**59.83**	**32.98**
Auk	19.73				**19.39**	66.04	11.90	0.11	11.24	**6.51**	**16.28**
Gull	29.05			1.91	**28.57**	12.69	42.14	6.85	44.34	**22.71**	**27.16**
Tern	0.01				**0.01**		0.07			**0.02**	**0.01**
Sterna Tern	1.71				**1.68**		0.82	0.12	0.36	**0.33**	**1.35**
Totals	**100.00**	**—**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table C–19. Percent relative abundance of each avian species group for each area for the May/June 2018 survey

Species Group	Percent Relative Abundance										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY TOTAL (%)
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Loon	3.97				**3.95**						**3.89**
Petrel	0.79				**0.79**						**0.78**
Shearwater	3.57				**3.56**				50.00	**50.00**	**4.28**
Gannet	1.19				**1.19**						**1.17**
Ardeidae	0.40				**0.40**						**0.39**
Phalarope	0.79				**0.79**						**0.78**
Gull	15.08				**15.02**						**14.79**
Tern	58.73				**58.50**				25.00	**25.00**	**57.98**
Sterna Tern	15.48			100.00	**15.81**				25.00	**25.00**	**15.95**
Totals	**100.00**	**—**	**—**	**100.00**	**100.00**	**—**	**—**	**—**	**100.00**	**100.00**	**100.00**

Table C–20. Percent relative abundance of each avian species group for each area for the May 2019 survey

Species Group	Percent Relative Abundance										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY TOTAL (%)
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Loon	6.77				**6.75**	88.89			2.33	**15.25**	**7.42**
Petrel						11.11				**1.69**	**0.13**
Shearwater	0.43				**0.43**						**0.40**
Storm-petrel	0.72				**0.72**						**0.66**
Gannet	0.86				**0.86**						**0.79**
Cormorant	0.29				**0.29**						**0.26**
Pelican	1.59				**1.58**						**1.46**
Ardeidae	0.14				**0.14**						**0.13**
Shorebird	46.40				**46.26**				4.65	**3.39**	**42.91**
Phalarope	4.61				**4.60**						**4.24**
Skua	0.14				**0.14**						**0.13**
Auk	0.29			20.00	**0.43**				16.28	**11.86**	**1.32**
Gull	9.08				**9.05**						**8.34**
Tern	16.57			20.00	**16.52**				18.60	**13.56**	**16.29**
Sterna Tern	12.1			60.00	**12.21**			100.00	2.33	**13.56**	**12.32**
Passerine							100.00		55.81	**40.68**	**3.18**
Totals	**100.00**	**—**	**—**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table C–21. Percent relative abundance of each avian species group for each area for the October 2018 survey

Species Group	Percent Relative Abundance										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY TOTAL (%)
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Loon	4.80				**4.79**				6.14	**5.84**	**5.09**
Fulmar	0.06				**0.06**						**0.05**
Petrel	0.32				**0.32**						**0.23**
Shearwater	3.33			16.67	**3.39**	25.00		5.56	0.51	**0.81**	**2.66**
Storm-petrel	0.13				**0.13**						**0.09**
Gannet	3.97				**3.96**	75.00				**0.49**	**2.98**
Cormorant	0.51				**0.51**						**0.37**
Pelican	1.34				**1.34**						**0.96**
Ardeidae	0.96				**0.96**						**0.69**
Raptor	0.06				**0.06**						**0.05**
Shorebird	1.02				**1.02**						**0.73**
Phalarope	1.86				**1.85**				0.85	**0.81**	**1.56**
Skua	0.06				**0.06**				0.17	**0.16**	**0.09**
Auk	0.13				**0.13**						**0.09**
Gull	30.09				**30.03**				1.02	**0.97**	**21.82**
Tern	28.68			50.00	**28.63**		50.00	66.67	19.62	**21.27**	**26.55**
Sterna Tern	22.60			33.33	**22.68**		50.00	27.78	71.67	**69.64**	**35.95**
Passerine	0.06				**0.06**						**0.05**
Totals	**100.00**	**—**	**—**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table C–22. Percent relative abundance of each avian species group for each area for the September 2019 survey

Species Group	Percent Relative Abundance										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY TOTAL (%)
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Duck	0.40				**0.38**						**0.34**
Petrel	0.05				**0.05**	14.29		0.69		**0.83**	**0.13**
Shearwater	5.90	50.00	25.58	41.86	**7.63**	42.86		53.47		**33.06**	**10.25**
Pelican	0.05				**0.05**						**0.04**
Ardeidae	0.05				**0.05**						**0.04**
Shorebird	0.10				**0.09**						**0.09**
Phalarope	1.55				**1.47**						**1.32**
Skua	0.10				**0.09**						**0.09**
Gull	2.25				**2.13**	14.29	4.76			**0.83**	**2.00**
Tern	36.07	50.00	2.33	3.49	**34.36**	28.57	95.24	27.78	83.56	**49.59**	**35.93**
Sterna Tern	53.43		72.09	54.65	**53.65**			17.36	16.44	**15.29**	**49.70**
Passerine	0.05				**0.05**			0.69		**0.41**	**0.09**
Totals	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table C–23. Percent relative abundance of each avian species group for each area for the December 2018 survey

Species Group	Percent Relative Abundance										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY TOTAL (%)
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Duck	4.77				**4.77**		0.51		1.01	**0.22**	**3.46**
Loon	16.53	60.00	100.00	76.92	**16.55**	2.17	19.59	9.81	17.30	**6.81**	**13.75**
Fulmar	0.01				**0.01**						**0.01**
Shearwater	0.03				**0.03**	8.73				**5.80**	**1.69**
Gannet	36.46	20.00		23.08	**36.45**	0.27	40.97	86.04	53.63	**19.01**	**31.44**
Cormorant	0.03				**0.03**						**0.02**
Pelican	0.35				**0.35**						**0.25**
Phalarope	2.29				**2.29**	7.07	25.45		19.50	**10.78**	**4.73**
Skua	0.03				**0.03**		0.25		0.09	**0.04**	**0.03**
Auk	3.69				**3.69**	0.59			0.09	**0.41**	**2.75**
Gull	31.48	20.00			**31.47**	81.15	3.56	4.15	4.14	**55.28**	**38.31**
Tern	0.25				**0.25**				0.28	**0.06**	**0.19**
Sterna Tern	4.07				**4.07**	0.03	9.67		3.96	**1.60**	**3.36**
Totals	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table C–24. Percent relative abundance of each avian species group for each area for the December 2019 survey

Species Group	Percent Relative Abundance										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY TOTAL (%)
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Duck	2.54				**2.53**						**1.70**
Loon	22.47	66.67	100.00	16.33	**22.47**	2.79	4.39	1.07	6.11	**4.51**	**16.58**
Shearwater	0.94				**0.94**			0.08		**0.02**	**0.64**
Gannet	34.30	33.33		0.68	**34.08**	1.68	16.41	3.71	0.63	**4.00**	**24.21**
Cormorant	0.04				**0.04**						**0.03**
Shorebird	0.04				**0.04**						**0.03**
Phalarope	21.01			82.99	**21.38**	3.91	68.73	86.90	88.63	**82.16**	**41.32**
Skua	0.03				**0.03**						**0.02**
Auk	0.23				**0.23**		0.39			**0.06**	**0.17**
Gull	9.79				**9.73**	91.62	4.39	3.71	0.75	**5.56**	**8.36**
Tern	0.08				**0.08**		0.13	0.08		**0.04**	**0.07**
Sterna Tern	8.52				**8.46**		5.56	4.45	3.88	**3.64**	**6.88**
Totals	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

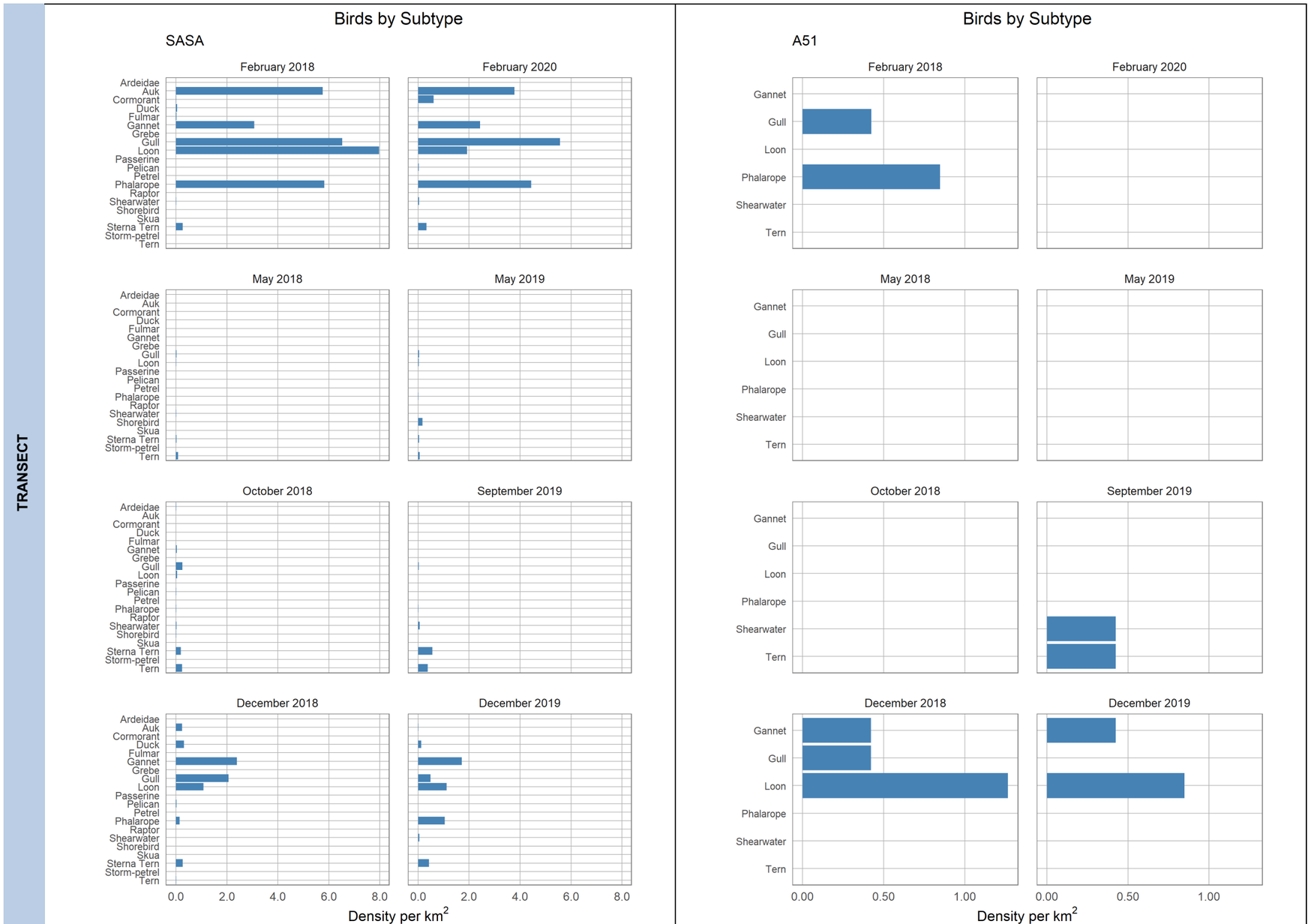

Figure C–1. Density (per km^2) of avian species groups during the February 2018 through February 2020 surveys for each area by survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

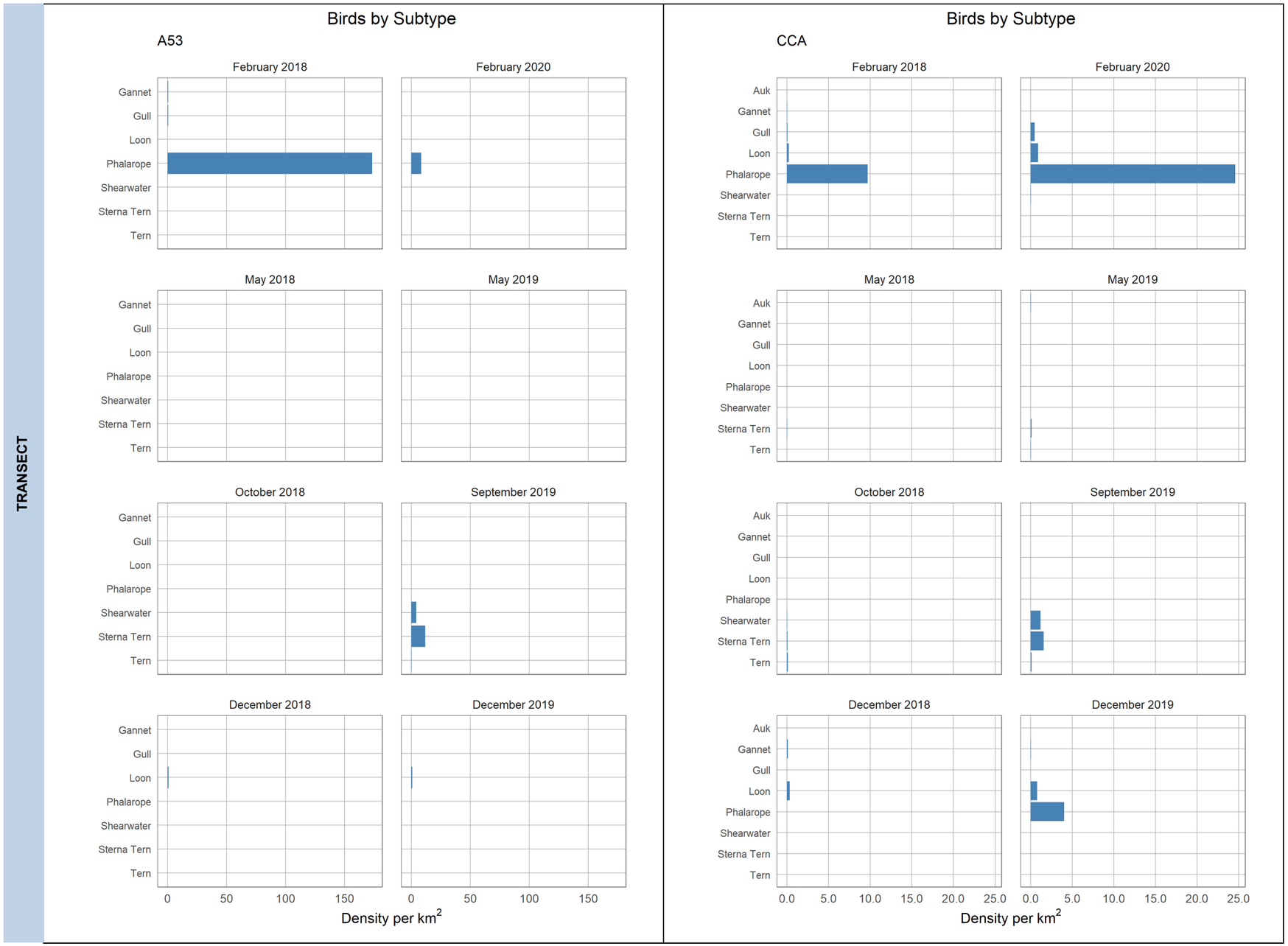

Figure C–1. (Continued)

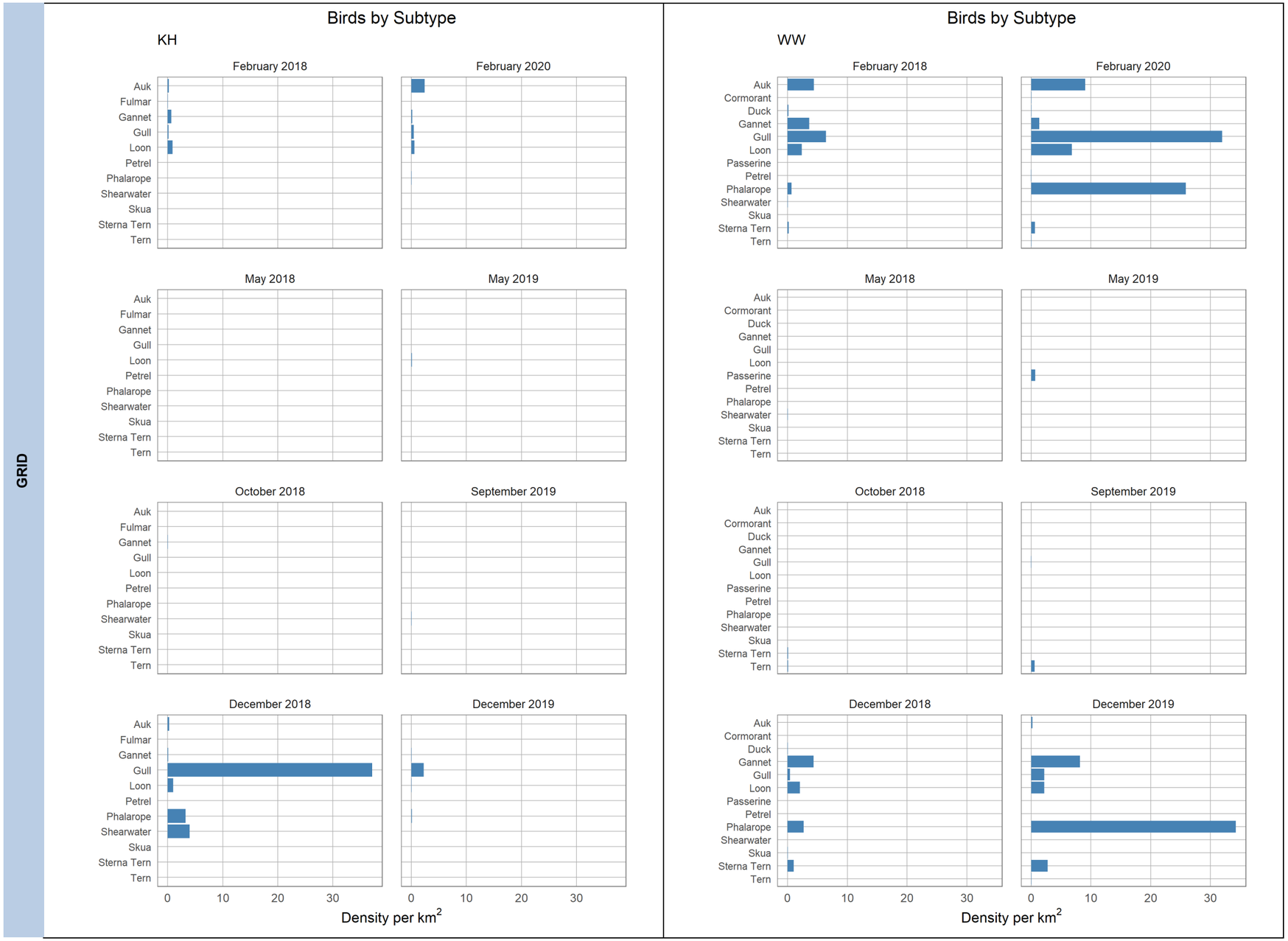

Figure C–1. (Continued)

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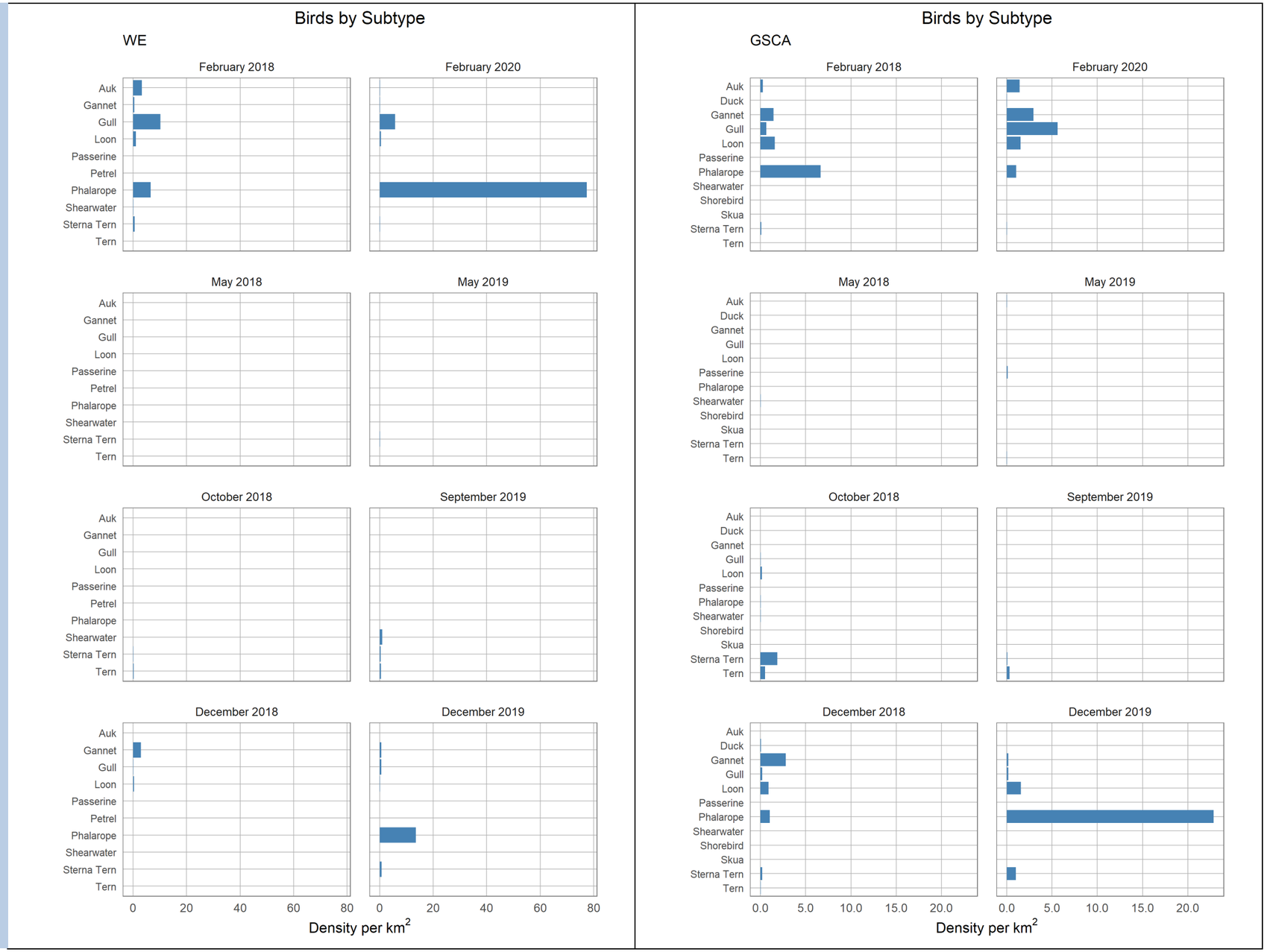


Figure C–1. (Continued)

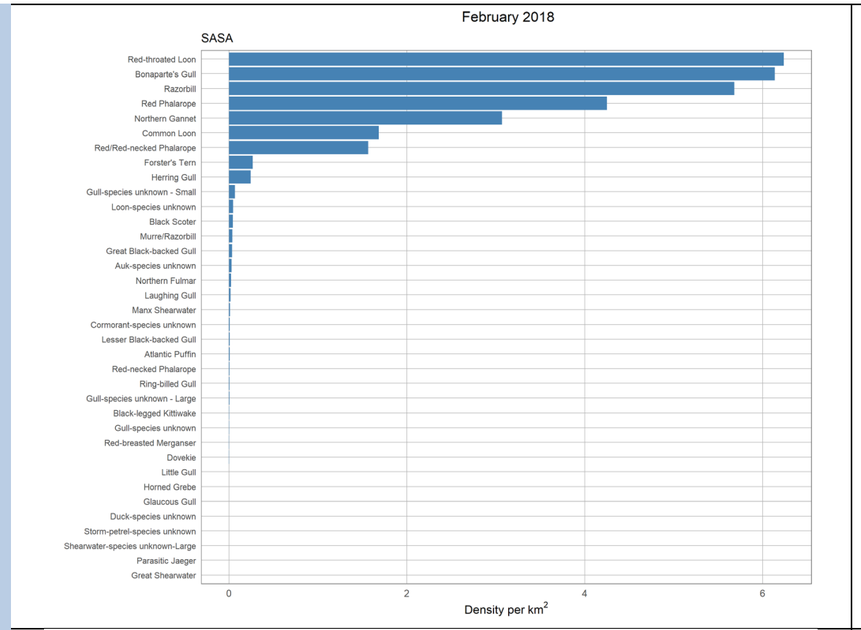
Table C–25. Avian Species Identified within each Species Group and the Density (per km^2) of Individuals for each Area during the February 2018 survey

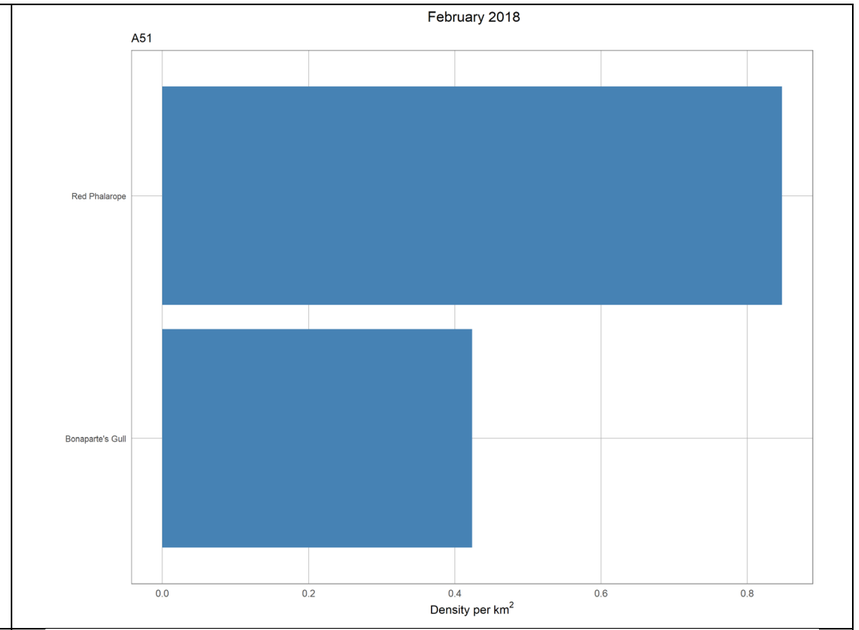
Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Duck	**0.0470**				**0.0461**		**0.1416**			**0.0130**	**0.0406**
Black Scoter	0.0444				0.0436		0.1133			0.0104	0.0381
Long-tailed Duck							0.0283			0.0026	0.0004
Red-breasted Merganser	0.0016				0.0015						0.0013
species unknown	0.0010				0.0010						0.0009
Loon	**7.9720**			**0.2312**	**7.8306**	**0.8967**	**2.3783**	**1.0849**	**1.5950**	**1.4144**	**6.7710**
Red-throated Loon	6.2383			0.0330	6.1261	0.0543	0.0849	0.0766	0.0553	0.0622	5.1247
Common Loon	1.6857			0.1982	1.6573	0.8424	2.2933	0.9955	1.5195	1.3393	1.6048
species unknown	0.0480				0.0471			0.0128	0.0201	0.0130	0.0415
Grebe	**0.0010**				**0.0010**						**0.0009**
Horned Grebe	0.0010				0.0010						0.0009
Fulmar	**0.0235**				**0.0231**	**0.0408**				**0.0078**	**0.0205**
Northern Fulmar	0.0235				0.0231	0.0408				0.0078	0.0205
Shearwater	**0.0115**				**0.0113**		**0.0283**	**0.0893**		**0.0207**	**0.0128**
Great Shearwater	0.0005				0.0005						0.0004
Manx Shearwater	0.0104				0.0102		0.0283	0.0893		0.0207	0.0120
species unknown-Large	0.0005				0.0005						0.0004
Storm-petrel	**0.0005**				**0.0005**						**0.0004**
species unknown	0.0005				0.0005						0.0004
Gannet	**3.0693**		**0.3846**	**0.0330**	**3.0149**	**0.6658**	**3.6240**	**0.4212**	**1.4440**	**1.2875**	**2.7296**
Northern Gannet	3.0693		0.3846	0.0330	3.0149	0.6658	3.6240	0.4212	1.4440	1.2875	2.7296
Cormorant	**0.0099**				**0.0097**						**0.0081**
species unknown	0.0099				0.0097						0.0081
Phalarope	**5.8202**	**0.8475**	**173.4615**	**9.6764**	**5.9171**		**0.6795**	**6.5220**	**6.6415**	**4.8055**	**5.7335**
Red-necked Phalarope	0.0057				0.0056						0.0047
Red Phalarope	4.2483	0.8475	173.4615	9.6764	4.3735		0.6795	6.5220	6.5912	4.7795	4.4405

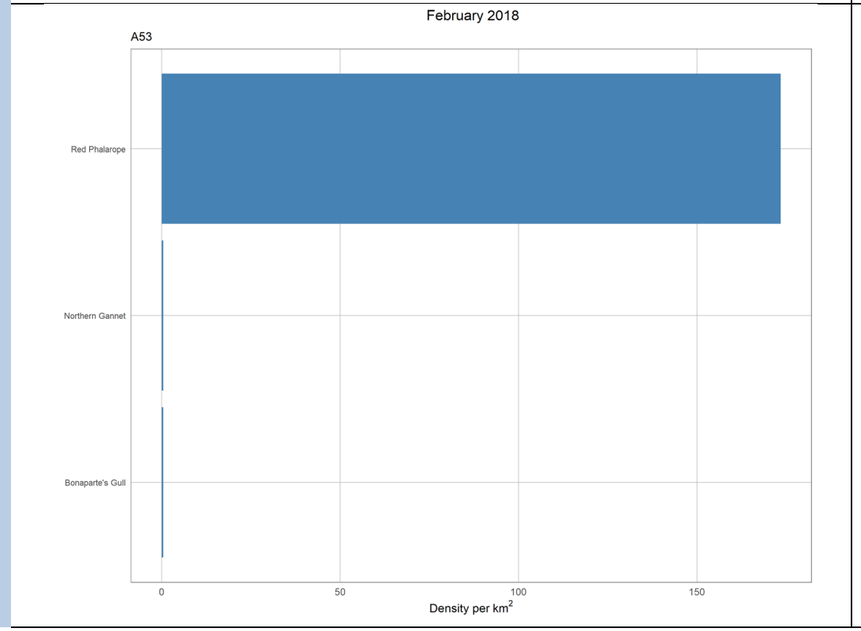
(continued)

Table C–25. (Continued)

Species	Density per km²										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Red/Red-necked Phalarope	1.5662				1.5379				0.0503	0.0259	1.2882
Skua	**0.0005**				**0.0005**	**0.0136**				**0.0026**	**0.0009**
Great Skua						0.0136				0.0026	0.0004
Parasitic Jaeger	0.0005				0.0005						0.0004
Auk	**5.7602**				**5.6562**	**0.2310**	**4.4168**	**3.2929**	**0.2767**	**1.2253**	**4.9244**
Dovekie	0.0016				0.0015						0.0013
Razorbill	5.6825				5.5798	0.1495	4.2186	3.2929	0.2717	1.1891	4.8547
Murre/Razorbill	0.0391				0.0384	0.0136	0.1982		0.0050	0.0233	0.0359
Atlantic Puffin	0.0084				0.0082	0.0679				0.0130	0.0090
species unknown	0.0287				0.0282						0.0235
Gull	**6.5259**	**0.4237**	**0.3846**	**0.0661**	**6.4085**	**0.1630**	**6.4553**	**10.1340**	**0.6591**	**3.0180**	**5.8486**
Black-legged Kittiwake	0.0037				0.0036	0.0679				0.0130	0.0051
Bonaparte's Gull	6.1355	0.4237	0.3846		6.0247	0.0136	6.3986	9.9043	0.6440	2.9299	5.5136
Little Gull	0.0010				0.0010						0.0009
Laughing Gull	0.0183				0.0179						0.0150
Ring-billed Gull	0.0052				0.0051			0.0128		0.0026	0.0047
Herring Gull	0.2442				0.2398		0.0283	0.2042	0.0101	0.0492	0.2084
Lesser Black-backed Gull	0.0089			0.0330	0.0092			0.0128		0.0026	0.0081
Glaucous Gull	0.0010				0.0010						0.0009
Great Black-backed Gull	0.0344				0.0338	0.0815				0.0155	0.0308
species unknown - Large	0.0047				0.0046		0.0283			0.0026	0.0043
species unknown - Small	0.0668			0.0330	0.0656				0.0050	0.0026	0.0552
species unknown	0.0021				0.0020						0.0017
***Sterna* Tern**	**0.2656**				**0.2609**		**0.1982**	**0.5871**	**0.1006**	**0.1891**	**0.2490**
Forster's Tern	0.2656				0.2609		0.1982	0.5871	0.1006	0.1891	0.2490
Total	**29.5073**	**1.2712**	**174.2308**	**10.0066**	**29.1804**	**2.0109**	**17.9219**	**22.1315**	**10.7170**	**11.9838**	**26.3403**







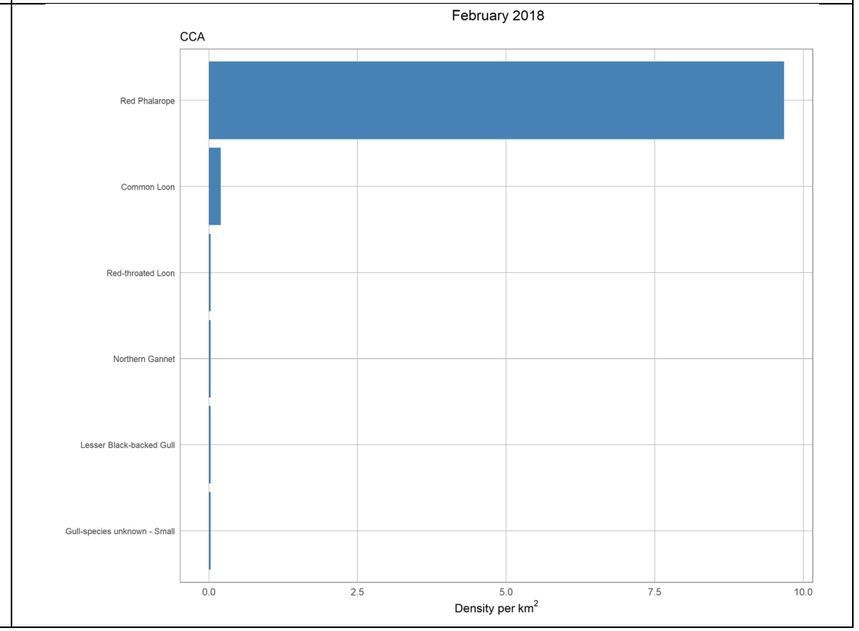


Figure C–2. Density (per km^2) of avian species identified in the February 2018 survey in each area, ordered by density for each area (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

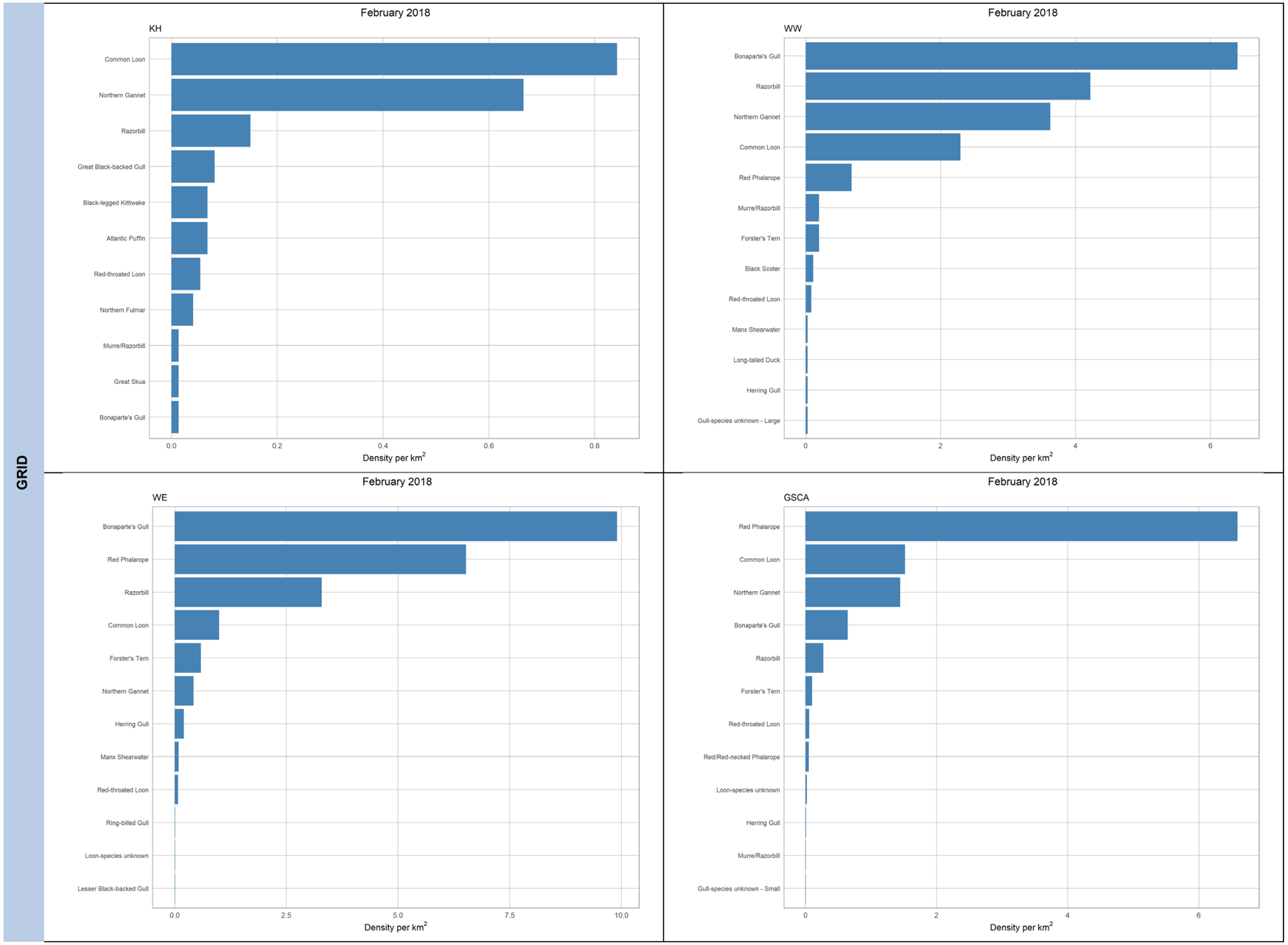


Figure C–2. (Continued)

Table C–26. Avian Species Identified within each Species Group and the Density (per km^2) of Individuals for each Area during the February 2020 survey

Species Group	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Duck	**0.0147**				**0.0144**		**0.0568**		**0.0403**	**0.0260**	**0.0163**
Greater Scaup	0.0126				0.0124						0.0103
Surf Scoter	0.0005				0.0005						0.0004
Black Scoter	0.0016				0.0015		0.0568		0.0151	0.0130	0.0034
Scoter unid.									0.0202	0.0104	0.0017
species unknown									0.0050	0.0026	0.0004
Loon	**1.9262**			**0.8917**	**1.8964**	**0.5586**	**6.8124**	**0.4479**	**1.5265**	**1.5314**	**1.8360**
Red-throated Loon	0.4628			0.1982	0.4554	0.0136	0.1135	0.0384	0.0907	0.0675	0.3912
Common Loon	1.3868			0.5614	1.3658	0.5313	6.6988	0.4095	1.4358	1.4614	1.3816
species unknown	0.0766			0.1321	0.0752	0.0136				0.0026	0.0632
Fulmar						**0.0136**				**0.0026**	**0.0004**
Northern Fulmar						0.0136				0.0026	0.0004
Petrel	**0.0010**				**0.0010**		**0.0284**			**0.0026**	**0.0013**
Black-capped Petrel	0.0010				0.0010						0.0009
species unknown							0.0284			0.0026	0.0004
Shearwater	**0.0378**			**0.0330**	**0.0376**	**0.0136**			**0.0151**	**0.0104**	**0.0331**
Manx Shearwater	0.0373			0.0330	0.0371	0.0136			0.0151	0.0104	0.0327
species unknown-Small	0.0005				0.0005						0.0004
Gannet	**2.4378**				**2.3935**	**0.1499**	**1.3341**	**0.1024**	**2.9523**	**1.6794**	**2.2753**
Northern Gannet	2.4378				2.3935	0.1499	1.3341	0.1024	2.9523	1.6794	2.2753
Cormorant	**0.6066**				**0.5956**		**0.0568**			**0.0052**	**0.4978**
Double-crested Cormorant	0.5997				0.5889						0.4913
species unknown	0.0068				0.0067		0.0568			0.0052	0.0064
Pelican	**0.0257**				**0.0252**						**0.0211**
Brown Pelican	0.0257				0.0252						0.0211

(continued)

Table C–26. (Continued)

Species Group	Density per km²										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Phalarope	**4.4370**		**8.4615**	**24.5707**	**4.6779**	**0.0409**	**25.8870**	**77.3867**	**1.0378**	**18.3772**	**6.9466**
Red Phalarope	4.4370		8.4615	24.5707	4.6779	0.0409	25.8870	77.3867	1.0378	18.3772	6.9466
Skua	**0.0005**				**0.0005**						**0.0004**
Parasitic Jaeger	0.0005				0.0005						0.0004
Auk	**3.7816**				**3.7129**	**2.4114**	**9.0264**	**0.0896**	**1.4207**	**1.9987**	**3.4290**
Common/Thick-billed Murre	0.0016				0.0015				0.0050	0.0026	0.0017
Razorbill	3.6336				3.5677	2.0845	8.9412	0.0896	1.4107	1.9234	3.2953
Murre/Razorbill	0.1359				0.1334		0.0852		0.0050	0.0104	0.1131
Atlantic Puffin	0.0005				0.0005	0.2997				0.0571	0.0099
species unknown	0.0100				0.0098	0.0272				0.0052	0.0090
Gull	**5.5667**			**0.4954**	**5.4718**	**0.4632**	**31.9614**	**5.7461**	**5.6073**	**6.9745**	**5.7206**
Black-legged Kittiwake	0.0257				0.0252	0.0545				0.0104	0.0228
Bonaparte's Gull	4.4732			0.3633	4.3966	0.0817	31.3085	5.6053	5.2799	6.6501	4.7698
Little Gull									0.0050	0.0026	0.0004
Laughing Gull	0.0021				0.0021						0.0017
Ring-billed Gull	0.0021				0.0021						0.0017
Herring Gull	0.6737				0.6615	0.0954	0.4258		0.1562	0.1376	0.5747
Lesser Black-backed Gull	0.0336				0.0330	0.0136			0.0050	0.0052	0.0284
Great Black-backed Gull	0.0467				0.0459		0.0284		0.0050	0.0052	0.0391
species unknown - Large	0.0210				0.0206		0.1419				0.0172
species unknown - Small	0.2849			0.1321	0.2813			0.1408	0.1461	0.1557	0.2605
species unknown	0.0037				0.0036	0.2180	0.0568		0.0101	0.0078	0.0043
Tern	**0.0021**				**0.0021**		**0.0568**			**0.0052**	**0.0026**
species unknown	0.0021				0.0021		0.0568			0.0052	0.0026
***Sterna* Tern**	**0.3274**				**0.3215**		**0.6245**	**0.1024**	**0.0453**	**0.1012**	**0.2850**
Forster's Tern	0.2277				0.2236		0.6245	0.0896	0.0403	0.0960	0.2025
Commic/Forster's Tern	0.0997				0.0979						0.0817
species unknown								0.0128	0.0050	0.0052	0.0009
Total	**19.1651**	—	**8.4615**	**25.9908**	**19.1505**	**3.6512**	**75.8445**	**83.8751**	**12.6455**	**30.7143**	**21.0655**

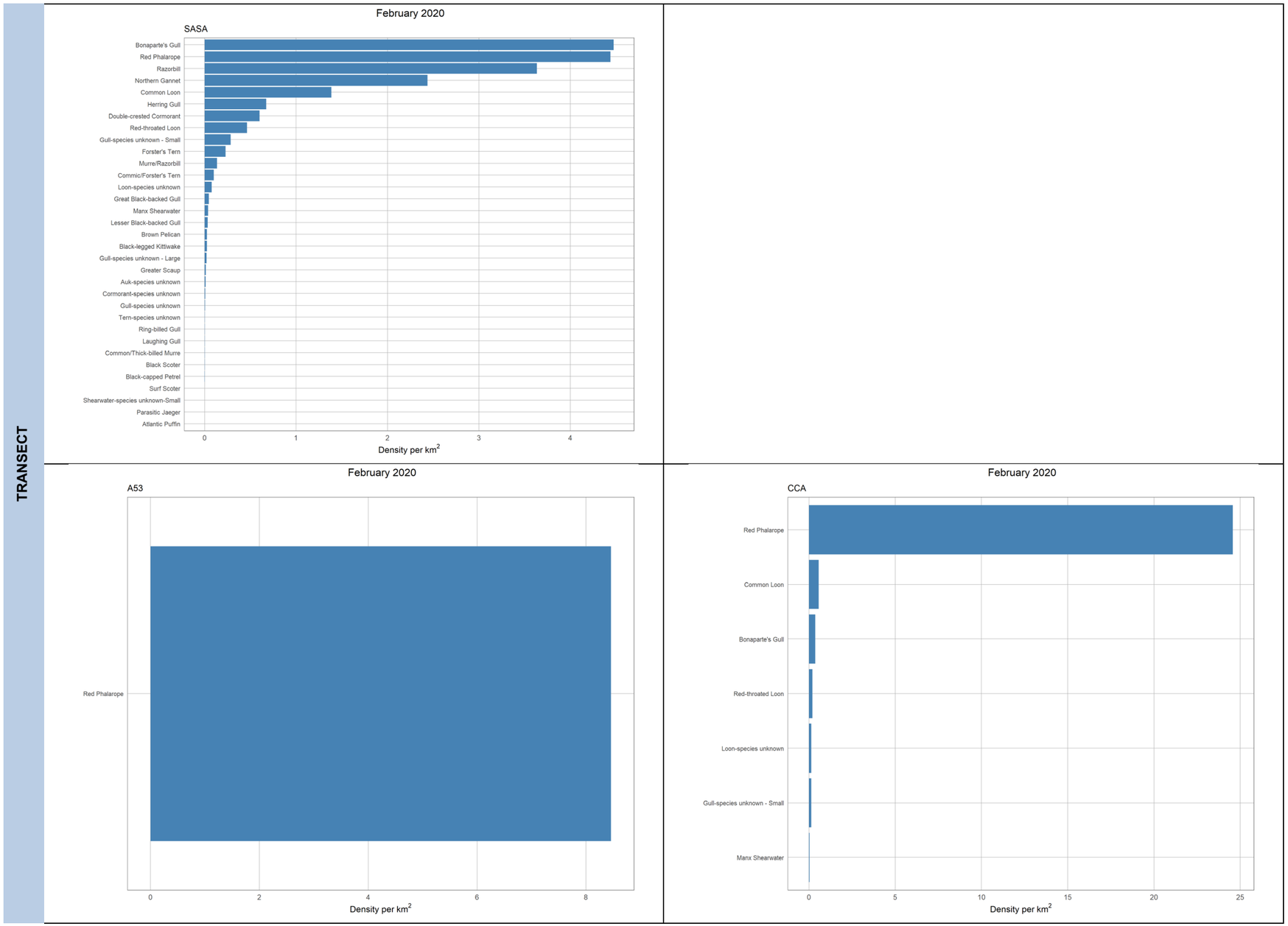


Figure C–3. Density (per km^2) of avian species identified in the February 2020 survey in each area, ordered by density for each area (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

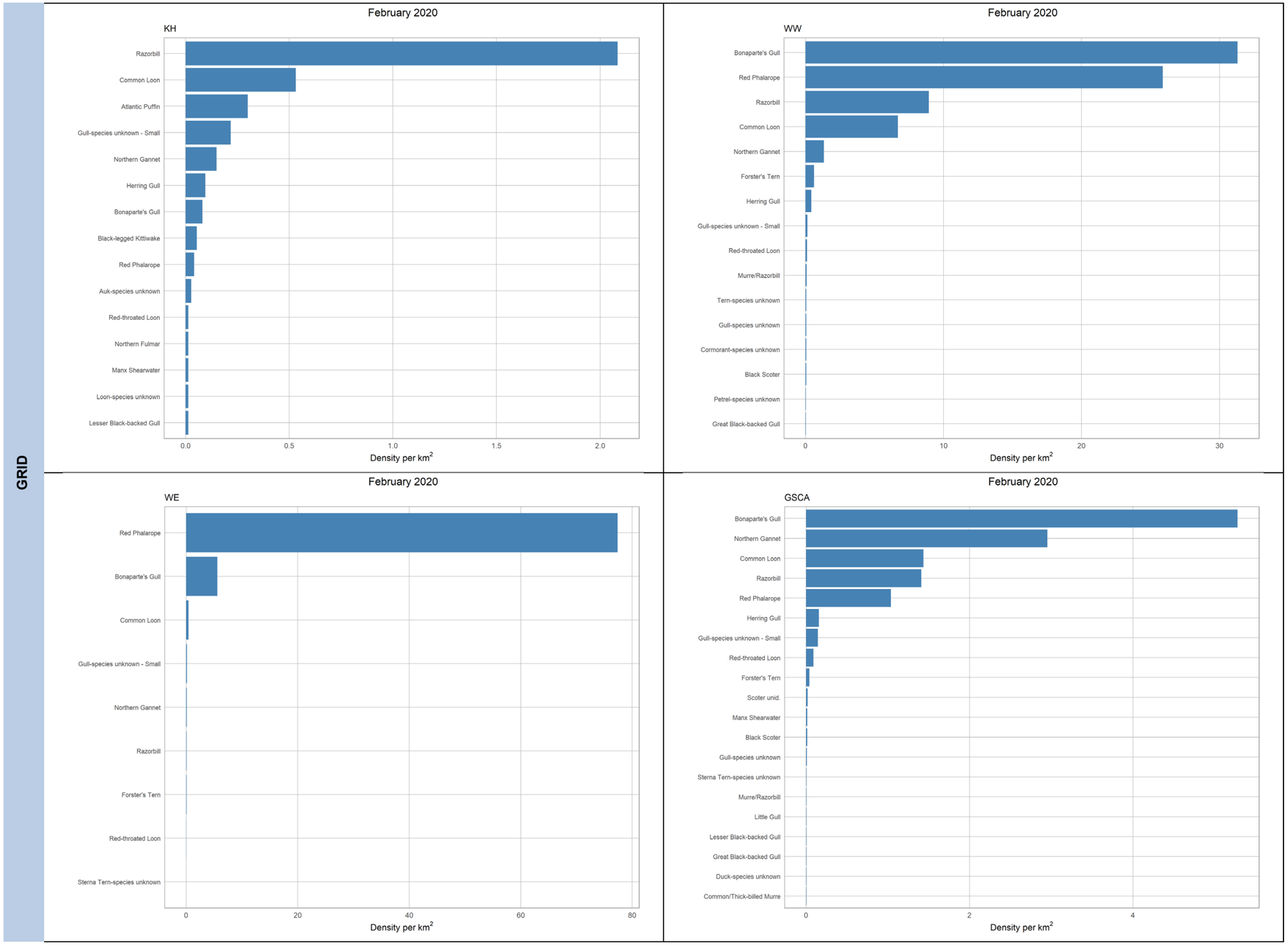


Figure C–3. (Continued)

Table C–27. Avian Species Identified within each Species Group and the Density (per km^2) of Individuals for each Area during the May/June 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Loon	**0.0058**				**0.0057**						**0.0046**
Common Loon	0.0058				0.0057						0.0046
Petrel	**0.0012**				**0.0011**						**0.0009**
Black-capped Petrel	0.0006				0.0006						0.0005
species unknown	0.0006				0.0006						0.0005
Shearwater	**0.0052**				**0.0051**				**0.0099**	**0.0051**	**0.0051**
Cory's Shearwater	0.0029				0.0028				0.0049	0.0026	0.0028
Great Shearwater	0.0017				0.0017						0.0014
species unknown-Large							0.0284		0.0049	0.0026	0.0005
species unknown-Small	0.0006				0.0006						0.0005
Gannet	**0.0017**				**0.0017**						**0.0014**
Northern Gannet	0.0017				0.0017						0.0014
Ardeidae	**0.0006**				**0.0006**						**0.0005**
Snowy Egret	0.0006				0.0006						0.0005
Phalarope	**0.0012**				**0.0011**						**0.0009**
Red/Red-necked Phalarope	0.0012				0.0011						0.0009
Gull	**0.0219**				**0.0215**						**0.0176**
Laughing Gull	0.0219				0.0215						0.0176
Tern	**0.0853**				**0.0836**				**0.0049**	**0.0026**	**0.0690**
Caspian Tern	0.0075				0.0073						0.0060
Black Tern	0.0167				0.0164						0.0134
Royal Tern	0.0415				0.0407				0.0049	0.0026	0.0338
Sandwich Tern	0.0179				0.0175						0.0144
species unknown	0.0017				0.0017						0.0014
***Sterna* Tern**	**0.0225**			**0.0330**	**0.0226**				**0.0049**	**0.0026**	**0.0190**
species unknown	0.0225			0.0330	0.0226				0.0049	0.0026	0.0190
Total	**0.1453**	—	—	**0.0330**	**0.1430**	—	—	—	**0.0198**	**0.0103**	**0.1190**

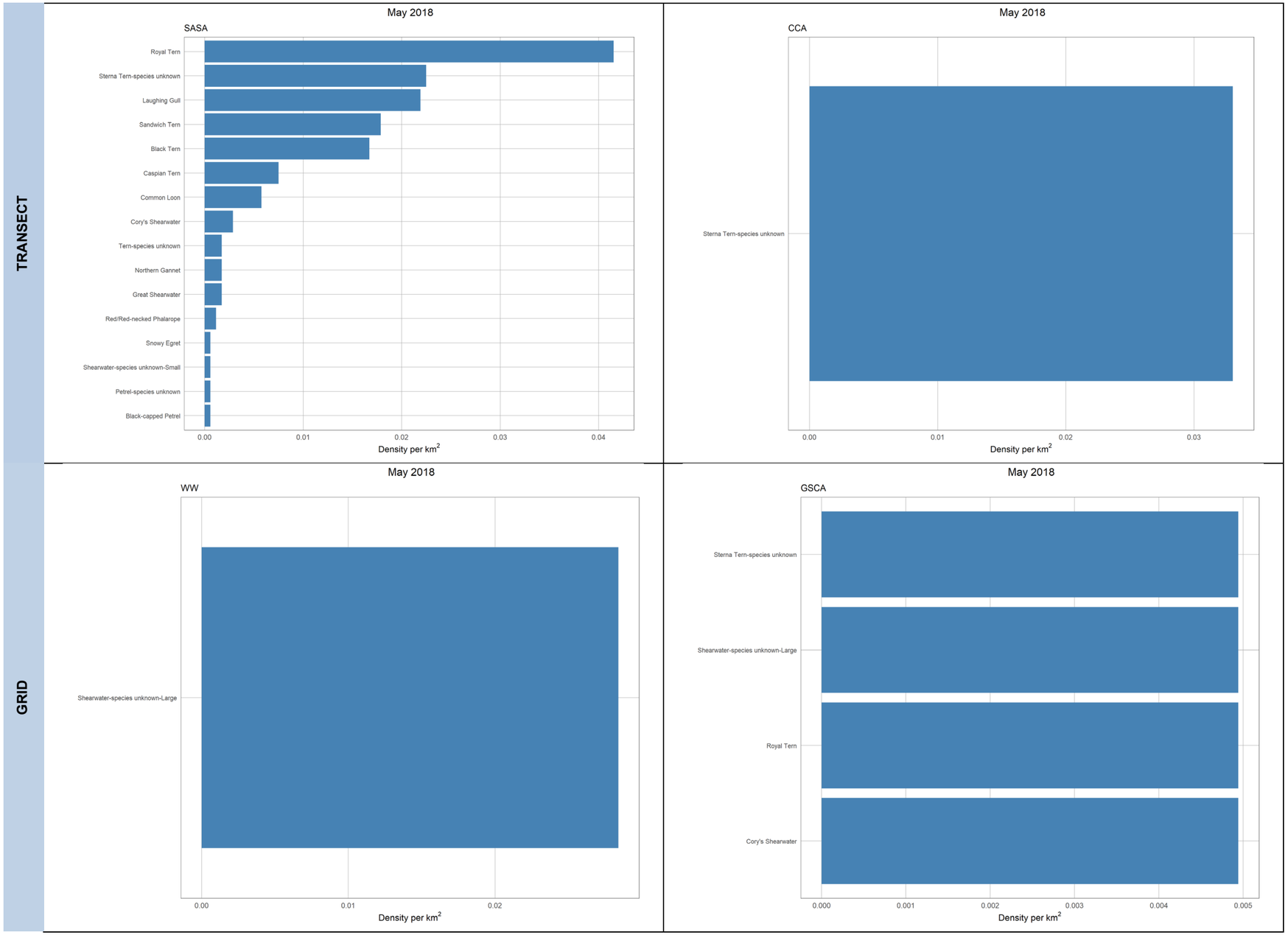


Figure C–4. Density (per km^2) of avian species identified in the May/June 2018 survey in each area, ordered by density for each area
Note: X-axes are scaled according to the maximum density for each area.

Table C–28. Avian Species Identified within each Species Group and the Density (per km^2) of Individuals for each Area during the May 2019 survey

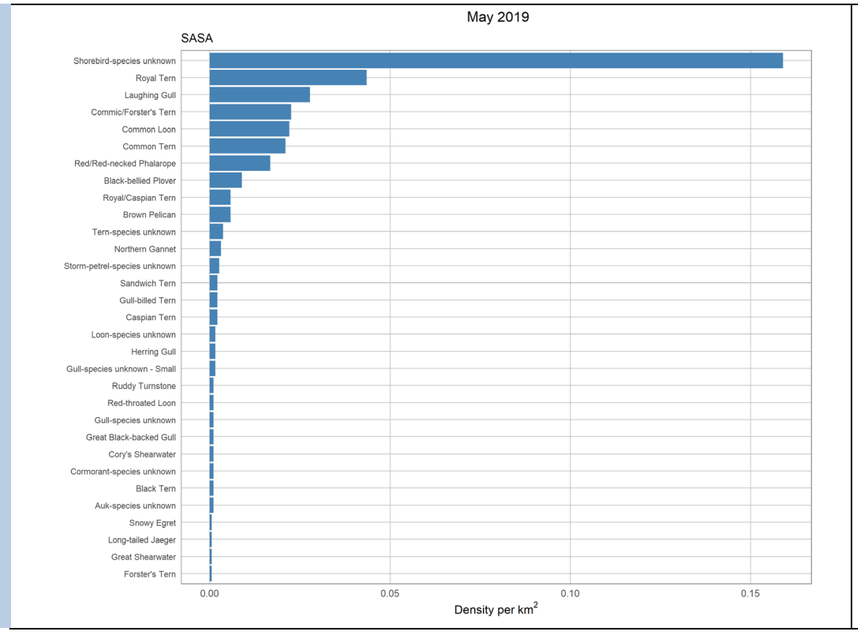
Species Group	Density (per km^2)										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Loon	**0.0247**				**0.0242**	**0.1090**			**0.0045**	**0.0221**	**0.0238**
Red-throated Loon	0.0010				0.0010						0.0009
Common Loon	0.0220				0.0216	0.1090			0.0045	0.0221	0.0217
species unknown	0.0016				0.0015						0.0013
Petrel						**0.0136**				**0.0025**	**0.0004**
Trindade Petrel						0.0136				0.0025	0.0004
Shearwater	**0.0016**				**0.0015**						**0.0013**
Cory's Shearwater	0.0010				0.0010						0.0009
Great Shearwater	0.0005				0.0005						0.0004
Storm-petrel	**0.0026**				**0.0026**						**0.0021**
species unknown	0.0026				0.0026						0.0021
Gannet	**0.0031**				**0.0031**						**0.0026**
Northern Gannet	0.0031				0.0031						0.0026
Cormorant	**0.0010**				**0.0010**						**0.0009**
species unknown	0.0010				0.0010						0.0009
Pelican	**0.0058**				**0.0057**						**0.0047**
Brown Pelican	0.0058				0.0057						0.0047
Ardeidae	**0.0005**				**0.0005**						**0.0004**
Snowy Egret	0.0005				0.0005						0.0004
Shorebird	**0.1689**				**0.1659**				**0.0091**	**0.0049**	**0.1379**
Black-bellied Plover	0.0089				0.0088						0.0072
Ruddy Turnstone	0.0010				0.0010						0.0009
species unknown	0.1590				0.1561				0.0091	0.0049	0.1298
Phalarope	**0.0168**				**0.0165**						**0.0136**
Red/Red-necked Phalarope	0.0168				0.0165						0.0136

(continued)

Table C–28. (Continued)

Species Group	Density (per km²)										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Skua	**0.0005**				**0.0005**						**0.0004**
Long-tailed Jaeger	0.0005				0.0005						0.0004
Auk	**0.0010**			**0.0330**	**0.0015**				**0.0317**	**0.0172**	**0.0043**
Dovekie				0.0330	0.0005				0.0317	0.0172	0.0034
species unknown	0.0010				0.0010						0.0009
Gull	**0.0330**				**0.0324**						**0.0268**
Laughing Gull	0.0278				0.0273						0.0226
Herring Gull	0.0016				0.0015						0.0013
Great Black-backed Gull	0.0010				0.0010						0.0009
species unknown - Small	0.0016				0.0015						0.0013
species unknown	0.0010				0.0010						0.0009
Tern	**0.0603**			**0.0330**	**0.0592**				**0.0362**	**0.0196**	**0.0524**
Gull-billed Tern	0.0021				0.0021						0.0017
Caspian Tern	0.0021				0.0021						0.0017
Black Tern	0.0010				0.0010						0.0009
Royal Tern	0.0435				0.0428				0.0362	0.0196	0.0387
Royal/Caspian Tern	0.0058				0.0057						0.0047
Sandwich Tern	0.0021			0.0330	0.0021						0.0017
species unknown	0.0037				0.0036						0.0030
***Sterna* Tern**	**0.0441**			**0.0991**	**0.0438**			**0.0896**	**0.0045**	**0.0196**	**0.0396**
Common Tern	0.0210				0.0206			0.0128		0.0025	0.0175
Forster's Tern	0.0005				0.0005						0.0004
Commic/Forster's Tern	0.0226			0.0991	0.0227			0.0768	0.0045	0.0172	0.0217
Passerine							**0.6812**		**0.1087**	**0.0589**	**0.0102**
species unknown							0.6812		0.1087	0.0589	0.0102
Total	**0.3641**	—	—	**0.1651**	**0.3585**	**0.1226**	**0.6812**	**0.0896**	**0.1947**	**0.1447**	**0.3214**

TRANSECT



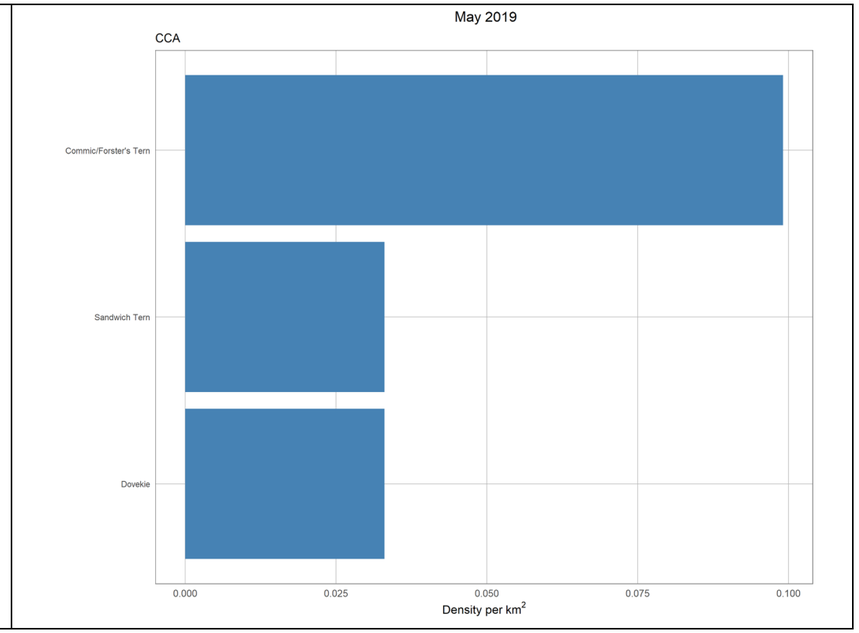


Figure C–5. Density (per km^2) of avian species identified in the May 2019 survey in each area, ordered by density for each area (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

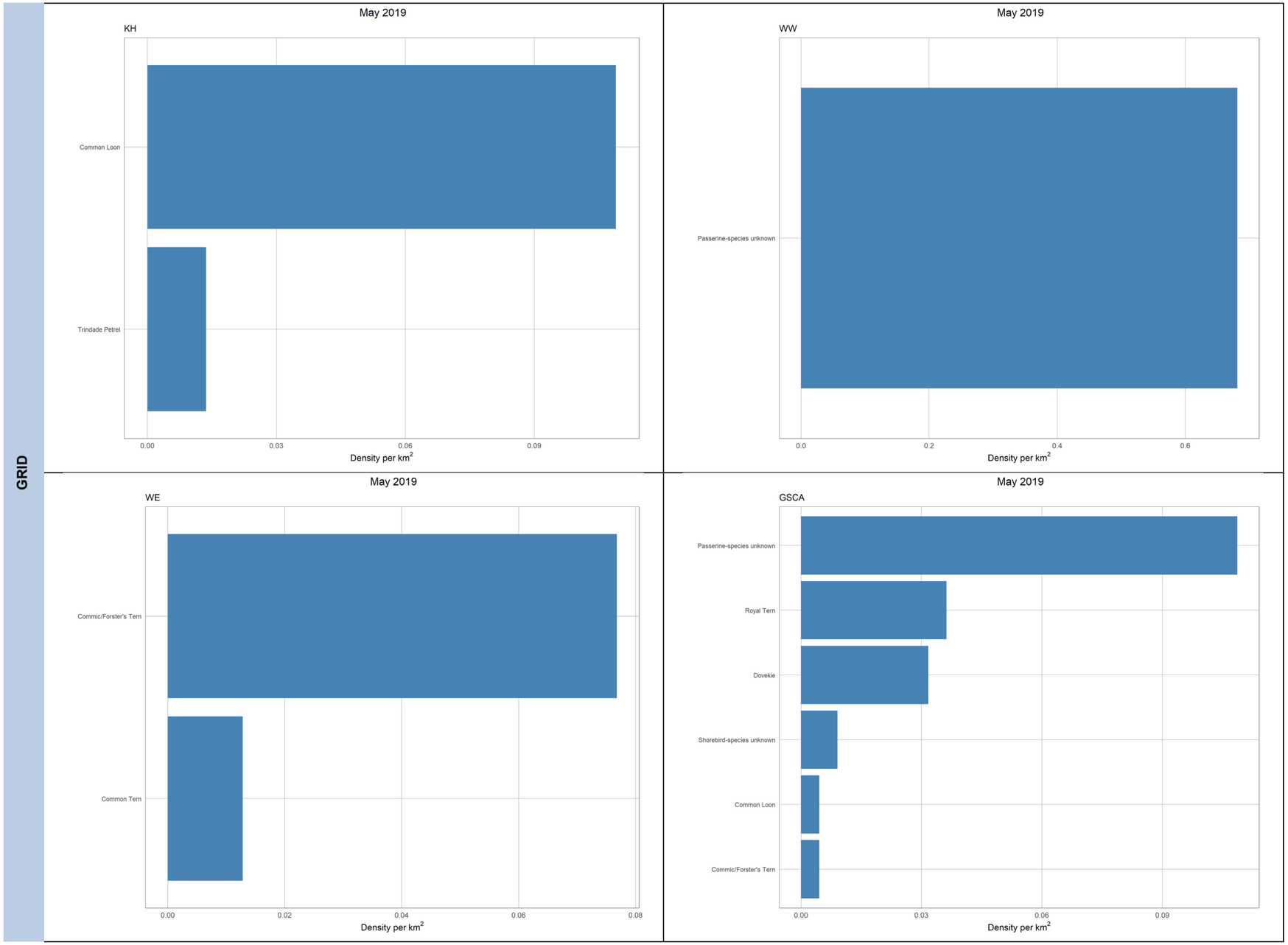


Figure C–5. (Continued)

Table C–29. Avian Species Identified within each Species Group and the Density (per km^2) of Individuals for each Area during the October 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Loon	**0.0415**				**0.0407**				**0.1599**	**0.0860**	**0.0491**
Red-throated Loon	0.0017				0.0016						0.0013
Common Loon	0.0398				0.0391				0.1599	0.0860	0.0477
Fulmar	**0.0006**				**0.0005**						**0.0004**
Northern Fulmar	0.0006				0.0005						0.0004
Petrel	**0.0028**				**0.0027**						**0.0022**
Black-capped Petrel	0.0011				0.0011						0.0009
species unknown	0.0017				0.0016						0.0013
Shearwater	**0.0288**			**0.0330**	**0.0288**	**0.0136**		**0.0128**	**0.0133**	**0.0119**	**0.0256**
Cory's Shearwater	0.0194				0.0190	0.0136		0.0128	0.0089	0.0096	0.0172
Great Shearwater	0.0011			0.0330	0.0016				0.0044	0.0024	0.0018
species unknown-Large	0.0072				0.0071						0.0057
species unknown-Small	0.0011				0.0011						0.0009
Storm-petrel	**0.0011**				**0.0011**						**0.0009**
species unknown	0.0011				0.0011						0.0009
Gannet	**0.0343**				**0.0336**	**0.0408**				**0.0072**	**0.0287**
Northern Gannet	0.0343				0.0336	0.0408				0.0072	0.0287
Cormorant	**0.0044**				**0.0043**						**0.0035**
Double-crested Cormorant	0.0044				0.0043						0.0035
Pelican	**0.0116**				**0.0114**						**0.0093**
Brown Pelican	0.0105				0.0103						0.0084
American White Pelican	0.0011				0.0011						0.0009

(continued)

Table C–29. (Continued)

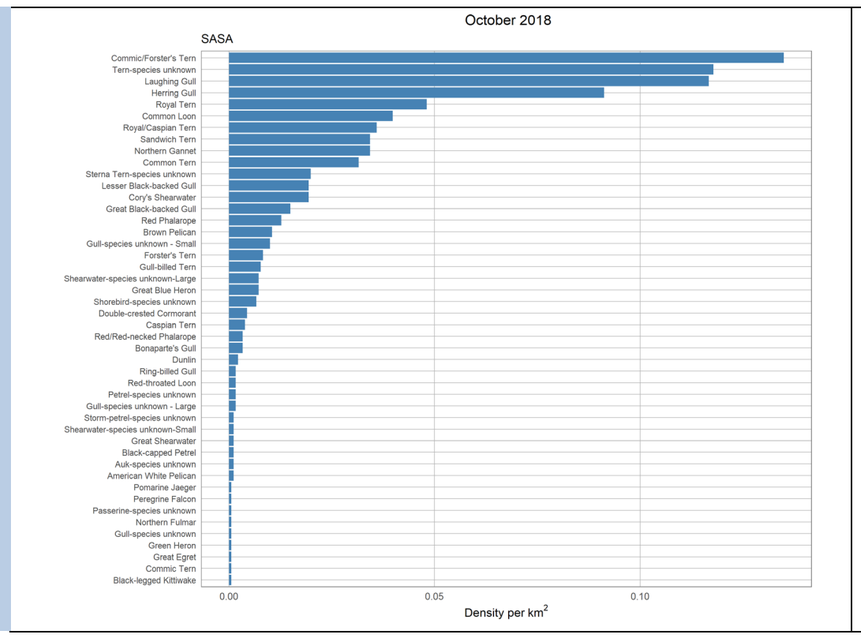
Species	Density per km²										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Ardeidae	**0.0083**				**0.0081**						**0.0066**
Great Blue Heron	0.0072				0.0071						0.0057
Great Egret	0.0006				0.0005						0.0004
Green Heron	0.0006				0.0005						0.0004
Raptor	**0.0006**				**0.0005**						**0.0004**
Peregrine Falcon	0.0006				0.0005						0.0004
Shorebird	**0.0088**				**0.0087**						**0.0071**
Dunlin	0.0022				0.0022						0.0018
species unknown	0.0066				0.0065						0.0053
Phalarope	**0.0160**				**0.0157**				**0.0222**	**0.0119**	**0.0150**
Red Phalarope	0.0127				0.0125				0.0222	0.0119	0.0124
Red/Red-necked Phalarope	0.0033				0.0033						0.0027
Skua	**0.0006**				**0.0005**				**0.0044**	**0.0024**	**0.0009**
Pomarine Jaeger	0.0006				0.0005						0.0004
Parasitic Jaeger									0.0044	0.0024	0.0004
Auk	**0.0011**				**0.0011**						**0.0009**
species unknown	0.0011				0.0011						0.0009
Gull	**0.2599**				**0.2550**				**0.0266**	**0.0143**	**0.2104**
Black-legged Kittiwake	0.0006				0.0005				0.0044	0.0024	0.0009
Bonaparte's Gull	0.0033				0.0033						0.0027
Laughing Gull	0.1167				0.1145						0.0933
Ring-billed Gull	0.0017				0.0016						0.0013
Herring Gull	0.0913				0.0895						0.0729
Lesser Black-backed Gull	0.0194				0.0190						0.0155
Great Black-backed Gull	0.0149				0.0146						0.0119

(continued)

Table C–29. (Continued)

Species	Density per km²										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
species unknown - Large	0.0017				0.0016						0.0013
species unknown - Small	0.0100				0.0098				0.0222	0.0119	0.0102
species unknown	0.0006				0.0005						0.0004
Tern	**0.2478**			**0.0991**	**0.2431**		**0.0962**	**0.1532**	**0.5107**	**0.3129**	**0.2560**
Bridled Tern								0.0255	0.0044	0.0072	0.0013
Gull-billed Tern	0.0077				0.0076						0.0062
Caspian Tern	0.0039				0.0038				0.0044	0.0024	0.0035
Royal Tern	0.0481			0.0330	0.0472		0.0962	0.1021	0.1021	0.0836	0.0539
Royal/Caspian Tern	0.0359				0.0353				0.0977	0.0525	0.0385
Sandwich Tern	0.0343			0.0661	0.0336				0.0178	0.0096	0.0292
species unknown	0.1178				0.1156			0.0255	0.2842	0.1576	0.1233
***Sterna* Tern**	**0.1952**			**0.0661**	**0.1926**		**0.0962**	**0.0638**	**1.8652**	**1.0245**	**0.3466**
Common Tern	0.0315				0.0309			0.0511	0.2531	0.1457	0.0522
Commic Tern	0.0006				0.0005						0.0004
Forster's Tern	0.0083				0.0081				0.3419	0.1839	0.0407
Commic/Forster's Tern	0.1349			0.0661	0.1335		0.0962	0.0128	1.2523	0.6854	0.2356
species unknown	0.0199				0.0195				0.0178	0.0096	0.0177
Passerine	**0.0006**				**0.0005**						**0.0004**
species unknown	0.0006				0.0005						0.0004
Total	**0.8639**	—	—	**0.1982**	**0.8491**	**0.0543**	**0.1923**	**0.2297**	**2.6024**	**1.4711**	**0.9642**

TRANSECT



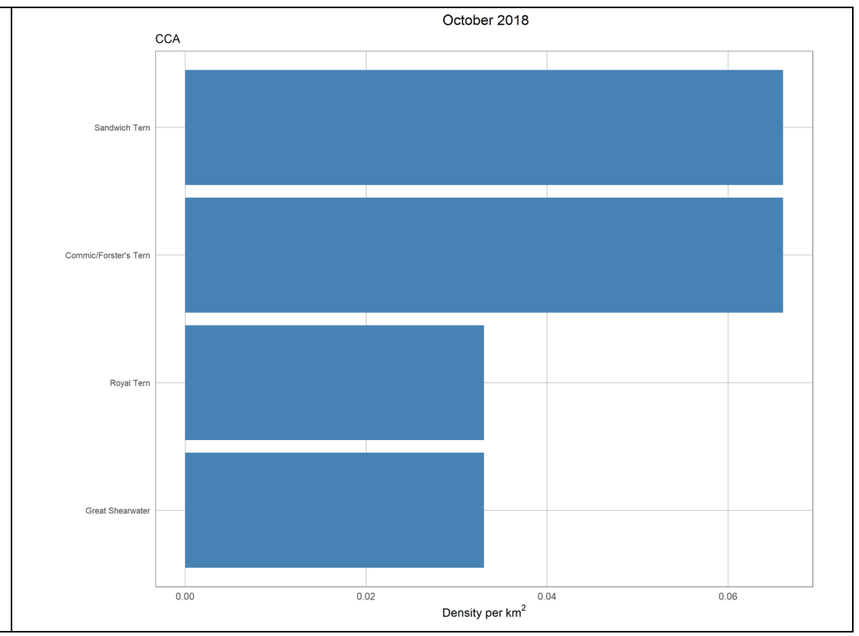


Figure C–6. Density (per km^2) of avian species identified in the October 2018 survey in each area, ordered by density for each area (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

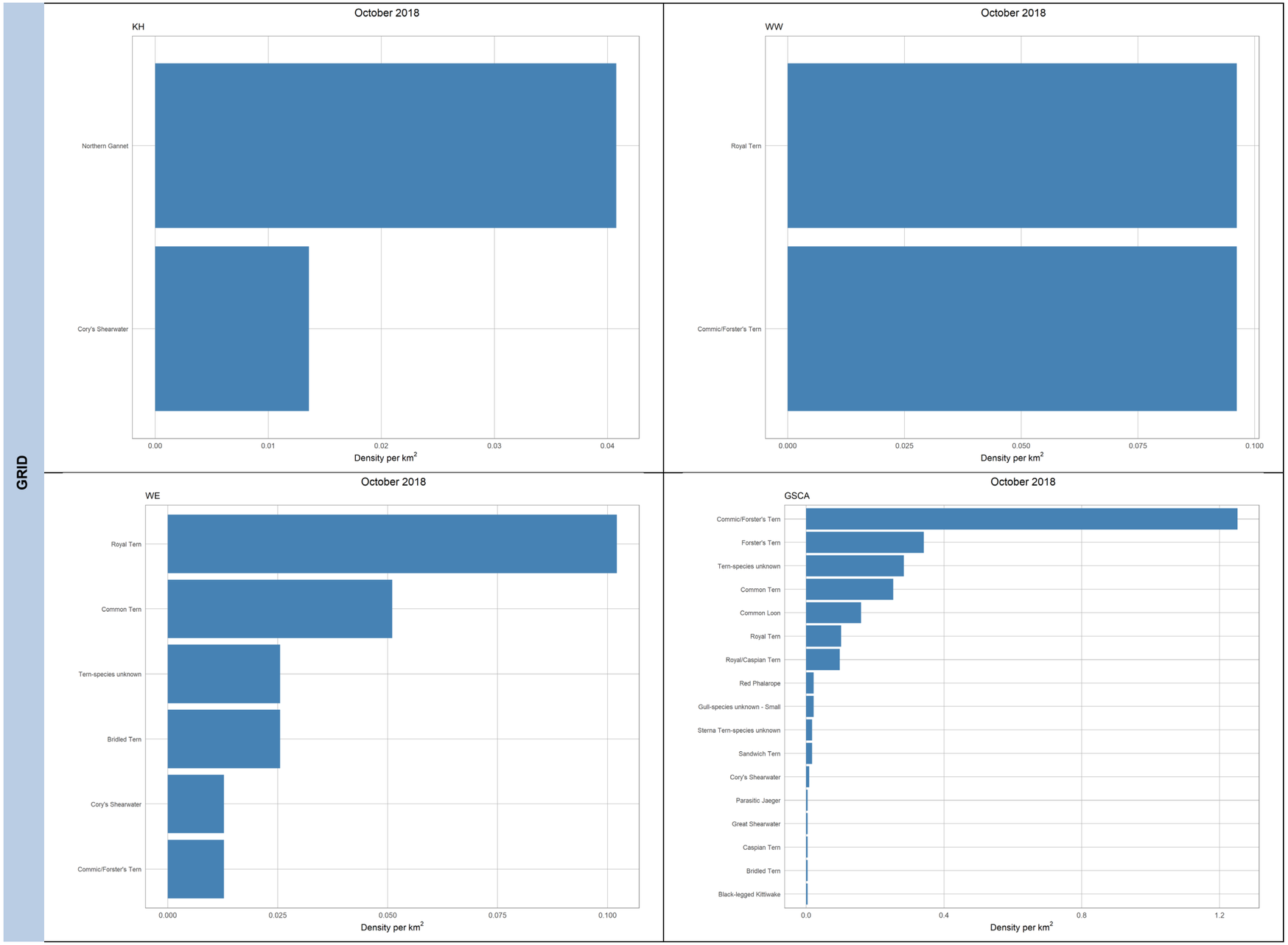


Figure C–6. (Continued)

Table C–30. Avian Species Identified within each Species Group and the Density (per km^2) of Individuals for each Area during the September 2019 survey

Species Group	Density (per km^2)										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Duck	**0.0042**				**0.0041**						**0.0034**
Redhead	0.0005				0.0005						0.0004
species unknown	0.0037				0.0036						0.0030
Petrel	**0.0005**				**0.0005**	**0.0136**		**0.0128**		**0.0052**	**0.0013**
Black-capped Petrel	0.0005				0.0005	0.0136		0.0128		0.0052	0.0013
Shearwater	**0.0616**	**0.4237**	**4.2308**	**1.1889**	**0.0825**	**0.0409**		**0.9862**		**0.2079**	**0.1031**
Cory's Shearwater	0.0339		0.7692	0.0991	0.0353	0.0136		0.5635		0.1170	0.0488
Great Shearwater	0.0016	0.4237			0.0015	0.0136		0.1537		0.0338	0.0068
Sooty Shearwater	0.0005				0.0005						0.0004
Audubon's Shearwater	0.0110		2.3077		0.0128	0.0136		0.2177		0.0468	0.0184
species unknown-Large	0.0037		0.7692	0.0661	0.0051			0.0128		0.0026	0.0047
species unknown-Small	0.0083		0.3846	1.0238	0.0246						0.0205
species unknown	0.0026				0.0026			0.0384		0.0078	0.0034
Pelican	**0.0005**				**0.0005**						**0.0004**
Brown Pelican	0.0005				0.0005						0.0004
Ardeidae	**0.0005**				**0.0005**						**0.0004**
Great Blue Heron	0.0005				0.0005						0.0004
Shorebird	**0.0010**				**0.0010**						**0.0009**
species unknown	0.0010				0.0010						0.0009
Phalarope	**0.0162**				**0.0159**						**0.0133**
Red-necked Phalarope	0.0026				0.0026						0.0021
Red Phalarope	0.0052				0.0051						0.0043
Red/Red-necked Phalarope	0.0083				0.0082						0.0068
Skua	**0.0010**				**0.0010**						**0.0009**
species unknown	0.0010				0.0010						0.0009

(continued)

Table C–30. (Continued)

Species Group	Density (per km^2)										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Gull	**0.0235**				**0.0231**	**0.0136**	**0.0284**			**0.0052**	**0.0201**
Black-legged Kittiwake	0.0005				0.0005						0.0004
Little Gull	0.0005				0.0005						0.0004
Laughing Gull	0.0203				0.0200						0.0167
Herring Gull						0.0136				0.0026	0.0004
Great Black-backed Gull	0.0005				0.0005						0.0004
species unknown - Large	0.0005				0.0005						0.0004
species unknown - Small	0.0010				0.0010		0.0284			0.0026	0.0013
Tern	**0.3762**	**0.4237**	**0.3846**	**0.0991**	**0.3714**	**0.0272**	**0.5677**	**0.5123**	**0.3081**	**0.3119**	**0.3616**
Sooty Tern	0.0026			0.0330	0.0031			0.0128		0.0026	0.0030
Bridled Tern	0.0083		0.3846		0.0087			0.0897		0.0182	0.0103
Sooty/Bridled Tern	0.0005				0.0005	0.0136		0.0768		0.0182	0.0034
Least Tern	0.0073				0.0072						0.0060
Gull-billed Tern								0.0128		0.0026	0.0004
Caspian Tern	0.0005				0.0005						0.0004
Black Tern	0.2030			0.0661	0.2003	0.0136		0.0512		0.0130	0.1695
Royal Tern	0.0871				0.0856		0.3406	0.2561	0.2525	0.2105	0.1061
Royal/Caspian Tern	0.0010	0.4237			0.0010		0.1419		0.0152	0.0182	0.0039
Sandwich Tern	0.0402				0.0394		0.0284		0.0202	0.0130	0.0351
Thalasseus Tern unid.	0.0115				0.0113		0.0284		0.0051	0.0026	0.0098
species unknown	0.0141				0.0138		0.0284	0.0128	0.0152	0.0130	0.0137
***Sterna* Tern**	**0.5572**		**11.9231**	**1.5522**	**0.5799**			**0.3202**	**0.0606**	**0.0962**	**0.5003**
Common Tern	0.3214		2.3077	0.8917	0.3274			0.2561	0.0051	0.0546	0.2825
Forster's Tern	0.0052				0.0051				0.0051	0.0026	0.0047
Commic/Forster's Tern	0.2270		9.6154	0.6605	0.2439			0.0640	0.0505	0.0390	0.2101
species unknown	0.0037				0.0036						0.0030
Passerine	**0.0005**				**0.0005**			**0.0128**		**0.0026**	**0.0009**
species unknown	0.0005				0.0005			0.0128		0.0026	0.0009
Total	**1.0429**	**0.8475**	**16.5385**	**2.8402**	**1.0810**	**0.0954**	**0.5961**	**1.8443**	**0.3687**	**0.6290**	**1.0066**

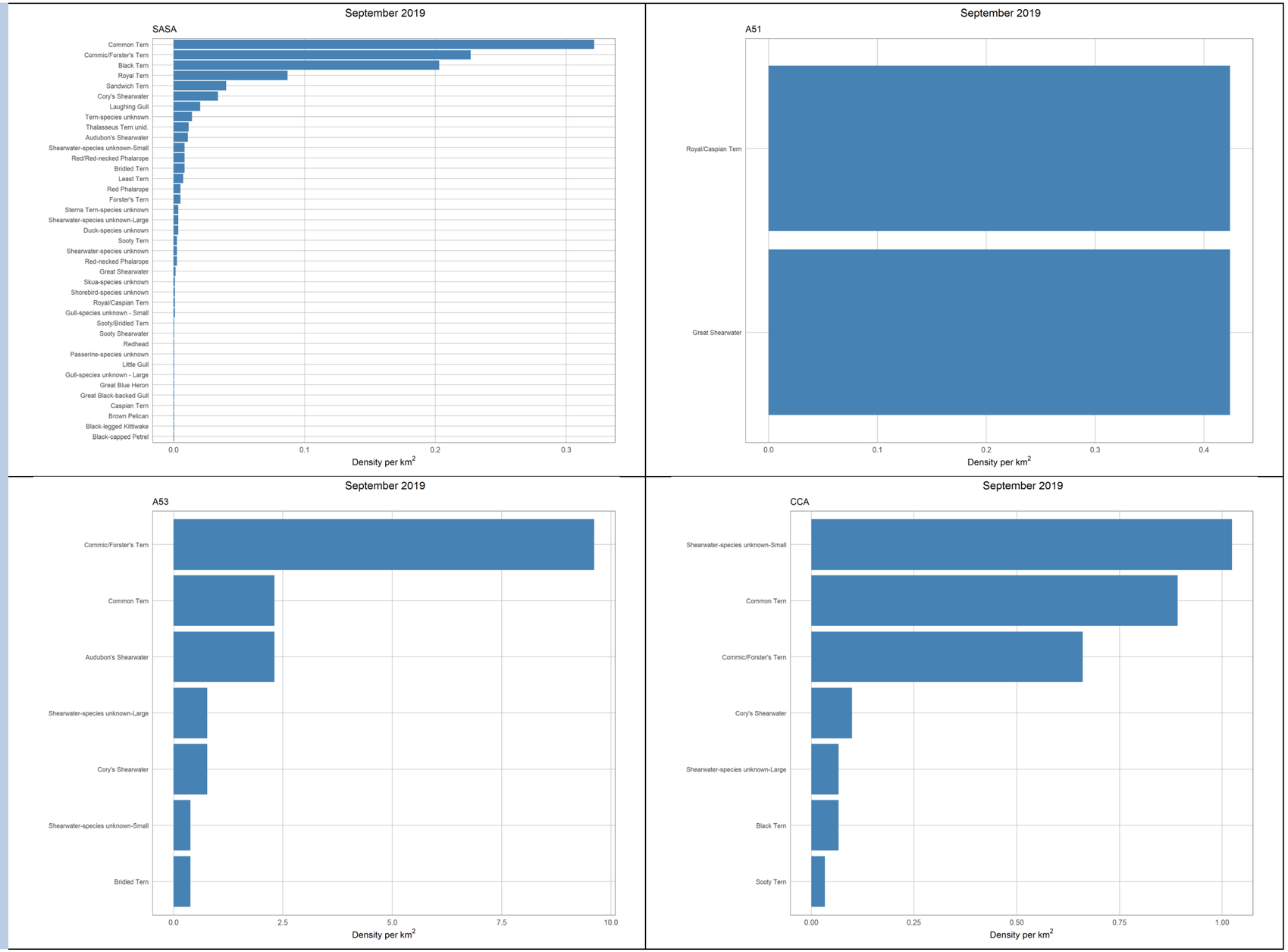


Figure C–7. Density (per km^2) of avian species identified in the September 2019 survey in each area, ordered by density for each area (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

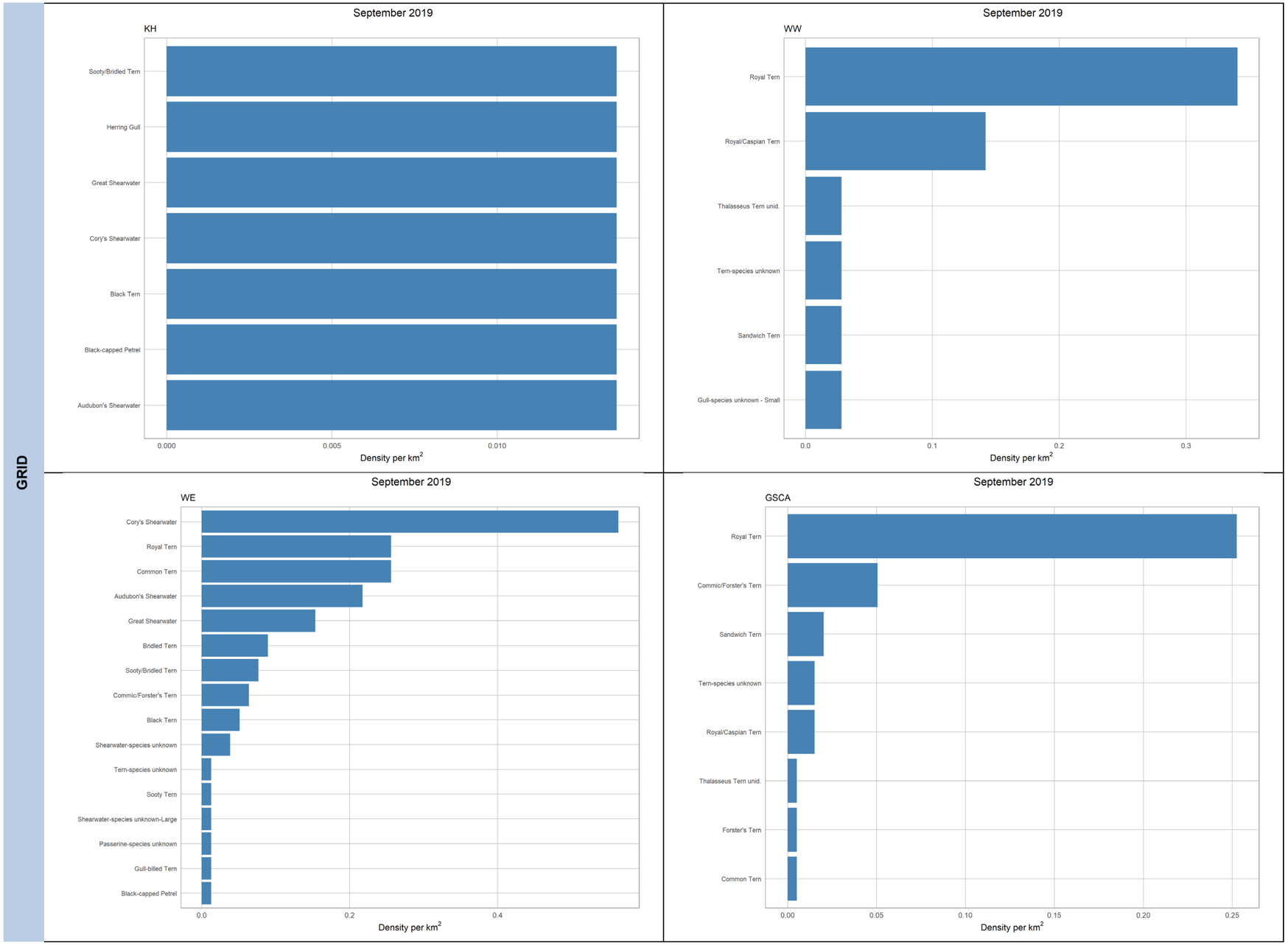


Figure C–7. (Continued)

Table C–31. Avian Species Identified within each Species Group and the Density (per km^2) of Individuals for each Area during the December 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Duck	**0.3133**				**0.3076**		**0.0541**		**0.0528**	**0.0277**	**0.2602**
American Black Duck	0.0005				0.0005						0.0004
Greater Scaup	0.0052				0.0051						0.0043
Lesser Scaup									0.0192	0.0101	0.0017
Surf Scoter	0.0016				0.0015						0.0013
White-winged Scoter	0.0037				0.0036				0.0048	0.0025	0.0034
Black Scoter	0.2898				0.2845				0.0192	0.0101	0.2381
Scoter unid.	0.0010				0.0010						0.0009
Red-breasted Merganser	0.0057				0.0056						0.0047
species unknown	0.0057				0.0056		0.0541		0.0096	0.0050	0.0055
Loon	**1.0845**	**1.2658**	**0.7663**	**0.3288**	**1.0669**	**0.9921**	**2.0828**	**0.3318**	**0.9021**	**0.8684**	**1.0333**
Red-throated Loon	0.2444				0.2399	0.0544	0.0270		0.0768	0.0529	0.2083
Common Loon	0.8271	1.2658	0.7663	0.3288	0.8141	0.9378	2.0557	0.3318	0.8157	0.8105	0.8135
species unknown	0.0131				0.0128				0.0096	0.0050	0.0115
Fulmar	**0.0005**				**0.0005**						**0.0004**
Northern Fulmar	0.0005				0.0005						0.0004
Shearwater	**0.0021**				**0.0021**	**3.9957**				**0.7400**	**0.1269**
Cory's Shearwater						0.0136				0.0025	0.0004
Sooty Shearwater						0.0544				0.0101	0.0017
Manx Shearwater	0.0005				0.0005	3.9277				0.7274	0.1235
species unknown-Large	0.0016				0.0015						0.0013
Gannet	**2.3920**	**0.4219**		**0.0987**	**2.3496**	**0.1223**	**4.3549**	**2.9100**	**2.7975**	**2.4239**	**2.3622**
Northern Gannet	2.3920	0.4219		0.0987	2.3496	0.1223	4.3549	2.9100	2.7975	2.4239	2.3622

(continued)

Table C–31. (Continued)

Species	Density per km²										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Cormorant	**0.0021**				**0.0021**						**0.0017**
Double-crested Cormorant	0.0010				0.0010						0.0009
species unknown	0.0010				0.0010						0.0009
Pelican	**0.0230**				**0.0226**						**0.0187**
Brown Pelican	0.0230				0.0226						0.0187
Phalarope	**0.1504**				**0.1477**	**3.2346**	**2.7049**		**1.0173**	**1.3743**	**0.3552**
Red-necked Phalarope	0.0016				0.0015	0.0680			0.0096	0.0176	0.0043
Red Phalarope	0.1405				0.1379	2.2832	2.7049		1.0077	1.1931	0.3165
Red/Red-necked Phalarope	0.0084				0.0082	0.8834				0.1636	0.0345
Skua	**0.0021**				**0.0021**		**0.0270**		**0.0048**	**0.0050**	**0.0026**
Pomarine Jaeger									0.0048	0.0025	0.0004
Parasitic Jaeger	0.0010				0.0010						0.0009
species unknown	0.0010				0.0010		0.0270			0.0025	0.0013
Auk	**0.2423**				**0.2379**	**0.2718**			**0.0048**	**0.0529**	**0.2066**
Common/Thick-billed Murre	0.0021				0.0021						0.0017
Razorbill	0.1953				0.1917	0.2175				0.0403	0.1661
Murre/Razorbill	0.0423				0.0415	0.0544			0.0048	0.0126	0.0366
Atlantic Puffin	0.0026				0.0026						0.0021
Gull	**2.0657**	**0.4219**			**2.0282**	**37.1432**	**0.3787**	**0.1404**	**0.2159**	**7.0501**	**2.8780**
Black-legged Kittiwake	0.0073				0.0072	7.4613				1.3818	0.2398
Bonaparte's Gull	0.2512				0.2466	14.6915	0.0811		0.0480	2.7536	0.6708
Little Gull	0.0005				0.0005						0.0004
Laughing Gull	0.1603				0.1574	0.0951	0.2164	0.1021	0.0384	0.0755	0.1435
Ring-billed Gull	0.0402				0.0395	0.2039		0.0128	0.0096	0.0453	0.0405
Herring Gull	1.1843	0.4219			1.1628	0.1903	0.0541	0.0128	0.1152	0.1032	0.9835

(continued)

Table C–31. (Continued)

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Iceland Gull	0.0016				0.0015						0.0013
Lesser Black-backed Gull	0.0261				0.0256			0.0128		0.0025	0.0217
Great Black-backed Gull	0.1415				0.1389	0.3262				0.0604	0.1256
species unknown - Large	0.0726				0.0713	0.0408				0.0076	0.0605
species unknown - Small	0.1775				0.1743	14.1343	0.0270		0.0048	2.6202	0.5882
species unknown	0.0026				0.0026						0.0021
Tern	**0.0162**				**0.0159**				**0.0144**	**0.0076**	**0.0145**
Royal Tern	0.0005				0.0005						0.0004
species unknown	0.0157				0.0154				0.0144	0.0076	0.0141
***Sterna* Tern**	**0.2673**				**0.2625**	**0.0136**	**1.0279**		**0.2063**	**0.2039**	**0.2526**
Common Tern	0.0005				0.0005						0.0004
Forster's Tern	0.2204				0.2164		0.5410		0.1823	0.1435	0.2040
Commic/Forster's Tern	0.0465				0.0456	0.0136	0.4869		0.0240	0.0604	0.0481
Total	**6.5614**	**2.1097**	**0.7663**	**0.4275**	**6.4455**	**45.7733**	**10.6302**	**3.3823**	**5.2159**	**12.7536**	**7.5129**

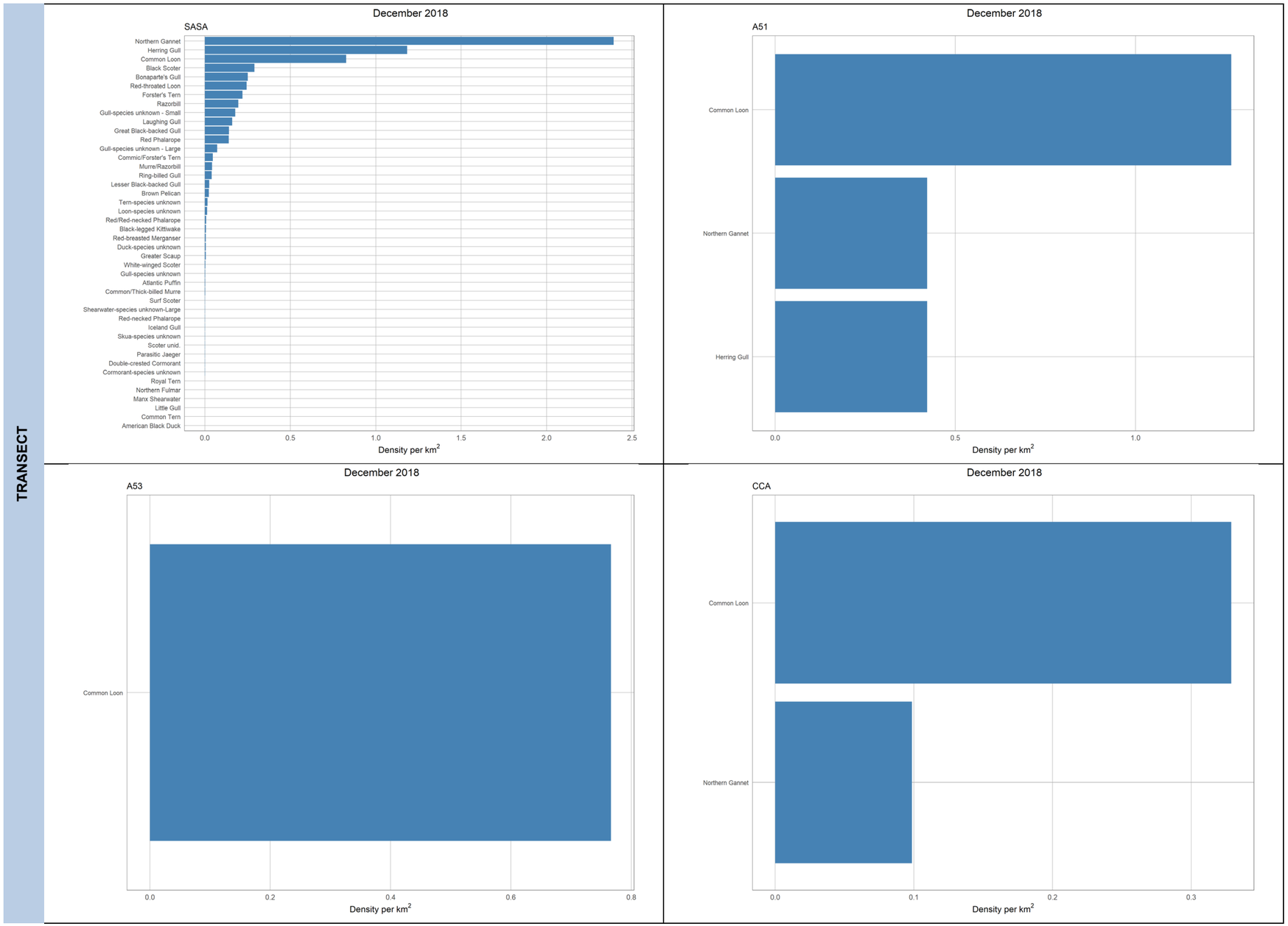


Figure C–8. Density (per km^2) of avian species identified in the December 2018 survey in each area, ordered by density for each area (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

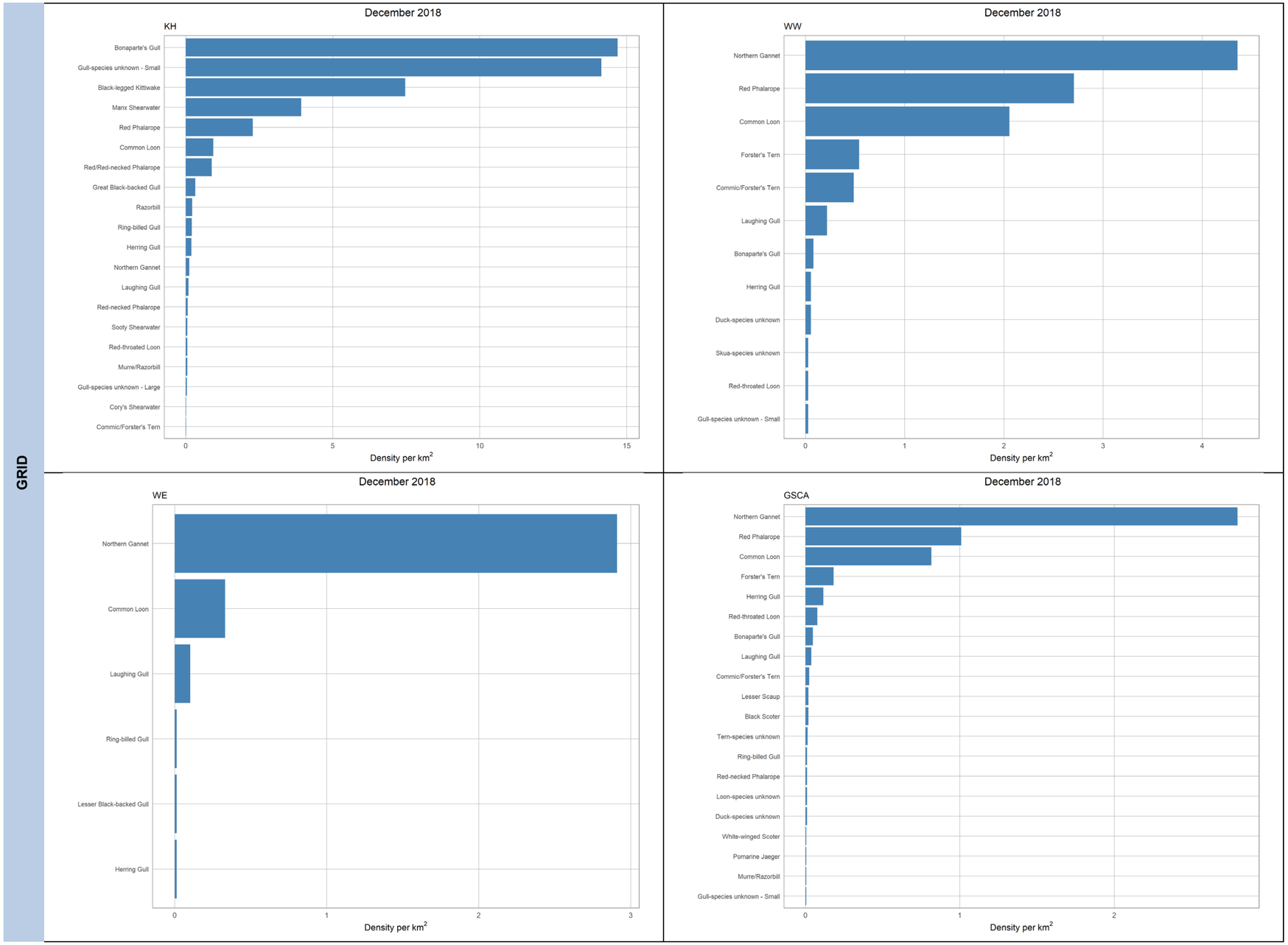


Figure C–8. (Continued)

Table C–32. Avian Species Identified within each Species Group and the Density (per km^2) of Individuals for each Area during the December 2019 survey

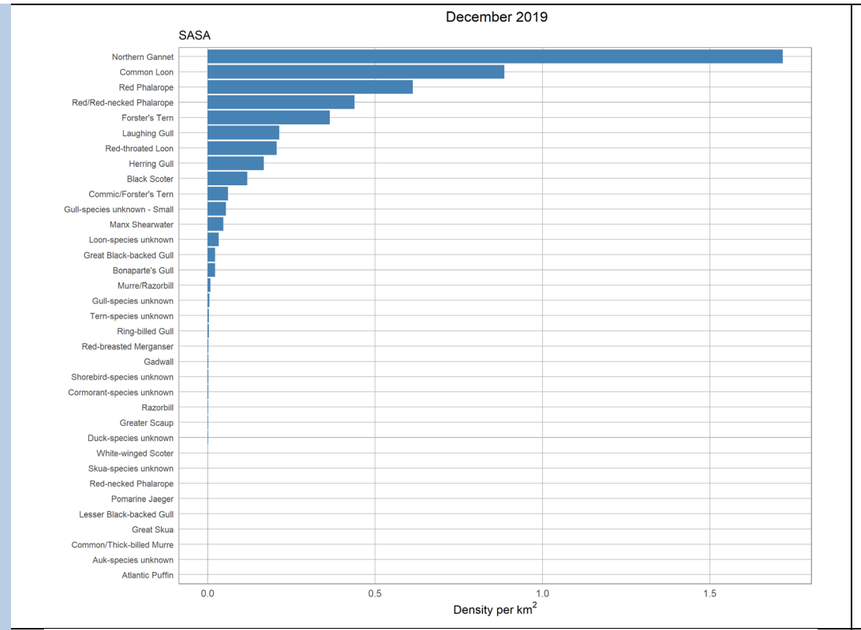
Species Group	Density (per km^2)										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Duck	**0.1273**				**0.1250**						**0.1097**
Gadwall	0.0026				0.0026						0.0023
Greater Scaup	0.0016				0.0015						0.0014
White-winged Scoter	0.0005				0.0005						0.0005
Black Scoter	0.1184				0.1163						0.1021
Red-breasted Merganser	0.0026				0.0026						0.0023
species unknown	0.0016				0.0015						0.0014
Loon	**1.1257**	**0.8475**	**0.7752**	**0.7926**	**1.1125**	**0.0681**	**2.1879**	**0.1664**	**1.5757**	**0.7817**	**1.0720**
Red-throated Loon	0.2065		0.7752	0.0330	0.2043	0.0136			0.0192	0.0111	0.1806
Common Loon	0.8862	0.8475		0.6605	0.8748	0.0545	2.1879	0.1664	1.5565	0.7706	0.8620
species unknown	0.0330			0.0991	0.0334						0.0294
Shearwater	**0.0472**				**0.0463**			**0.0128**		**0.0037**	**0.0411**
Manx Shearwater	0.0472				0.0463			0.0128		0.0037	0.0411
Gannet	**1.7179**	**0.4237**		**0.0330**	**1.6873**	**0.0408**	**8.1725**	**0.5760**	**0.1633**	**0.6932**	**1.5655**
Northern Gannet	1.7179	0.4237		0.0330	1.6873	0.0408	8.1725	0.5760	0.1633	0.6932	1.5655
Cormorant	**0.0021**				**0.0021**						**0.0018**
species unknown	0.0021				0.0021						0.0018
Shorebird	**0.0021**				**0.0021**						**0.0018**
species unknown	0.0021				0.0021						0.0018
Phalarope	**1.0523**			**4.0291**	**1.0585**	**0.0953**	**34.2342**	**13.5031**	**22.8382**	**14.2294**	**2.6714**
Red-necked Phalarope	0.0005				0.0005		0.1287	0.0384		0.0184	0.0027
Red Phalarope	0.6126			3.5007	0.6185		20.0129	13.2856	22.8382	13.3260	2.1747
Red/Red-necked Phalarope	0.4392			0.5284	0.4394	0.0953	14.0927	0.1792		0.8850	0.4940
Skua	**0.0016**				**0.0015**						**0.0014**
Great Skua	0.0005				0.0005						0.0005
Pomarine Jaeger	0.0005				0.0005						0.0005
species unknown	0.0005				0.0005						0.0005

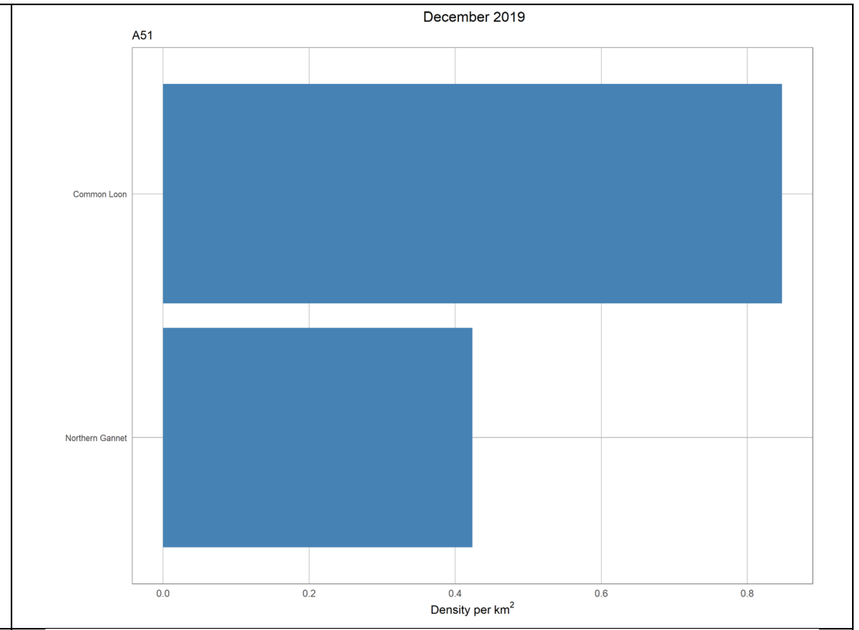
(continued)

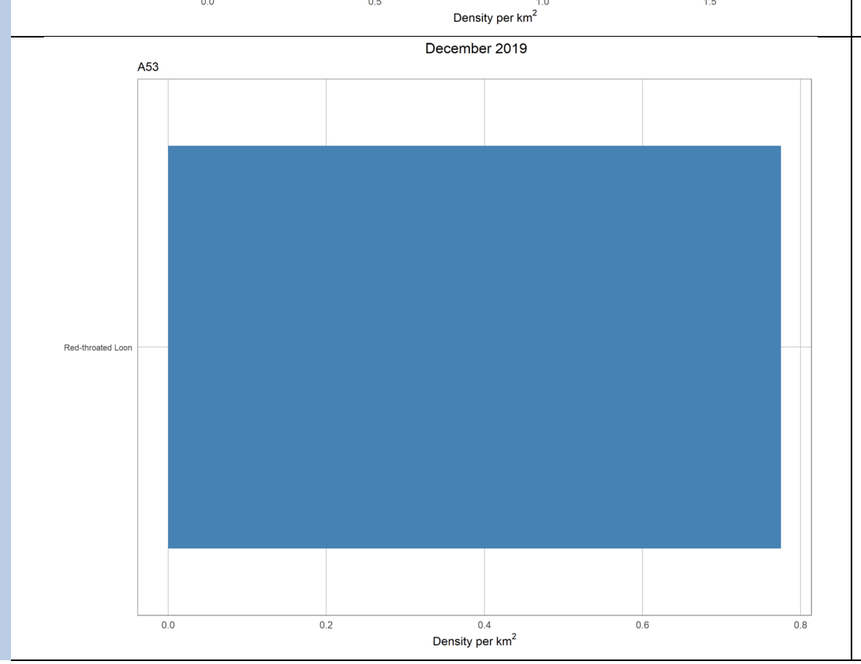
Table C–32. (Continued)

Species Group	Density (per km^2)										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	TOTAL	KH	WW	WE	GSCA	TOTAL	
Auk	**0.0115**				**0.0113**		**0.1931**			**0.0111**	**0.0113**
Common/Thick-billed Murre	0.0005				0.0005						0.0005
Razorbill	0.0016				0.0015						0.0014
Murre/Razorbill	0.0084				0.0082		0.1931			0.0111	0.0086
Atlantic Puffin	0.0005				0.0005						0.0005
species unknown	0.0005				0.0005						0.0005
Gull	**0.4905**				**0.4816**	**2.2328**	**2.1879**	**0.5760**	**0.1922**	**0.9624**	**0.5405**
Black-legged Kittiwake						0.0136	0.0644		0.0096	0.0111	0.0014
Bonaparte's Gull	0.0225				0.0221	1.4840	0.3218	0.0128	0.1057	0.4646	0.0763
Laughing Gull	0.2138				0.2099		0.0644			0.0037	0.1847
Ring-billed Gull	0.0037				0.0036						0.0032
Herring Gull	0.1677				0.1647	0.3131	1.7375	0.5248	0.0384	0.3429	0.1865
Lesser Black-backed Gull	0.0005				0.0005				0.0096	0.0037	0.0009
Great Black-backed Gull	0.0225				0.0221	0.3131			0.0096	0.0885	0.0303
species unknown - Large						0.0136				0.0037	0.0005
species unknown - Small	0.0545				0.0535			0.0384	0.0192	0.0442	0.0524
species unknown	0.0052				0.0051	0.0953					0.0045
Tern	**0.0042**				**0.0041**		**0.0644**	**0.0128**		**0.0074**	**0.0045**
species unknown	0.0042				0.0041		0.0644	0.0128		0.0074	0.0045
***Sterna* Tern**	**0.4266**				**0.4189**		**2.7671**	**0.6912**	**0.9992**	**0.6305**	**0.4448**
Forster's Tern	0.3653				0.3587		2.7671	0.4992	0.9896	0.5715	0.3847
Commic/Forster's Tern	0.0613				0.0602						0.0528
species unknown								0.1920	0.0096	0.0590	0.0072
Total	**5.0090**	**1.2712**	**0.7752**	**4.8547**	**4.9511**	**2.4370**	**49.8069**	**15.5382**	**25.7686**	**17.3193**	**6.4658**

TRANSECT







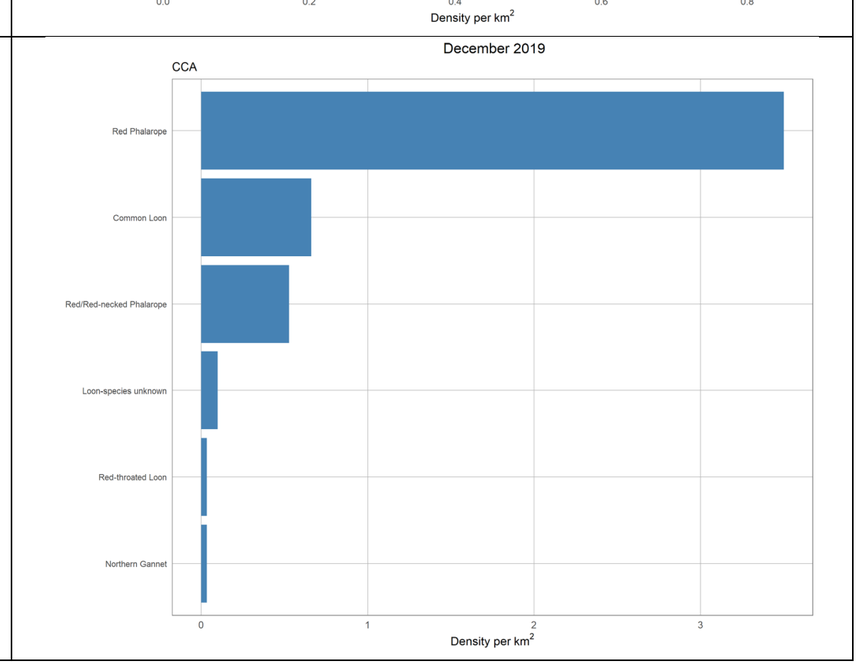


Figure C–9. Density (per km^2) of avian species identified in the December 2019 survey in each area, ordered by density for each area (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

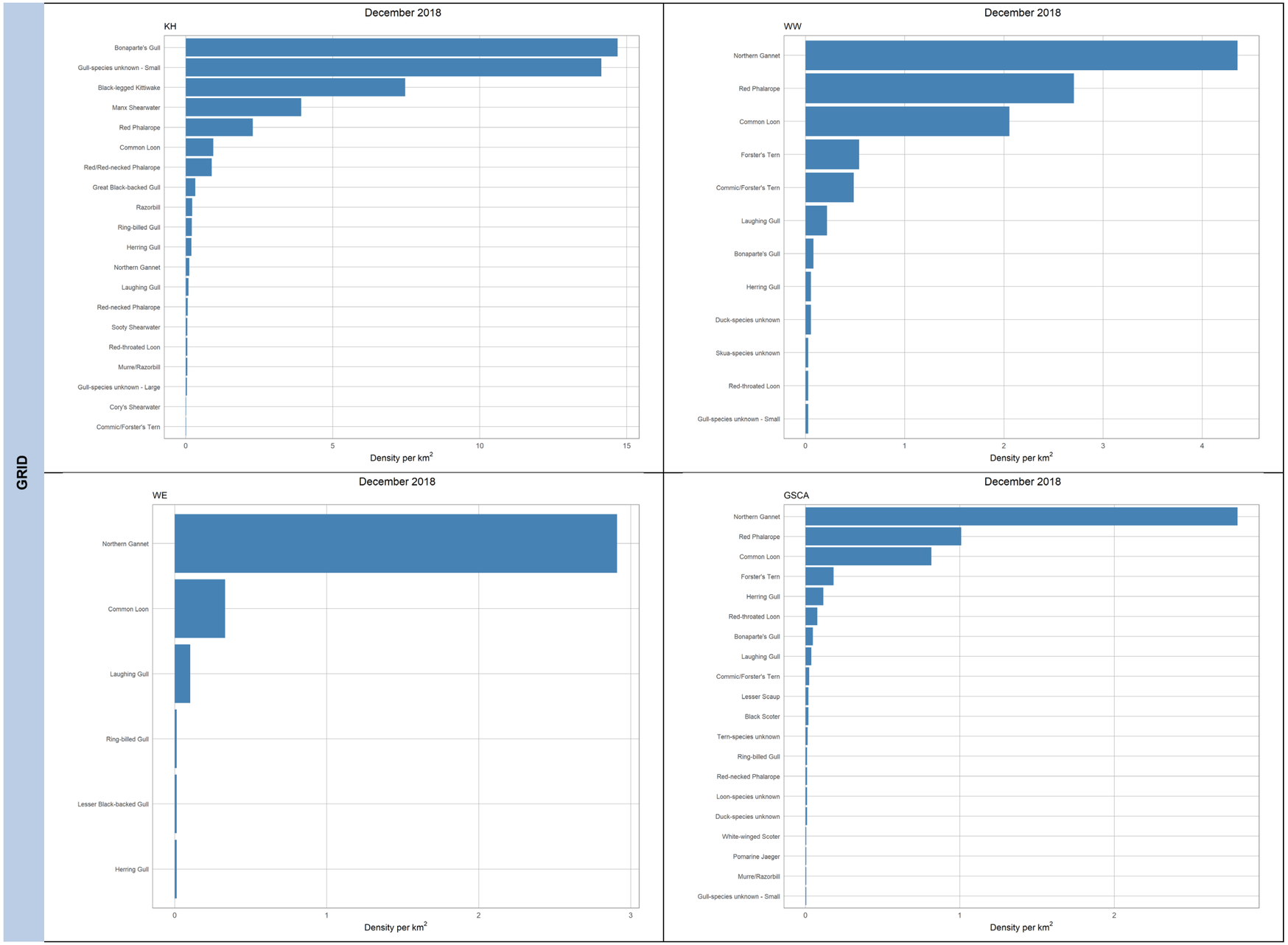


Figure C–9. (Continued)

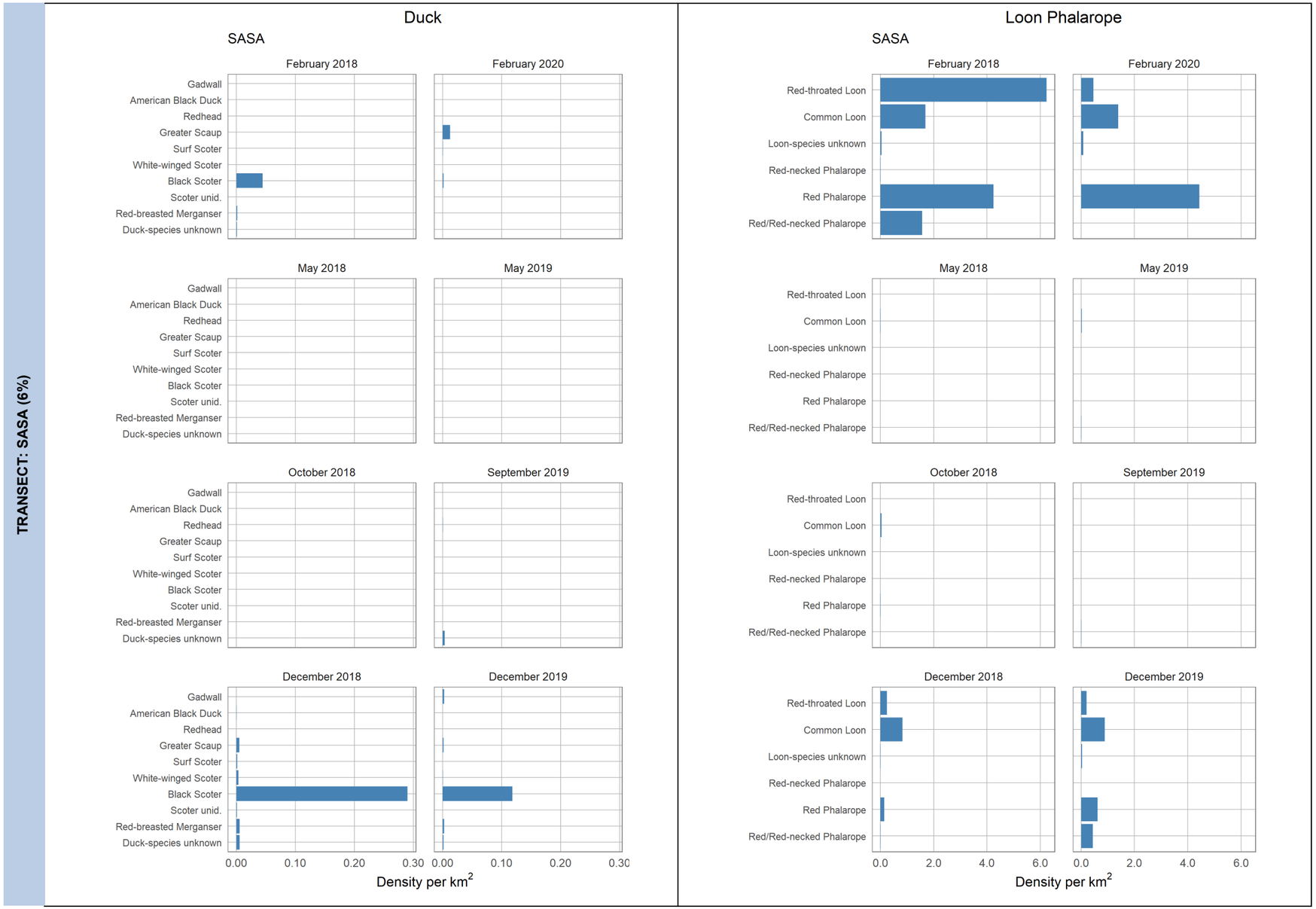
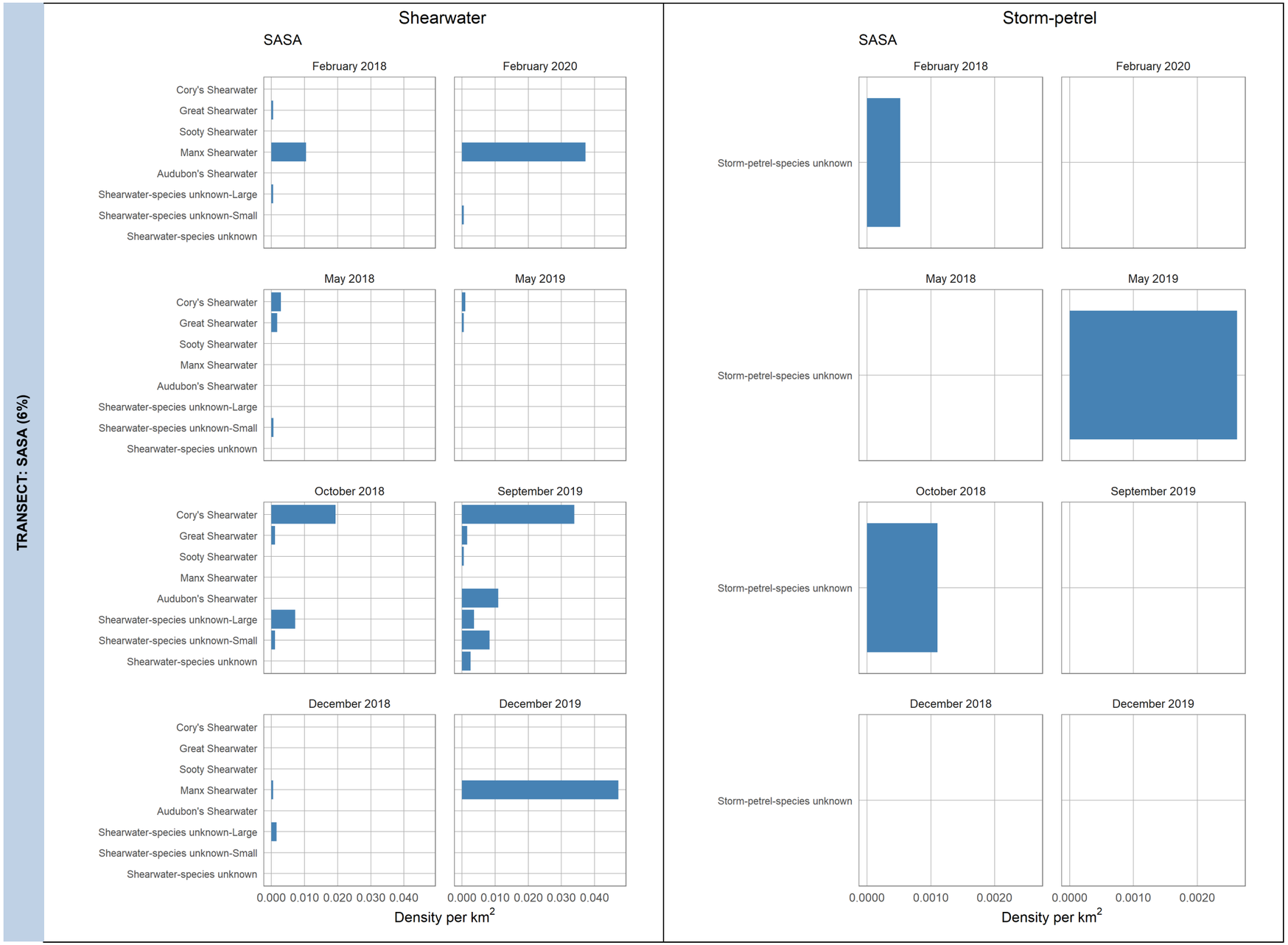


Figure C–10. Density (per km^2) of species (by species group) identified in the February 2018 through February 2020 surveys in the South Atlantic Survey Area (SASA; counts include all of A51, part of A53, and part of CCA) (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.
Species groups with minimal observation numbers were not included.



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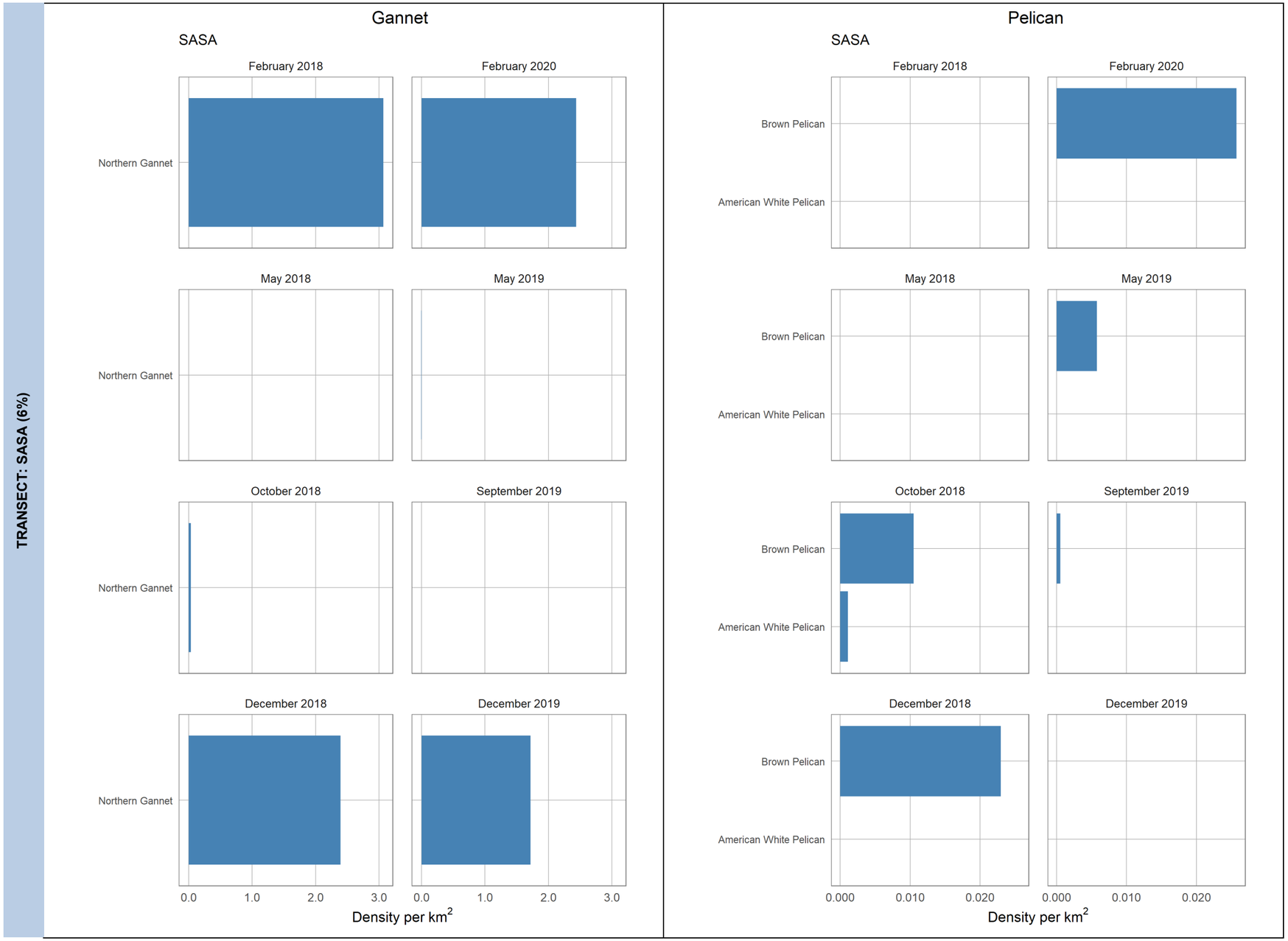

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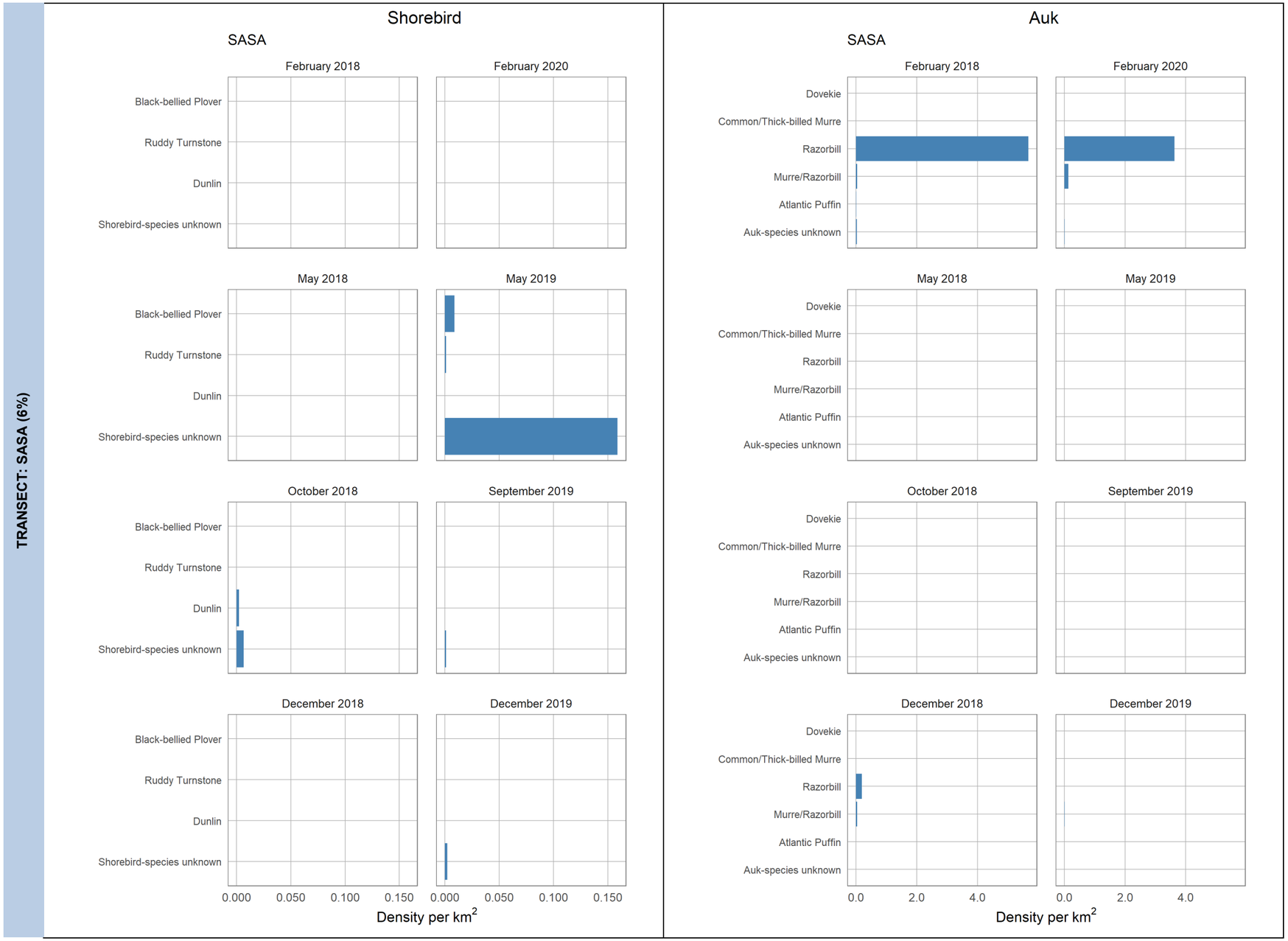

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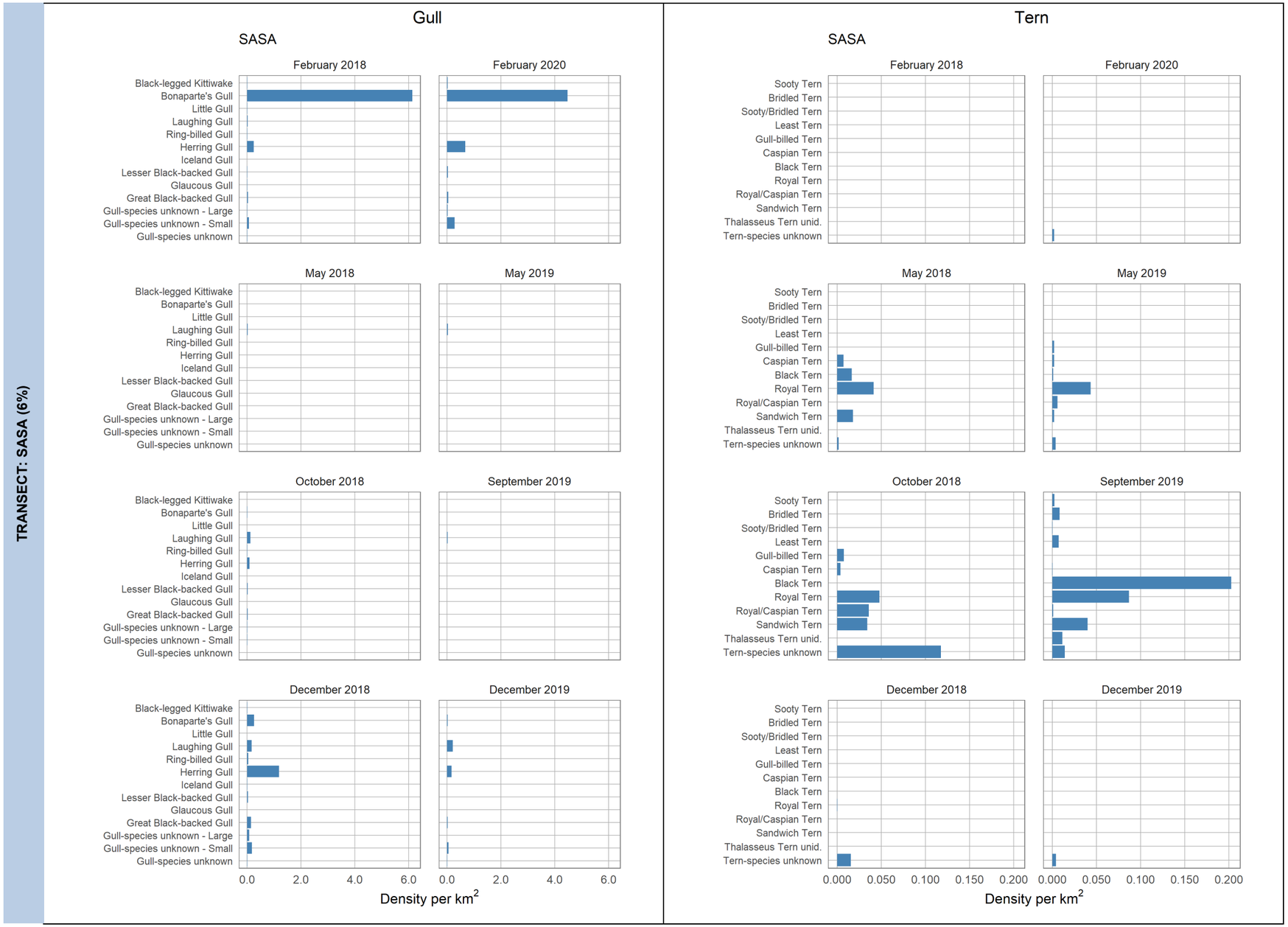

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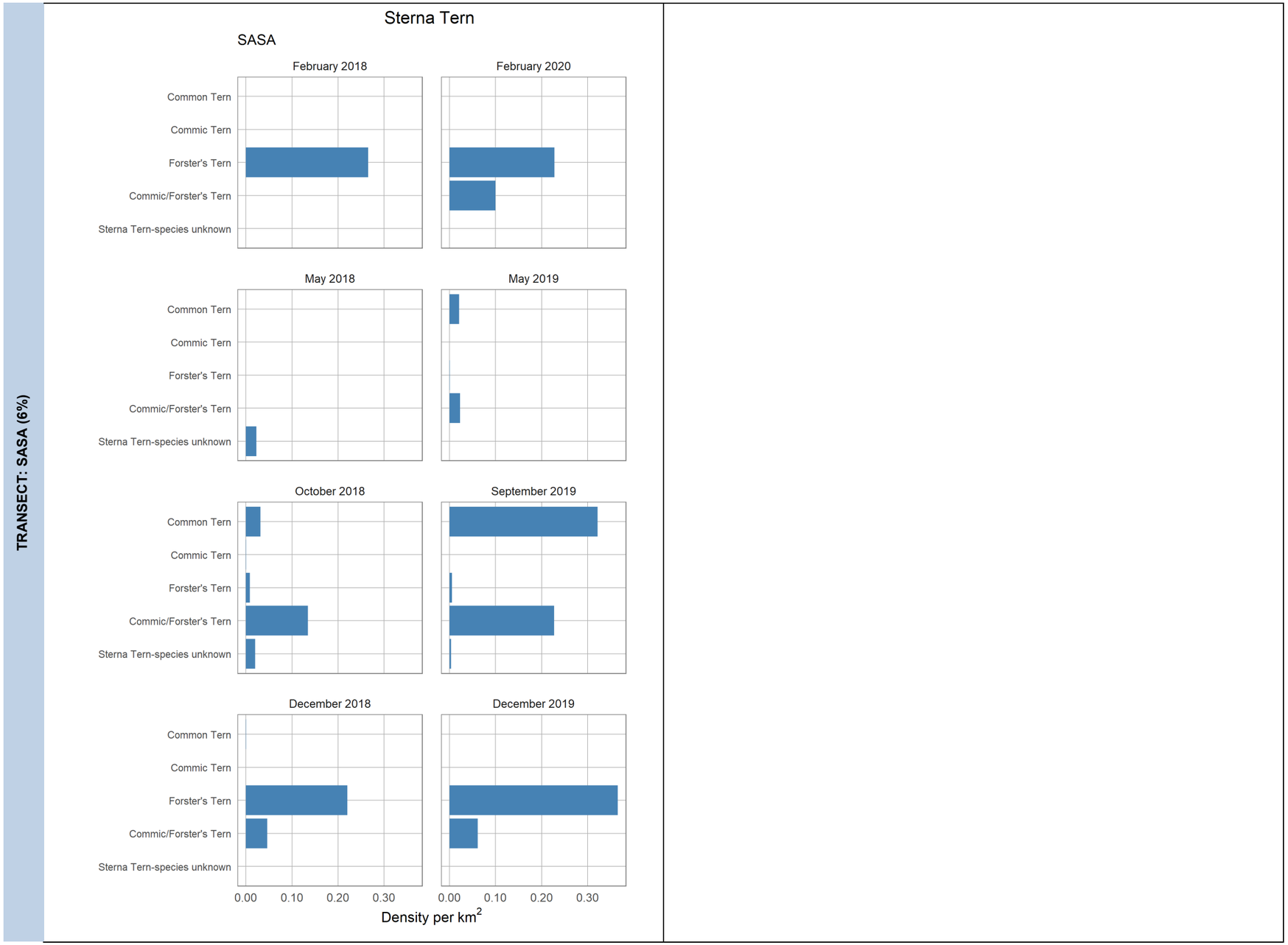

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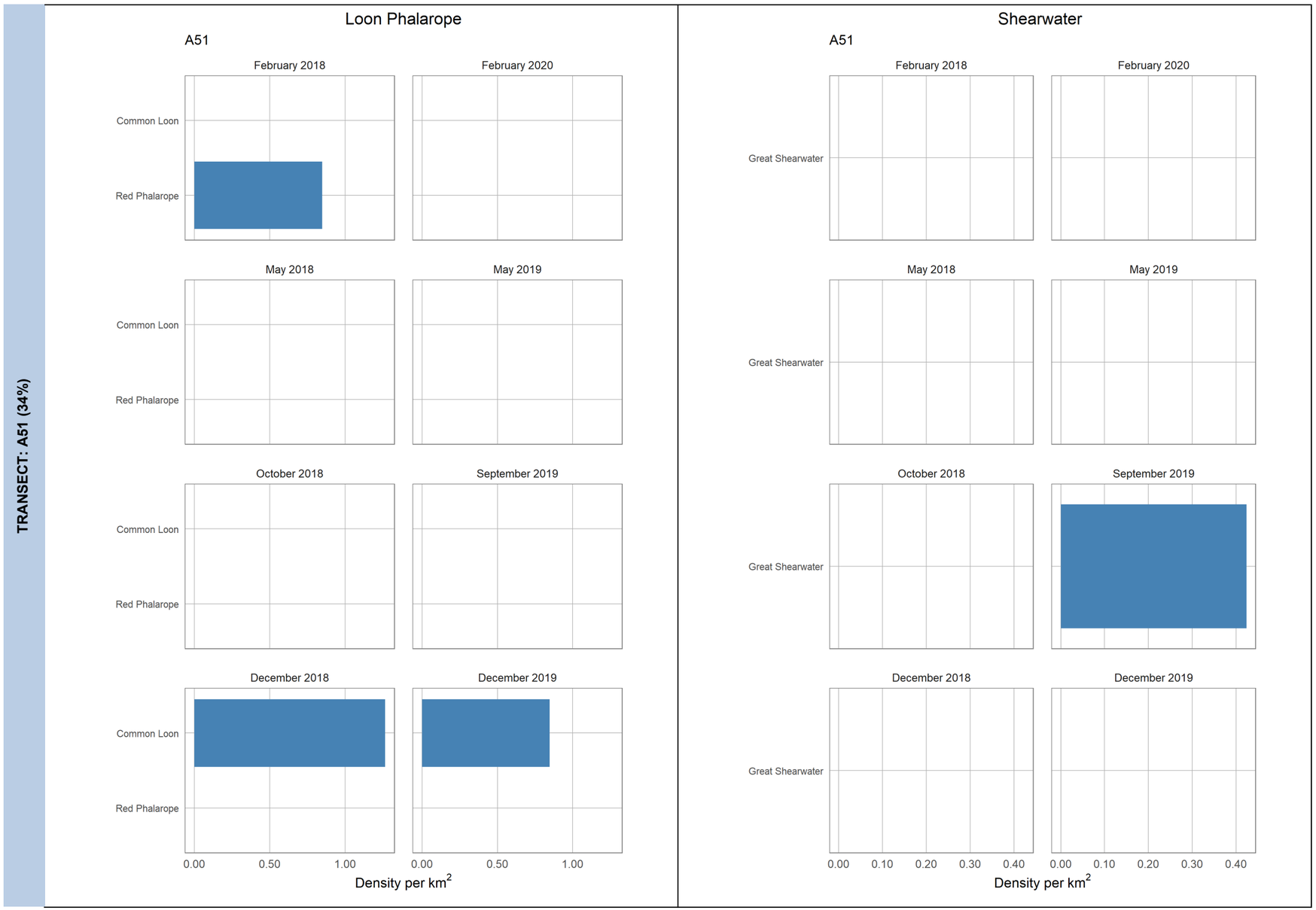
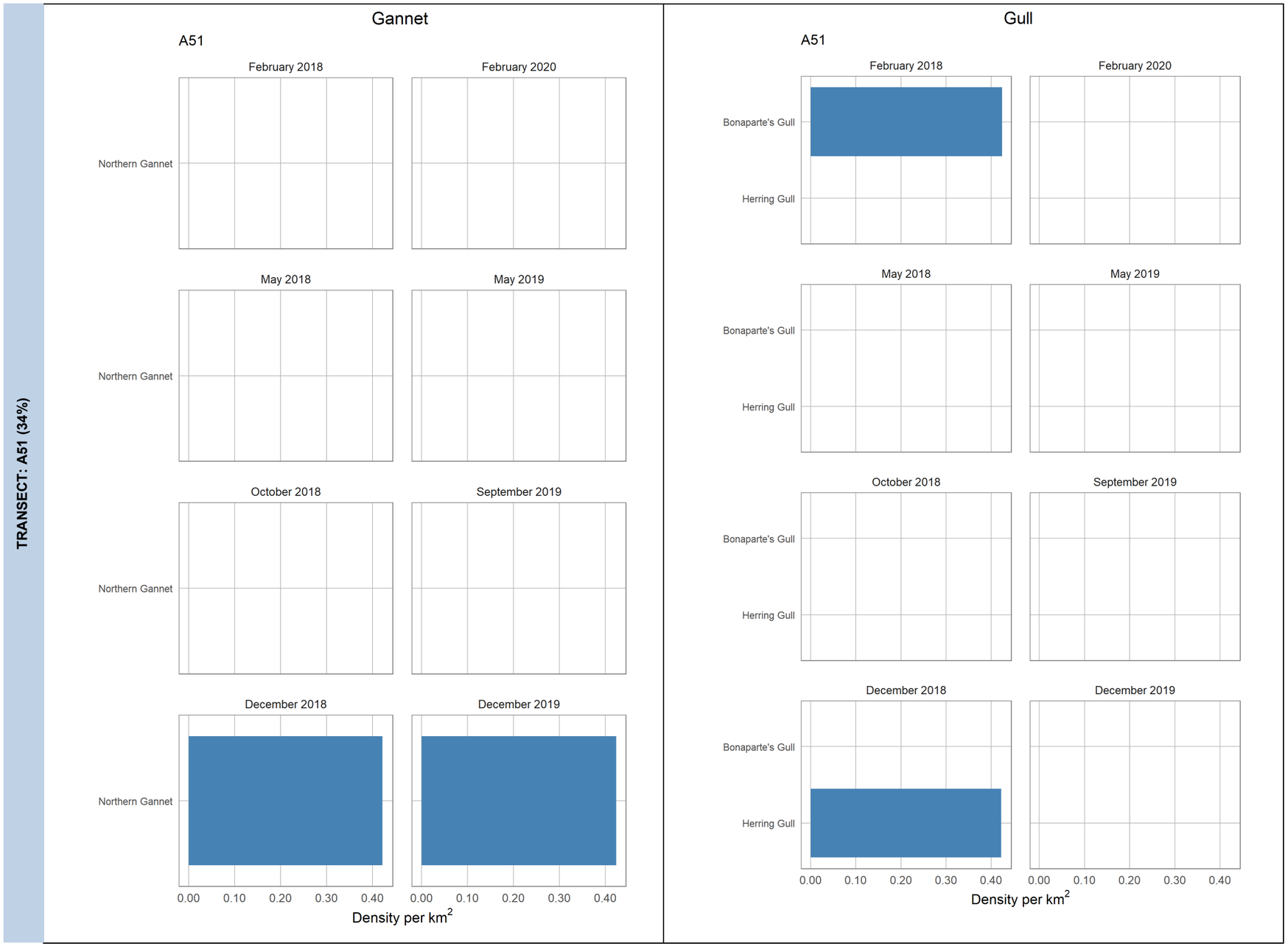


Figure C–11. Density (per km^2) of species (by species group) identified in the February 2018 through February 2020 surveys in Area 51 (A51) (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.
Species groups with minimal observation numbers were not included.



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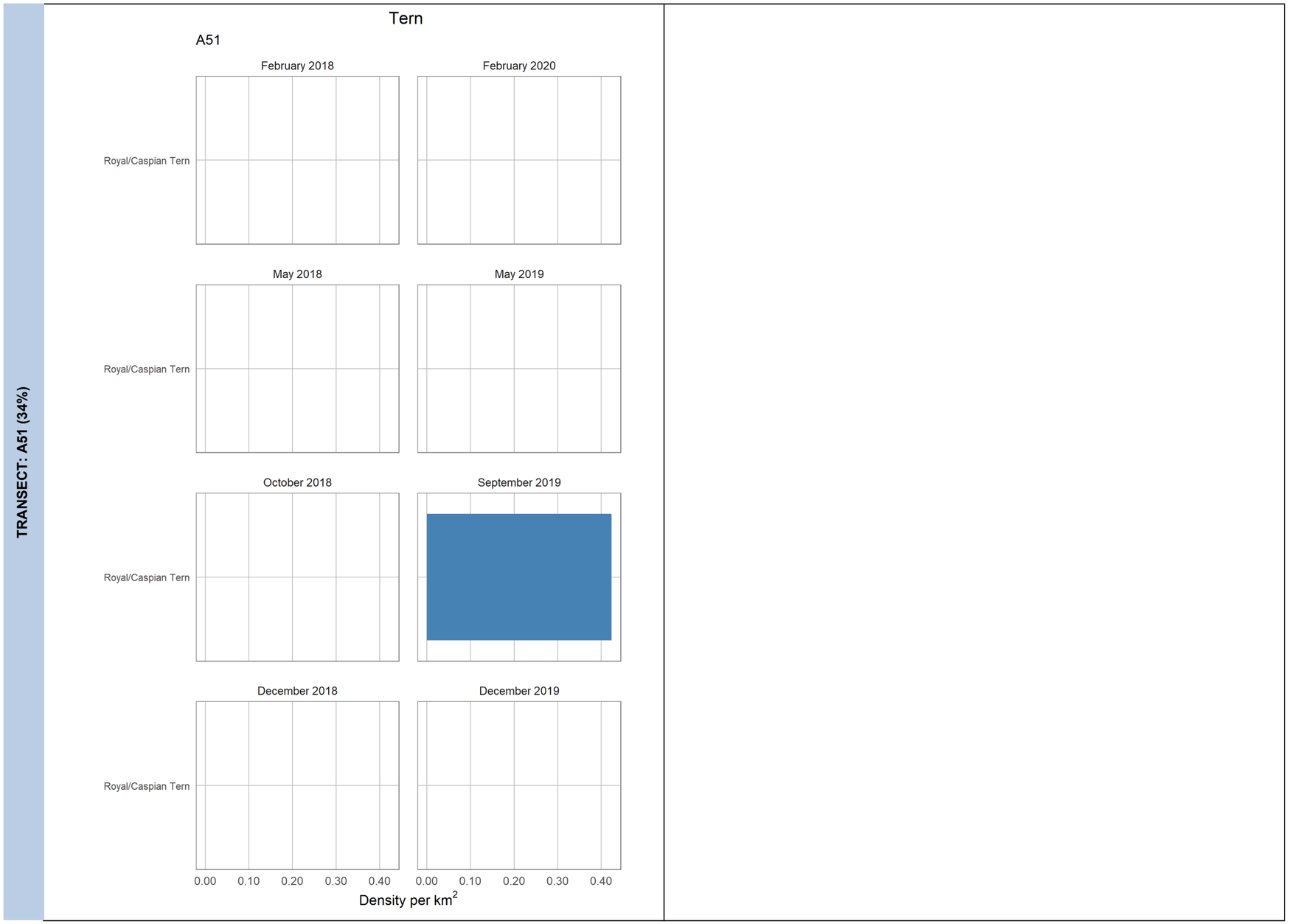

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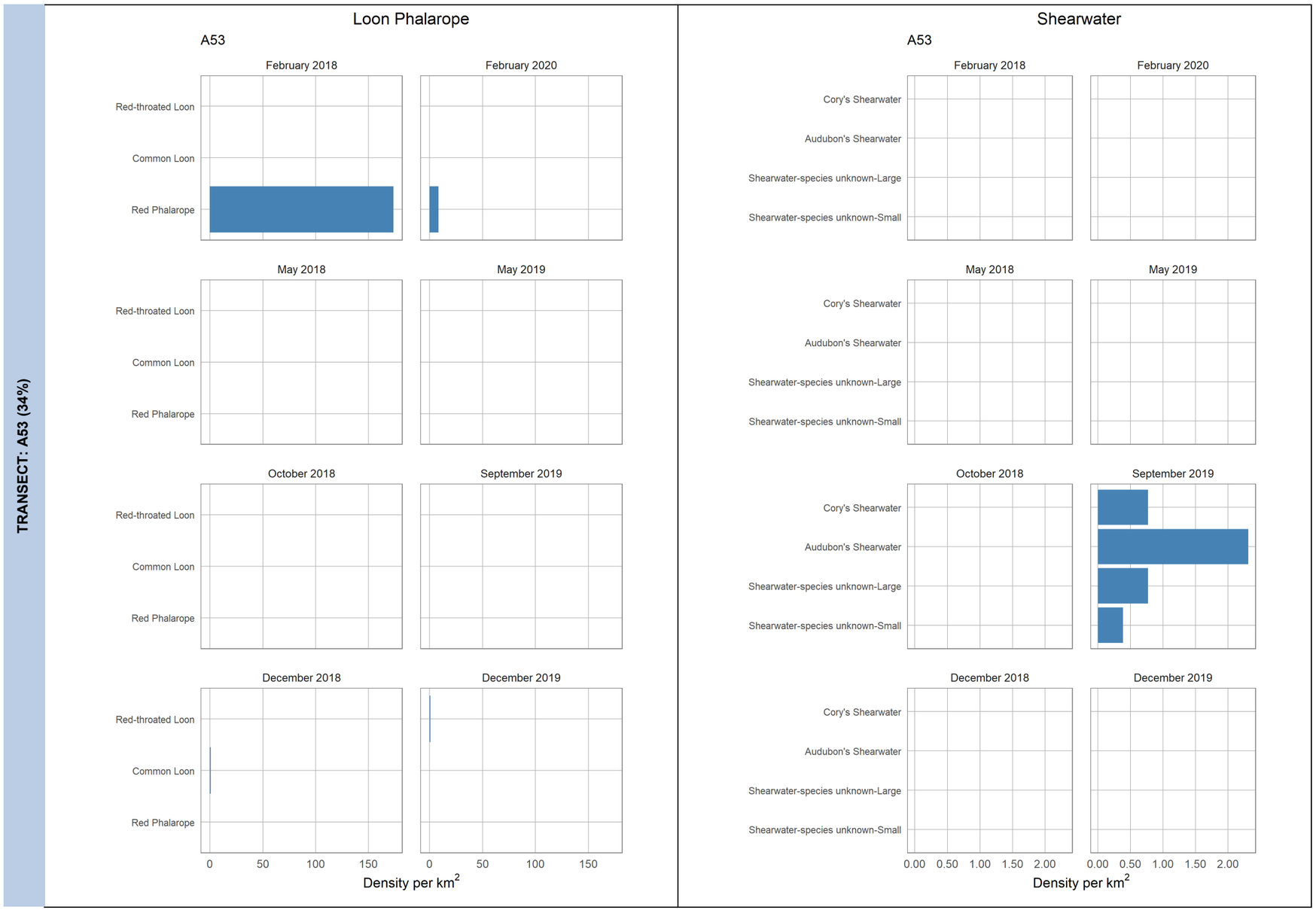
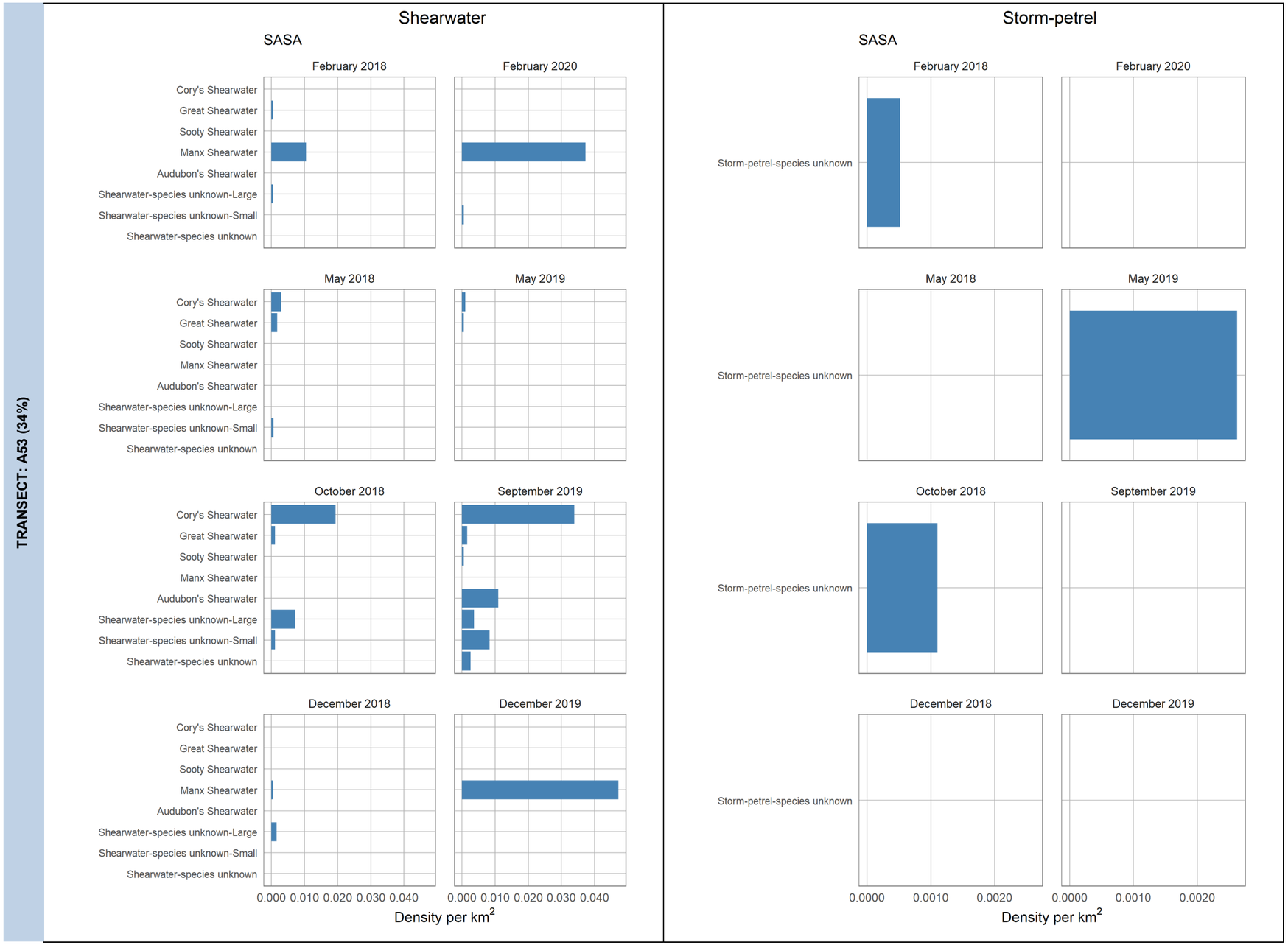


Figure C–12. Density (per km^2) of species (by species group) identified in the February 2018 through February 2020 surveys in Area 53 (A53) (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.
Species groups with minimal observation numbers were not included.



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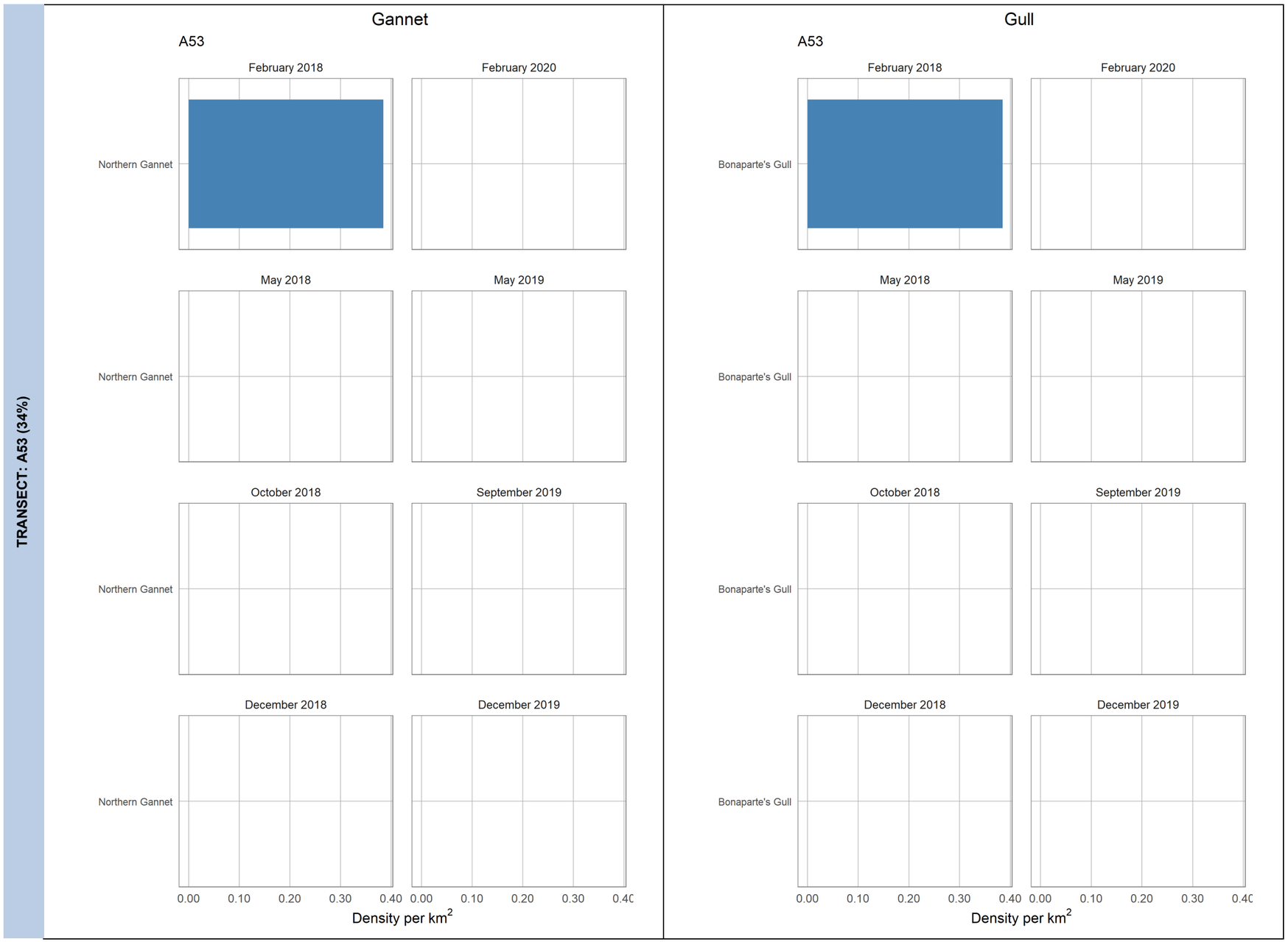

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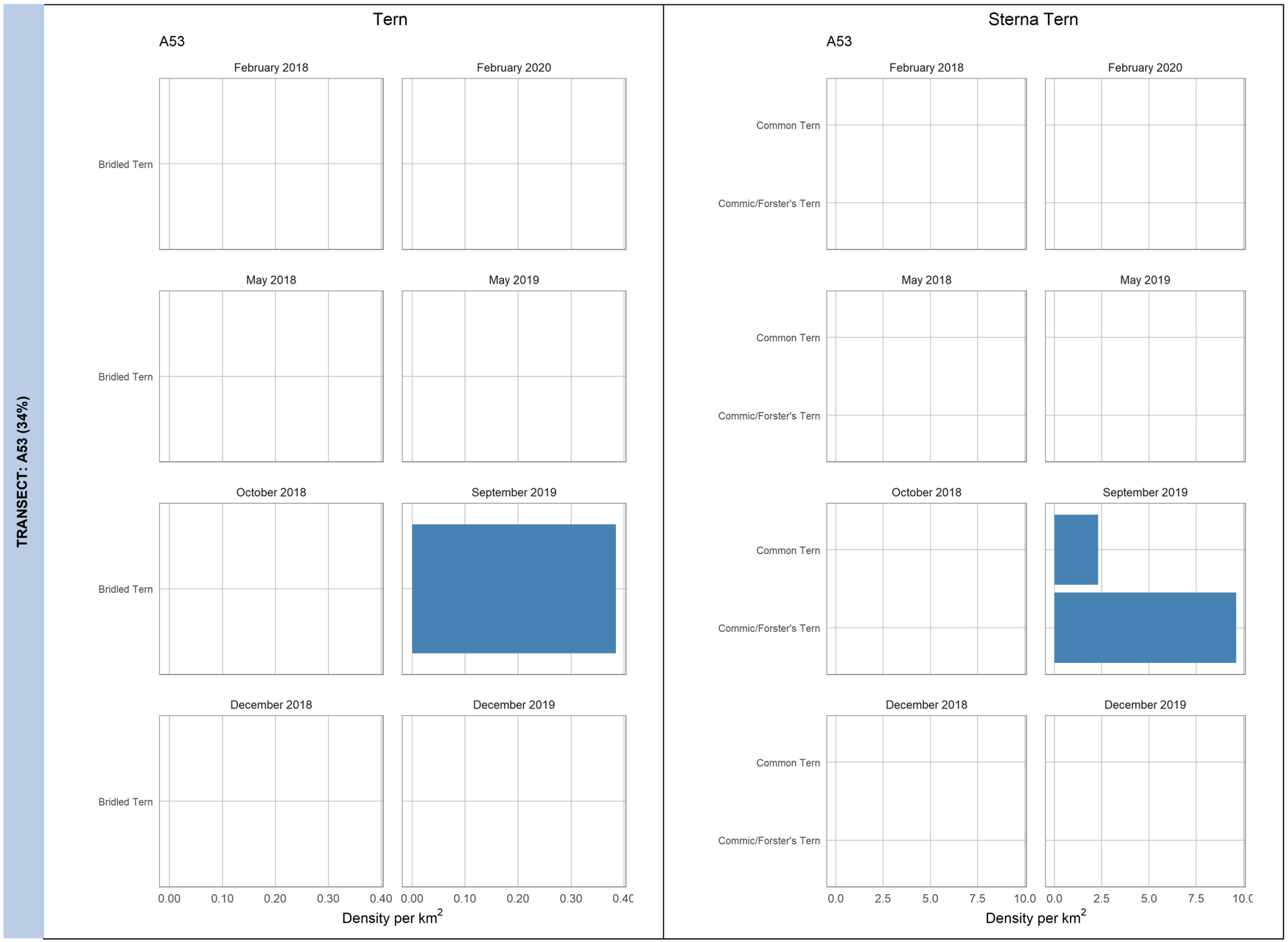

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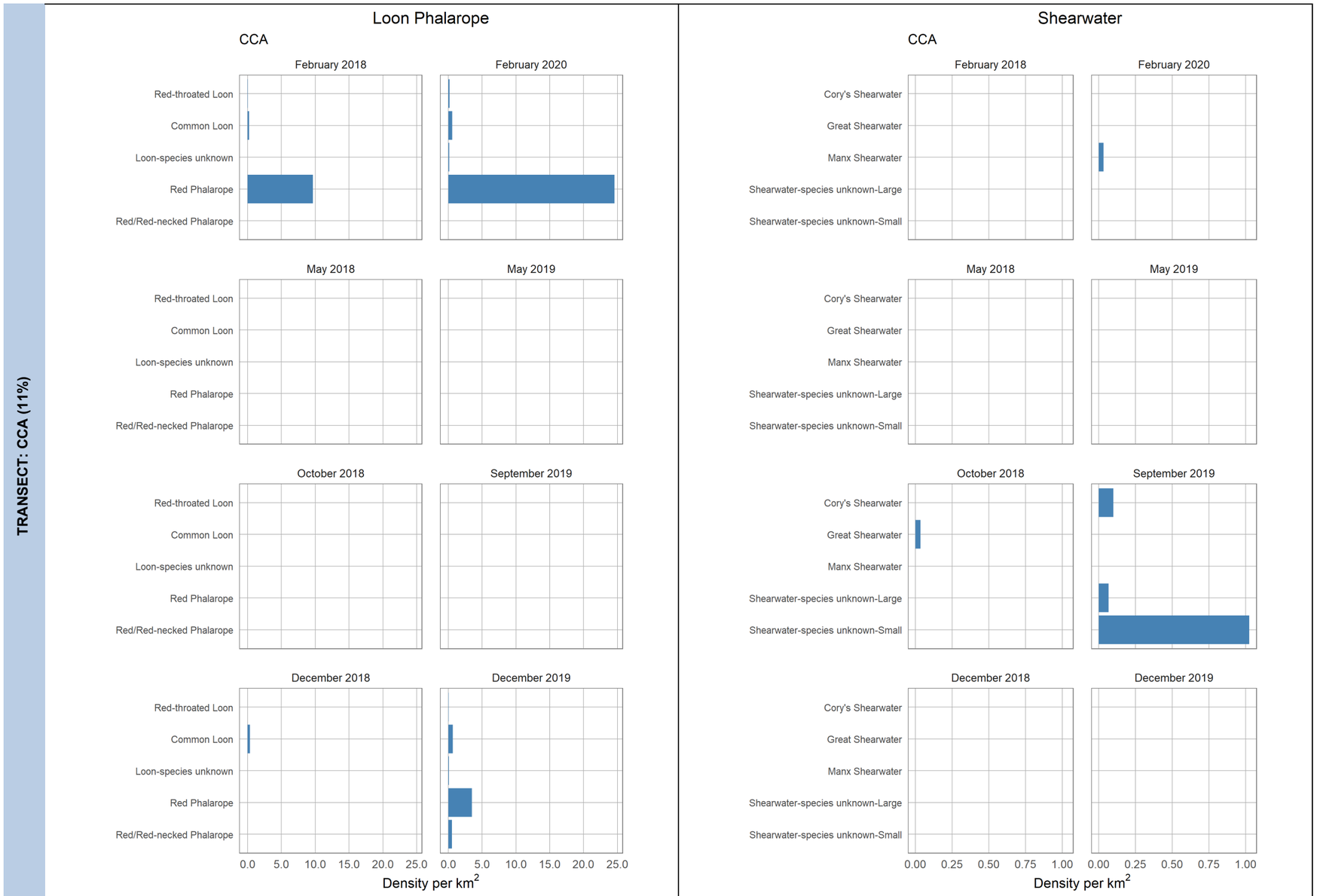
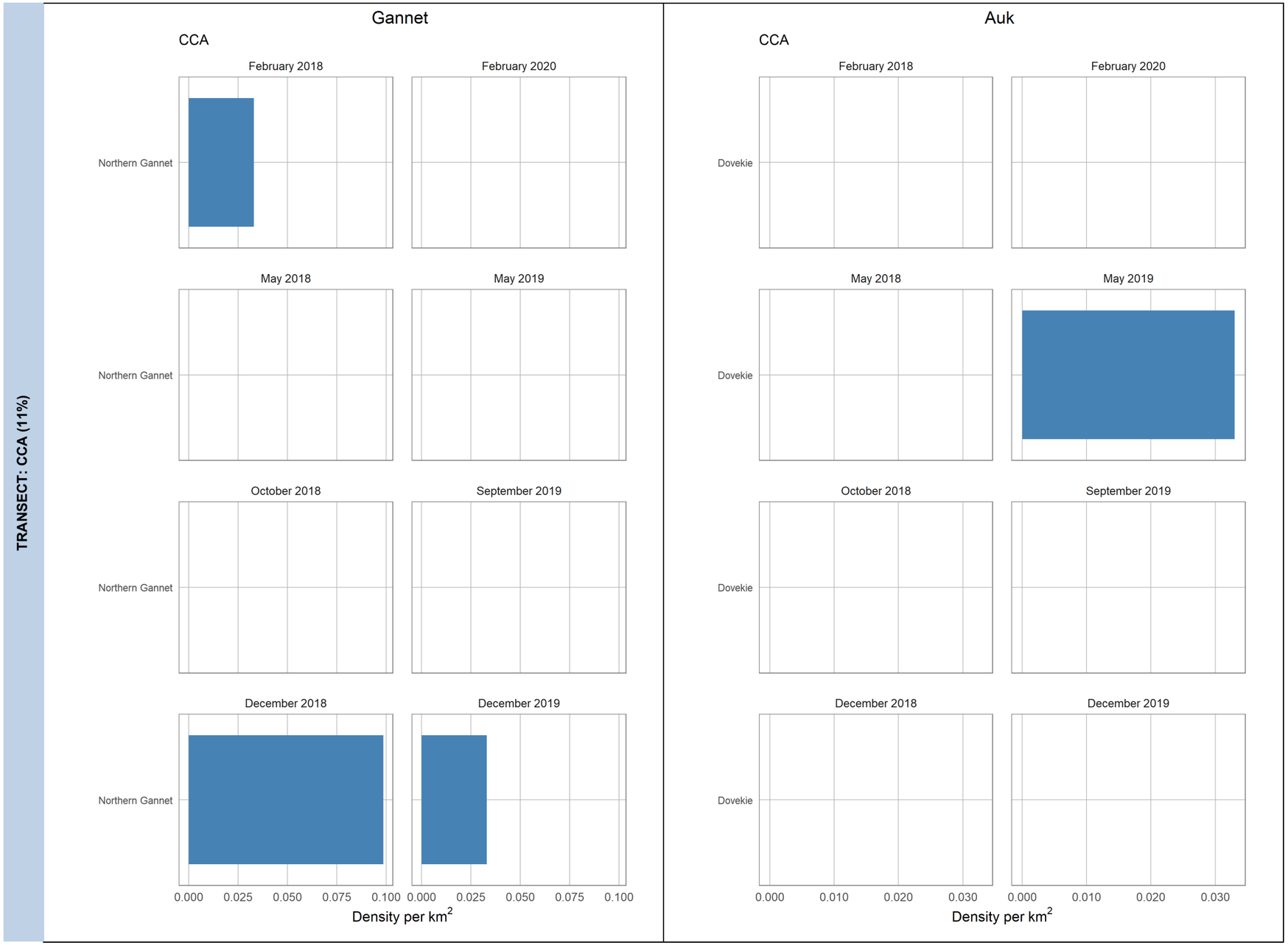


Figure C–13. Density (per km^2) of species (by species group) identified in the February 2018 through February 2020 surveys in the Charleston Call Area (CCA) (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.
Species groups with minimal observation numbers were not included.



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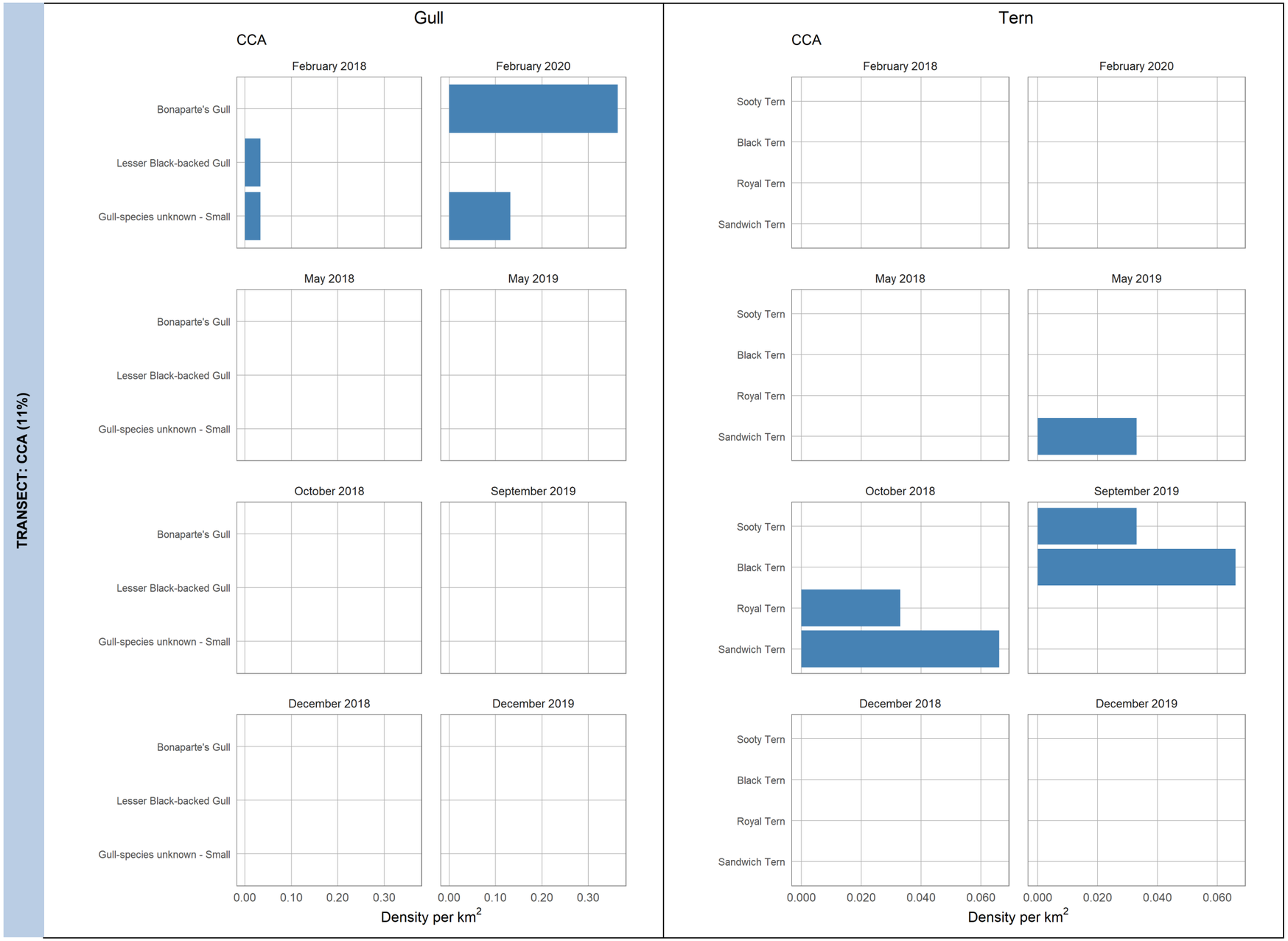

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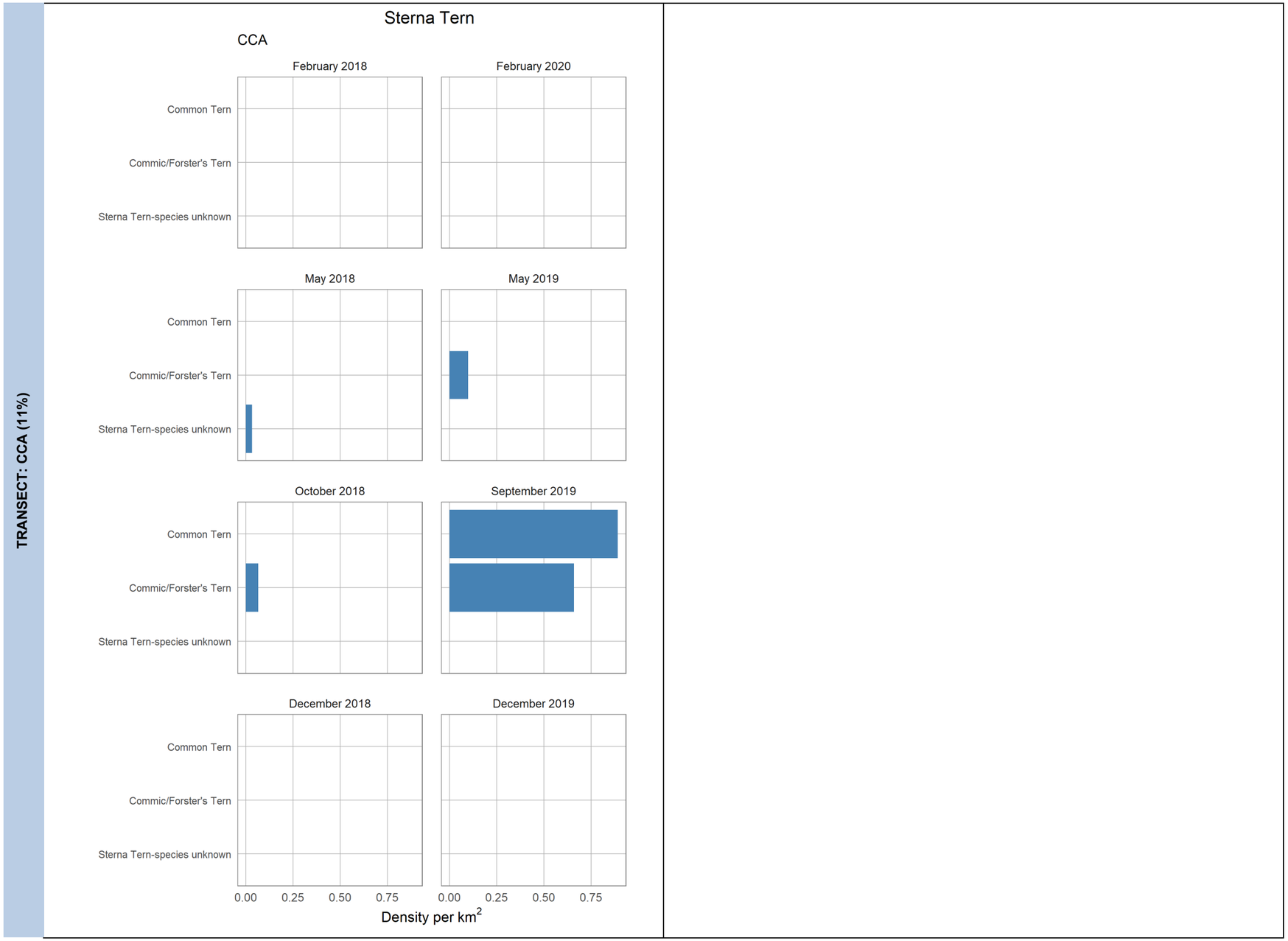

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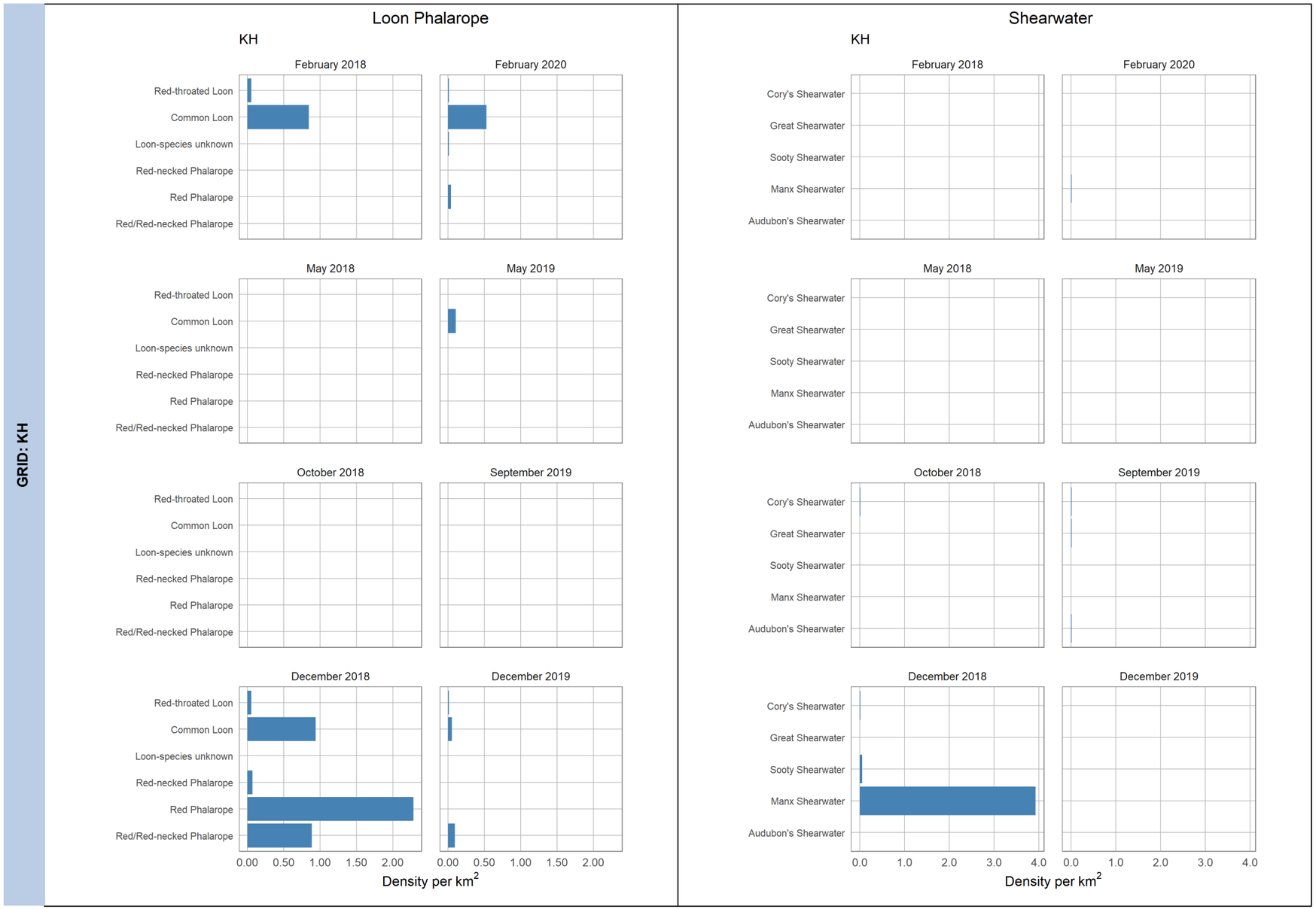
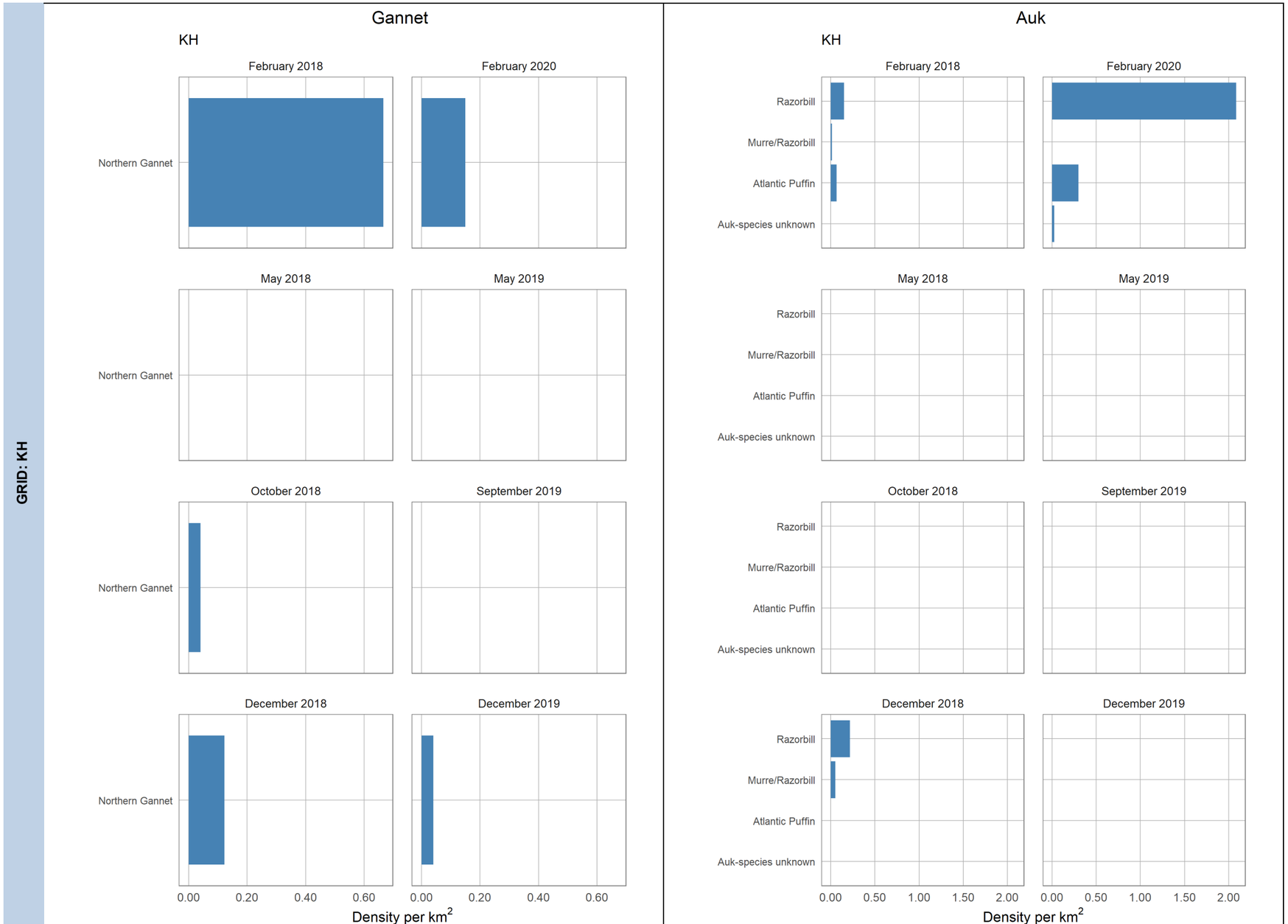


Figure C–14. Density (per km^2) of species (by species group) identified in the February 2018 through February 2020 surveys in Kitty Hawk (KH) (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.
Species groups with minimal observation numbers were not included.



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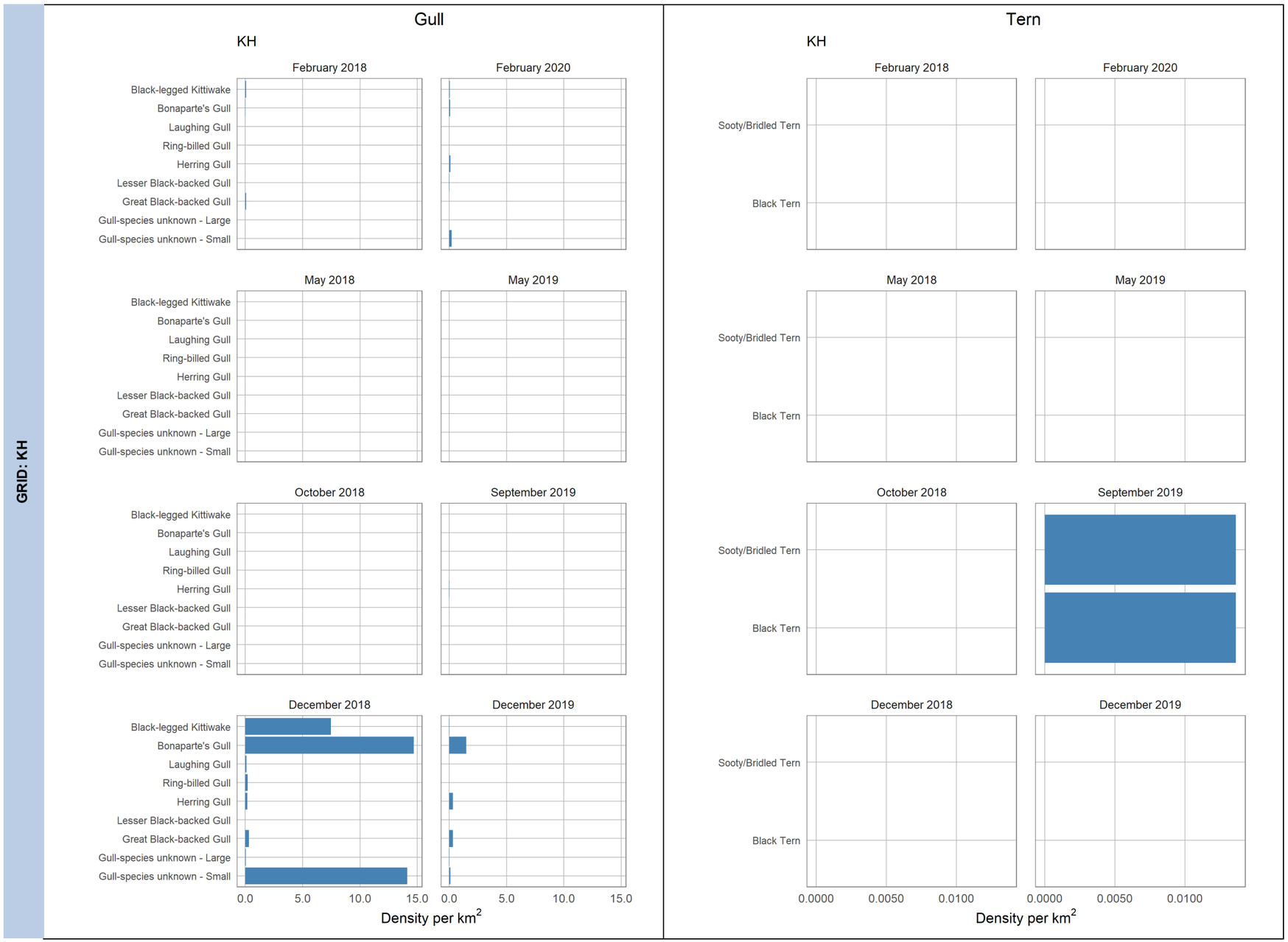

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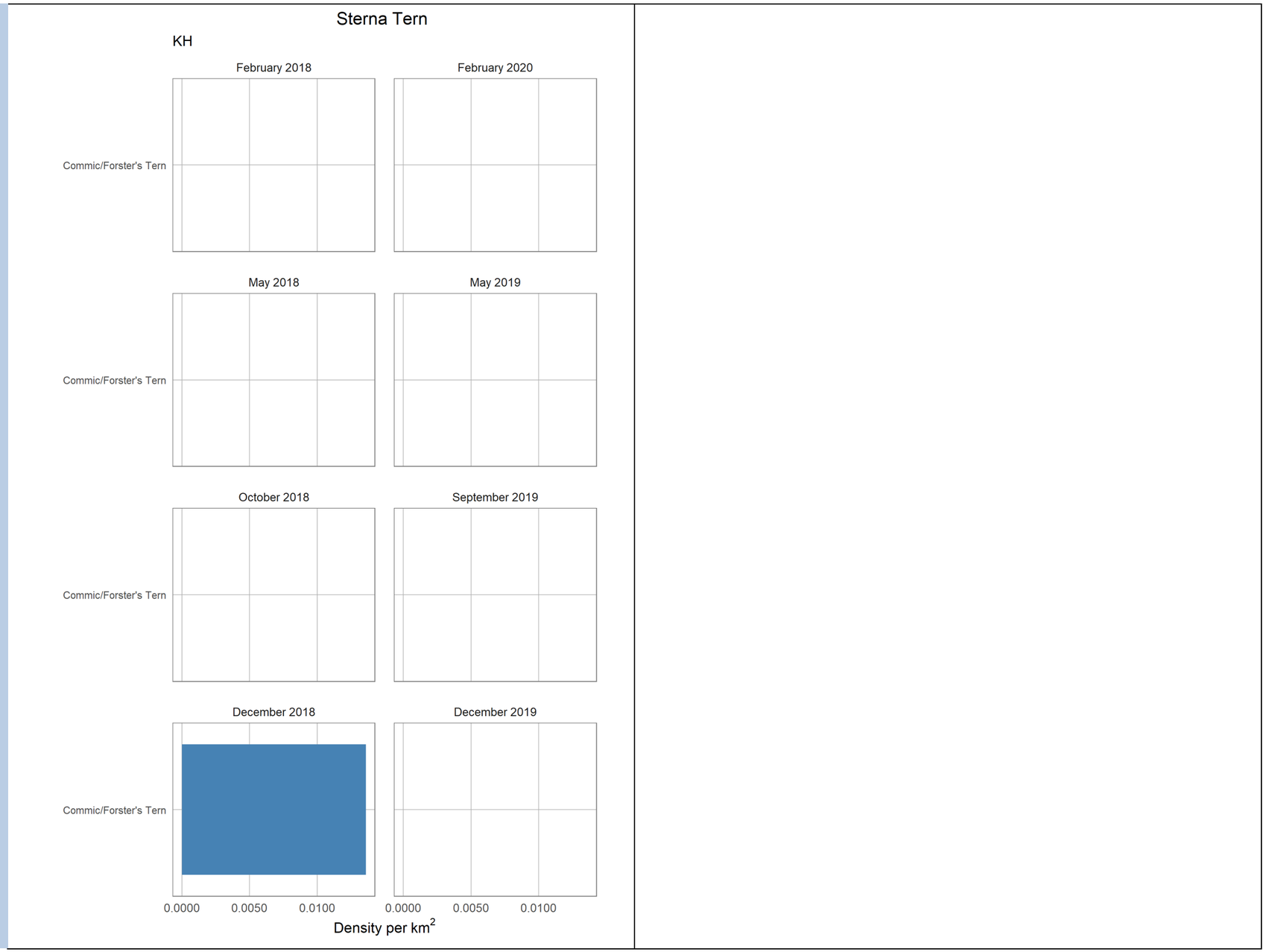

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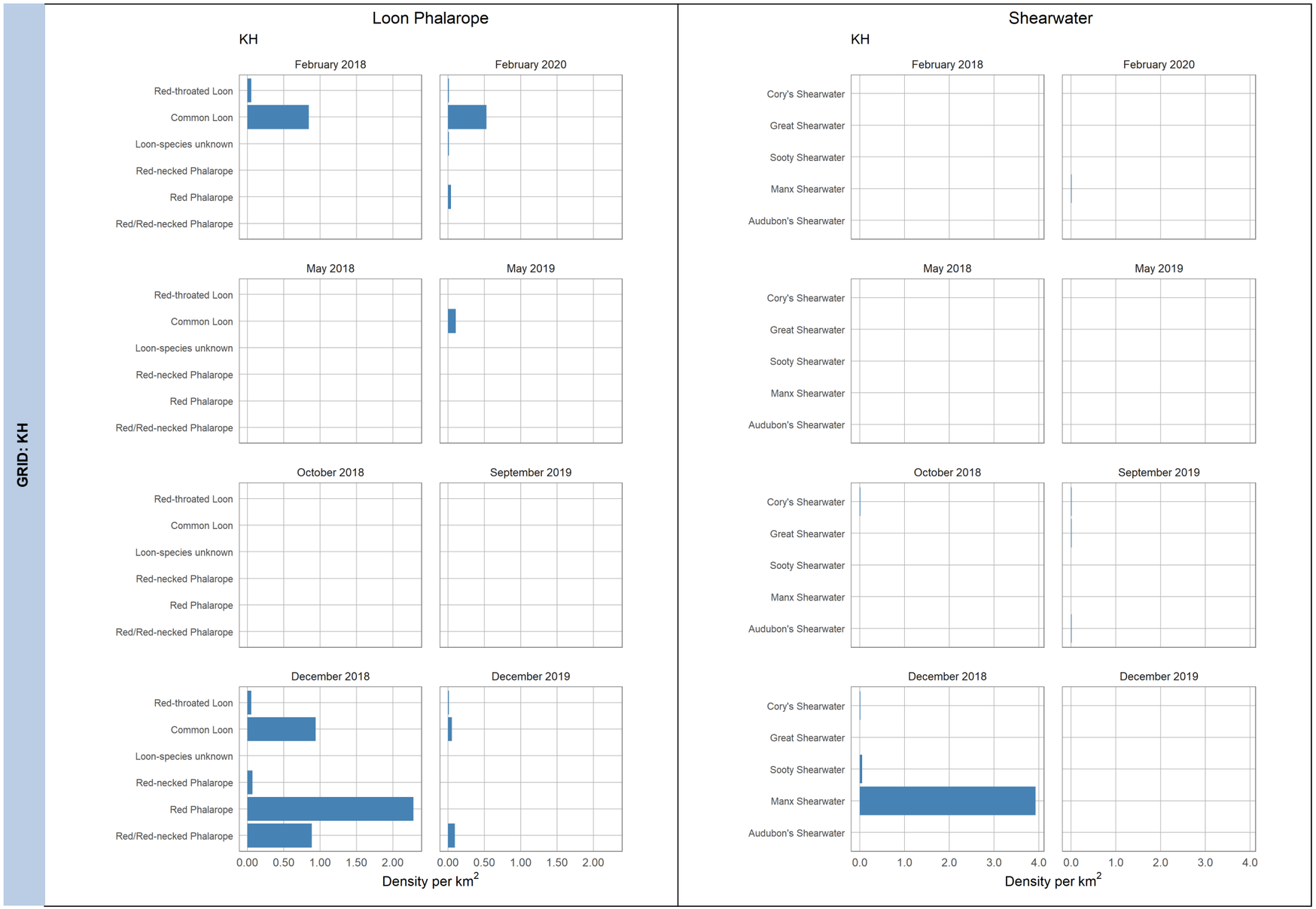
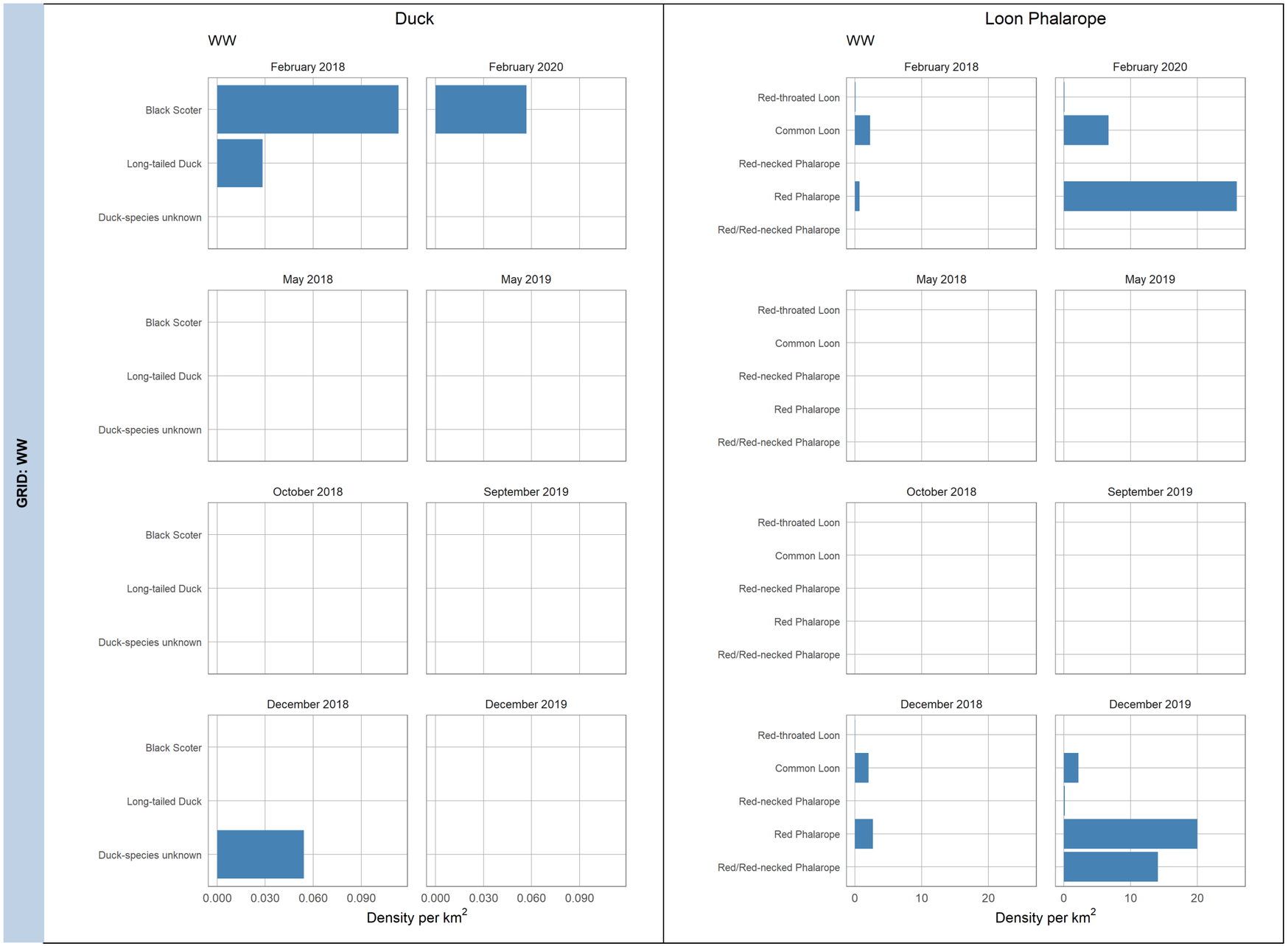


Figure C–15. Density (per km^2) of species (by species group) identified in the February 2018 through February 2020 surveys in Wilmington West (WW) (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.
Species groups with minimal observation numbers were not included.



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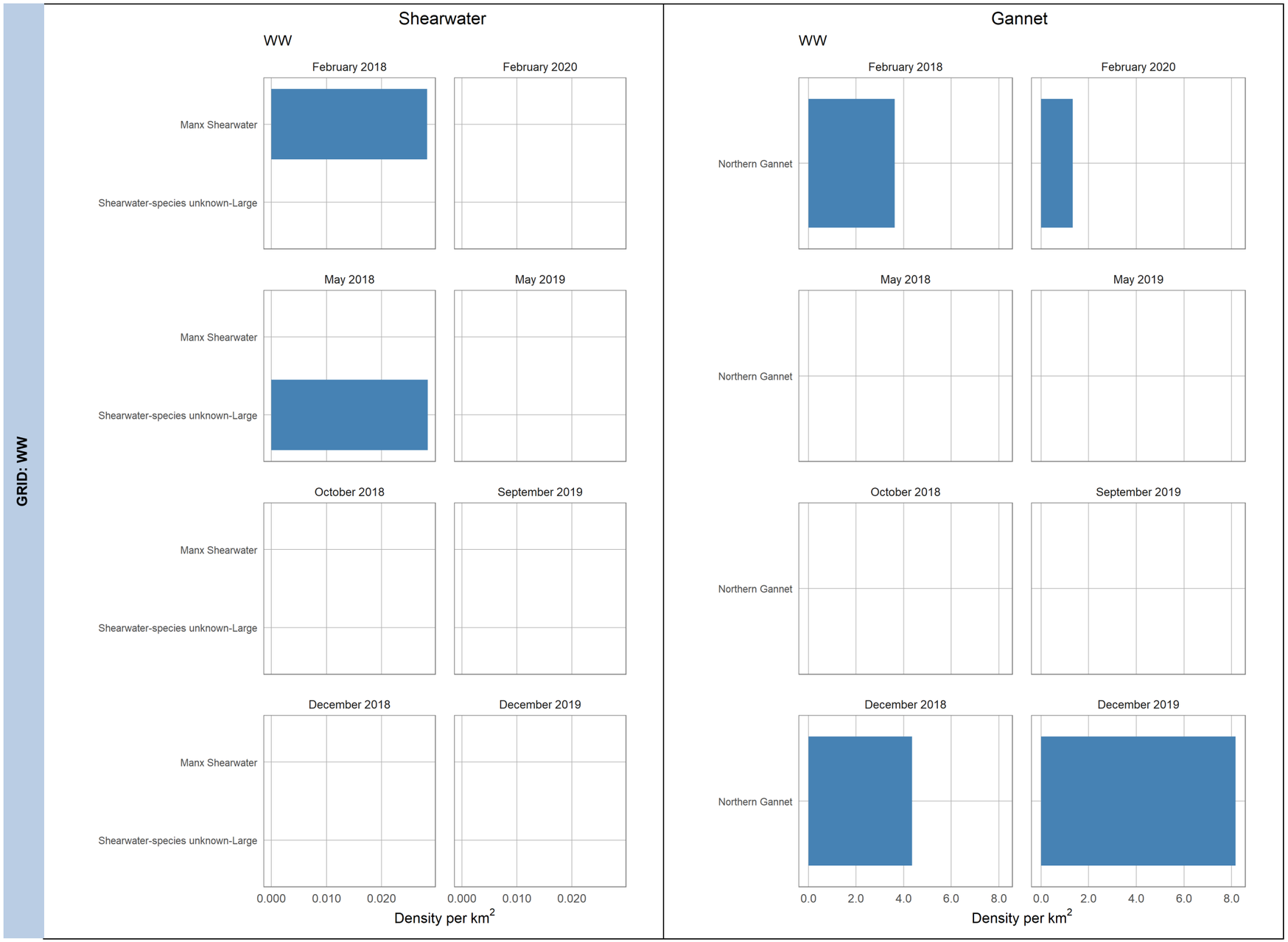

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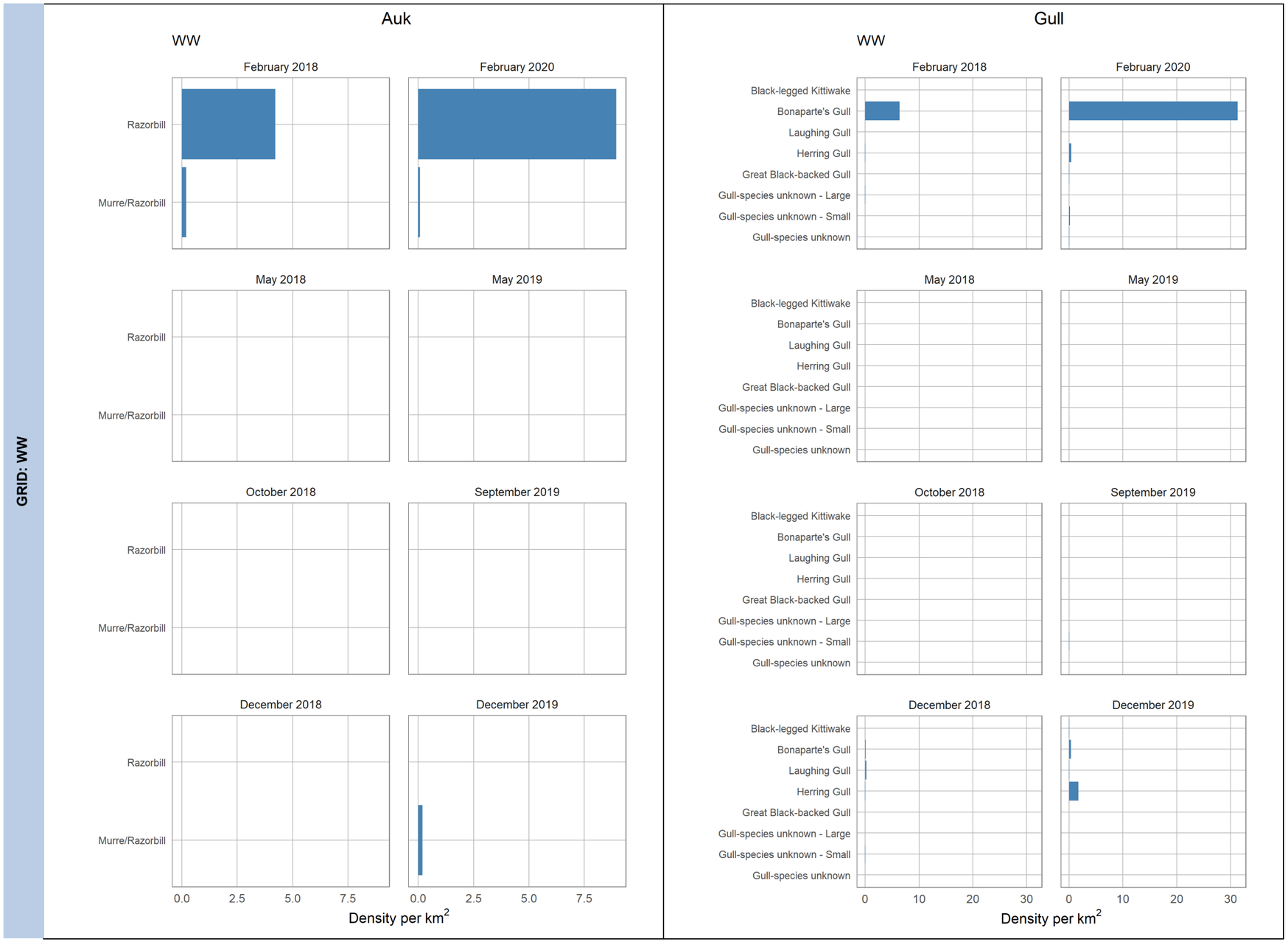

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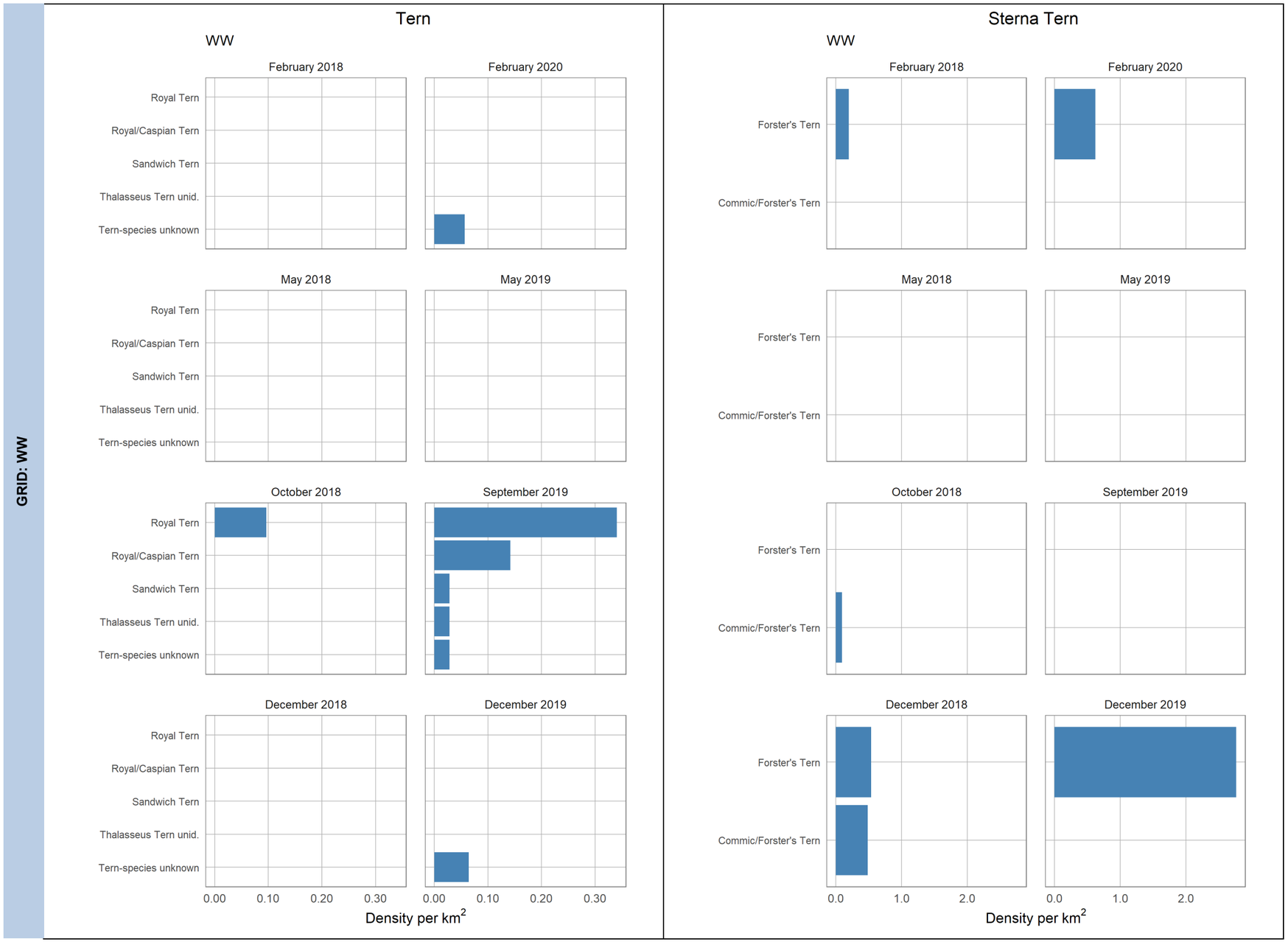


Figure C–15. (Continued)

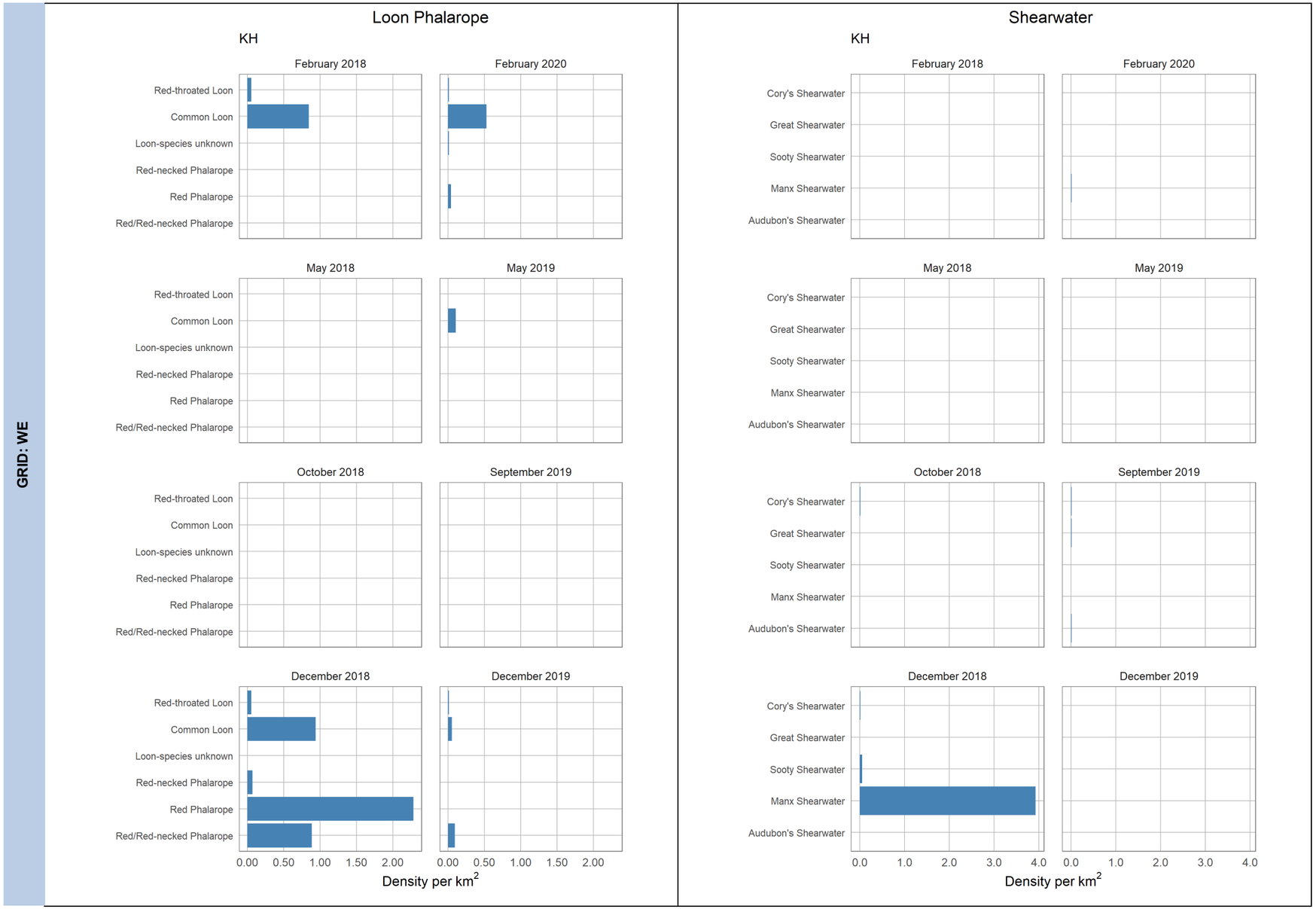
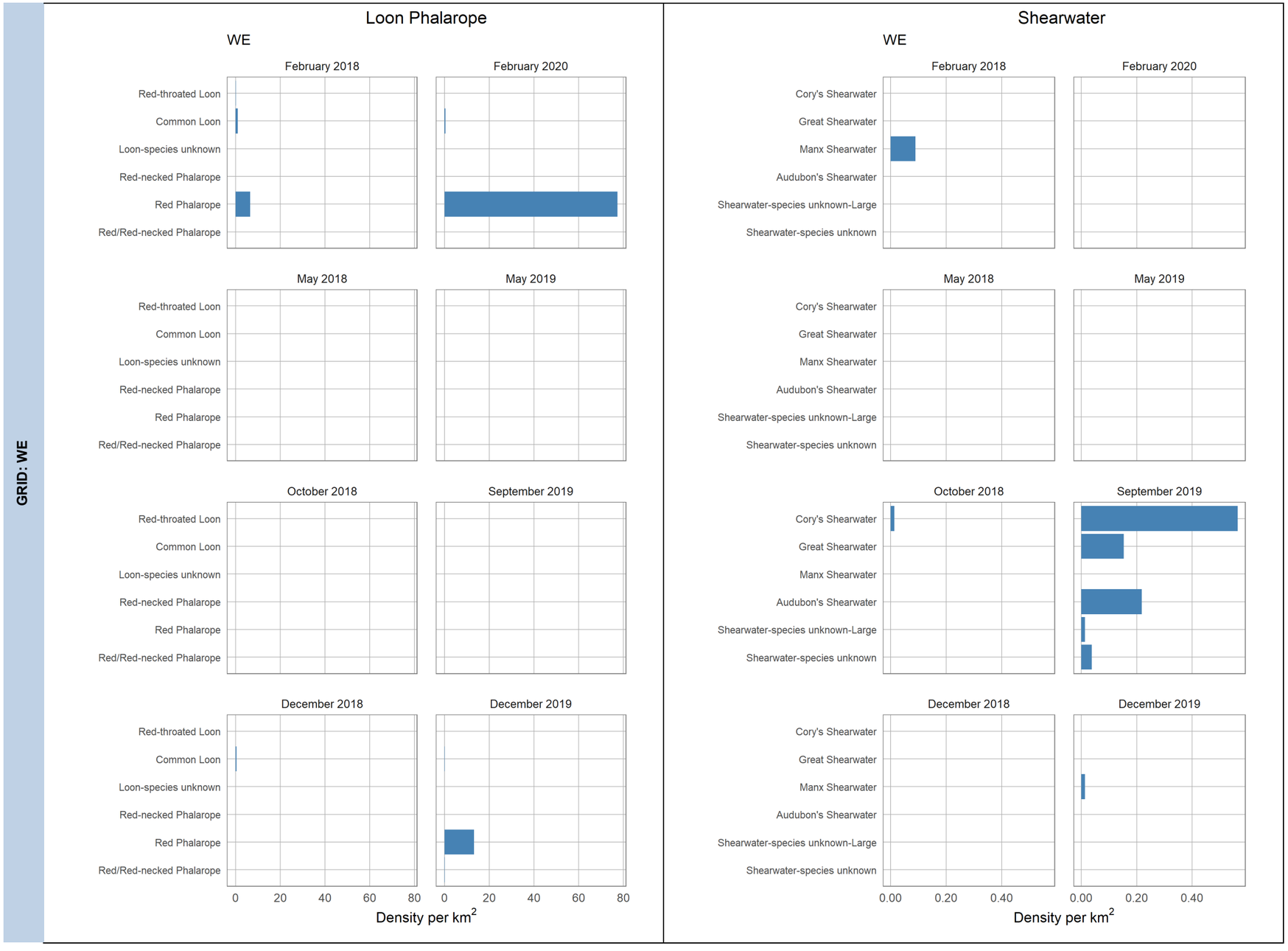


Figure C–16. Density (per km^2) of species (by species group) identified in the February 2018 through February 2020 surveys in Wilmington East (WE) (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.
Species groups with minimal observation numbers were not included.



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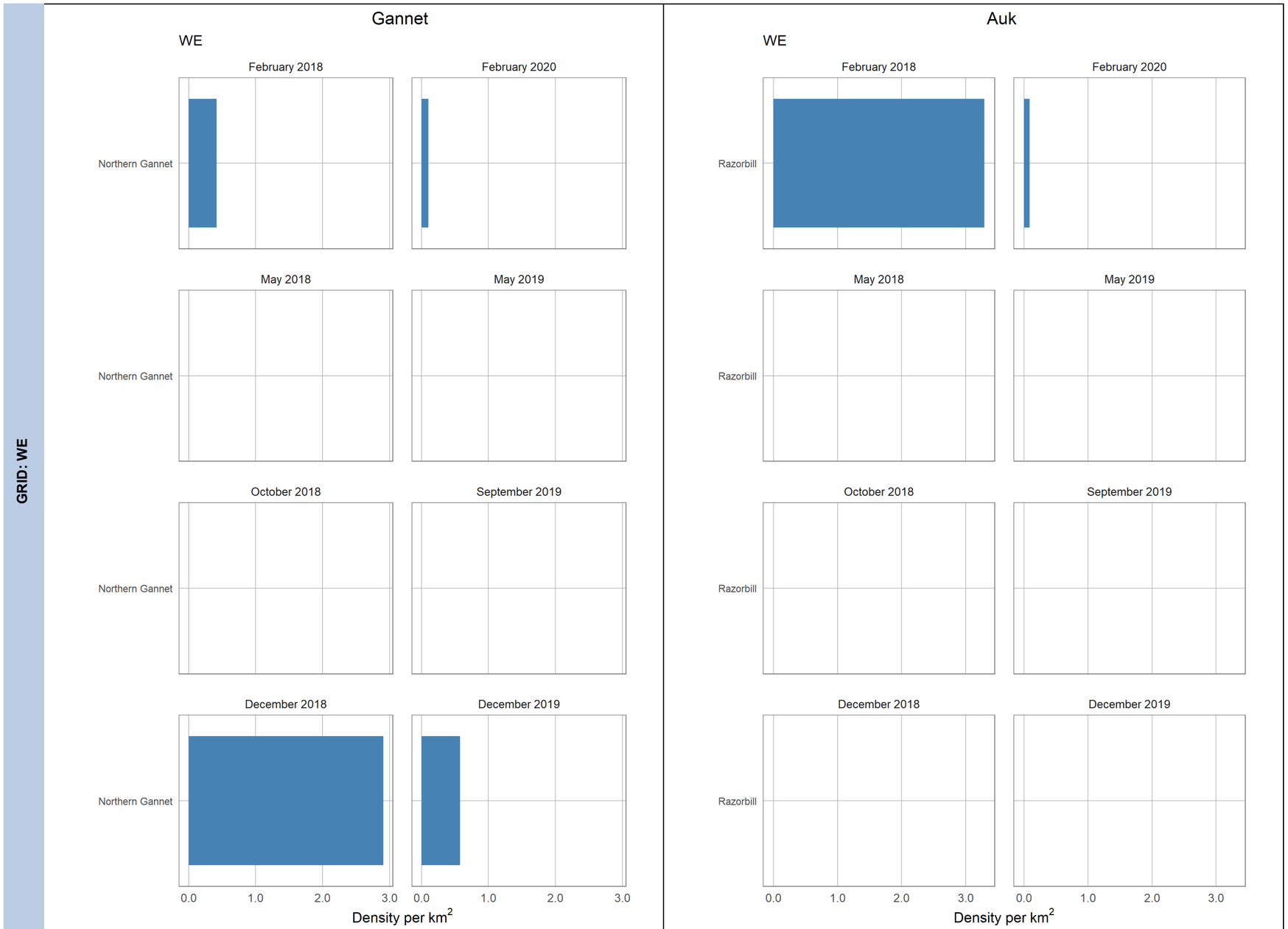

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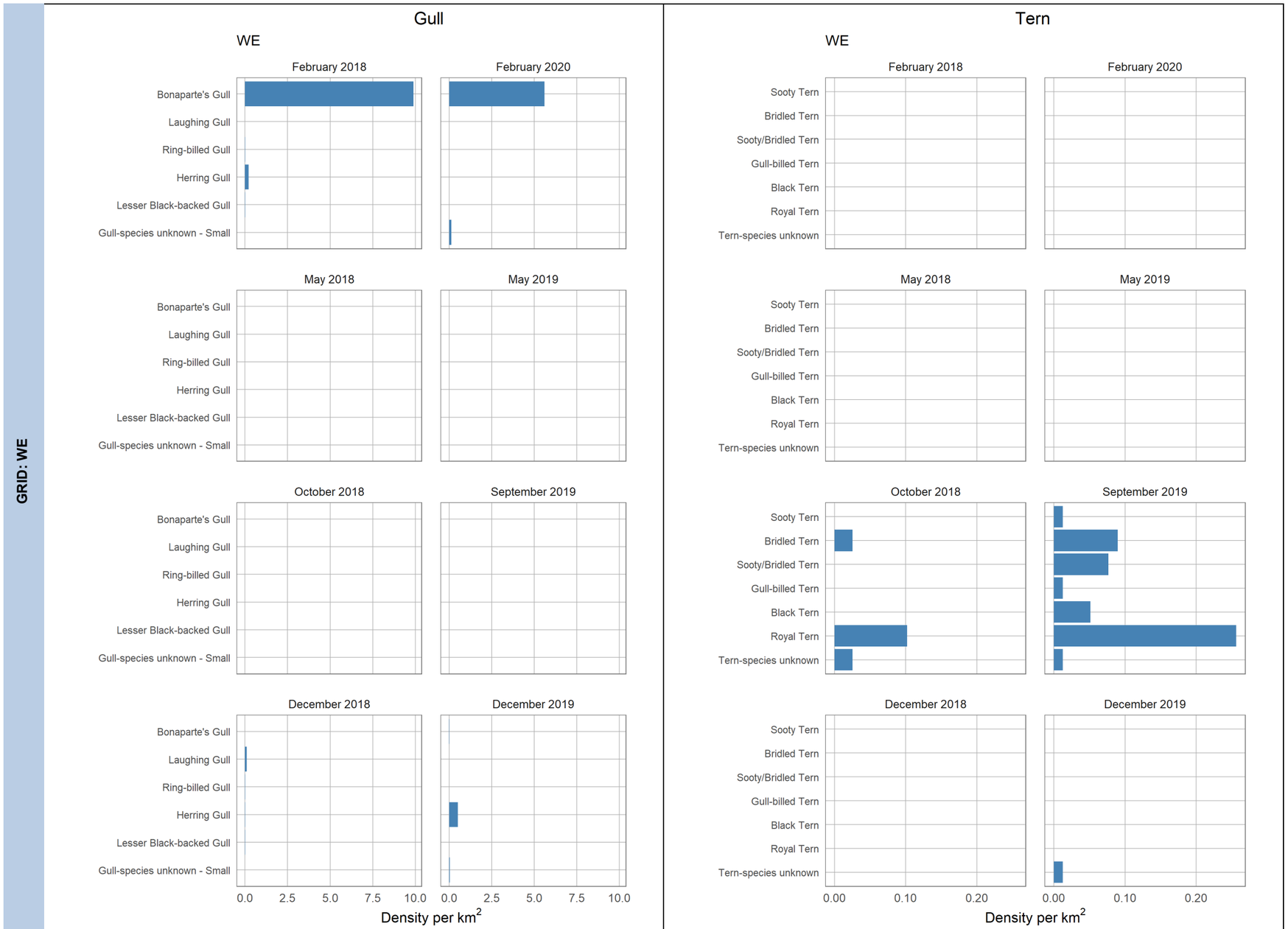
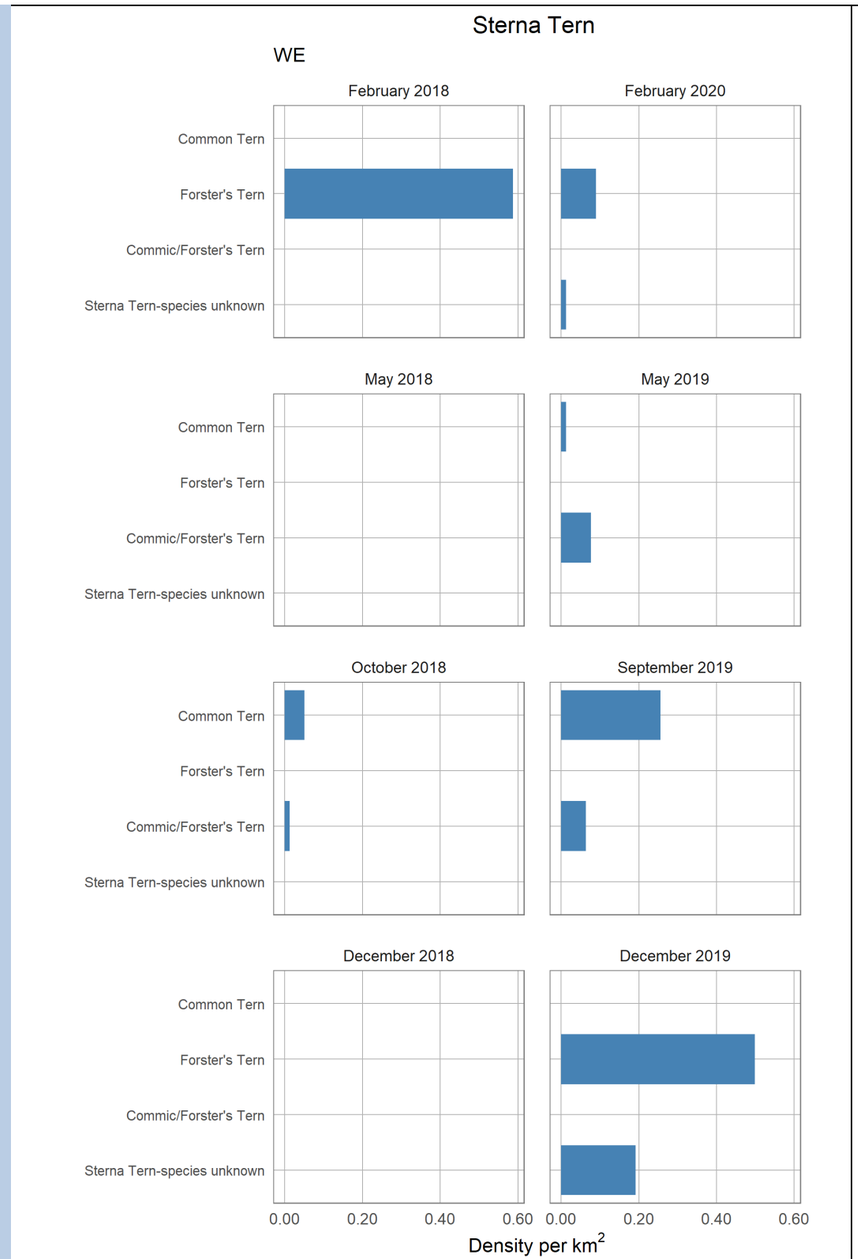


Figure C–16. (Continued)

GRID: WW



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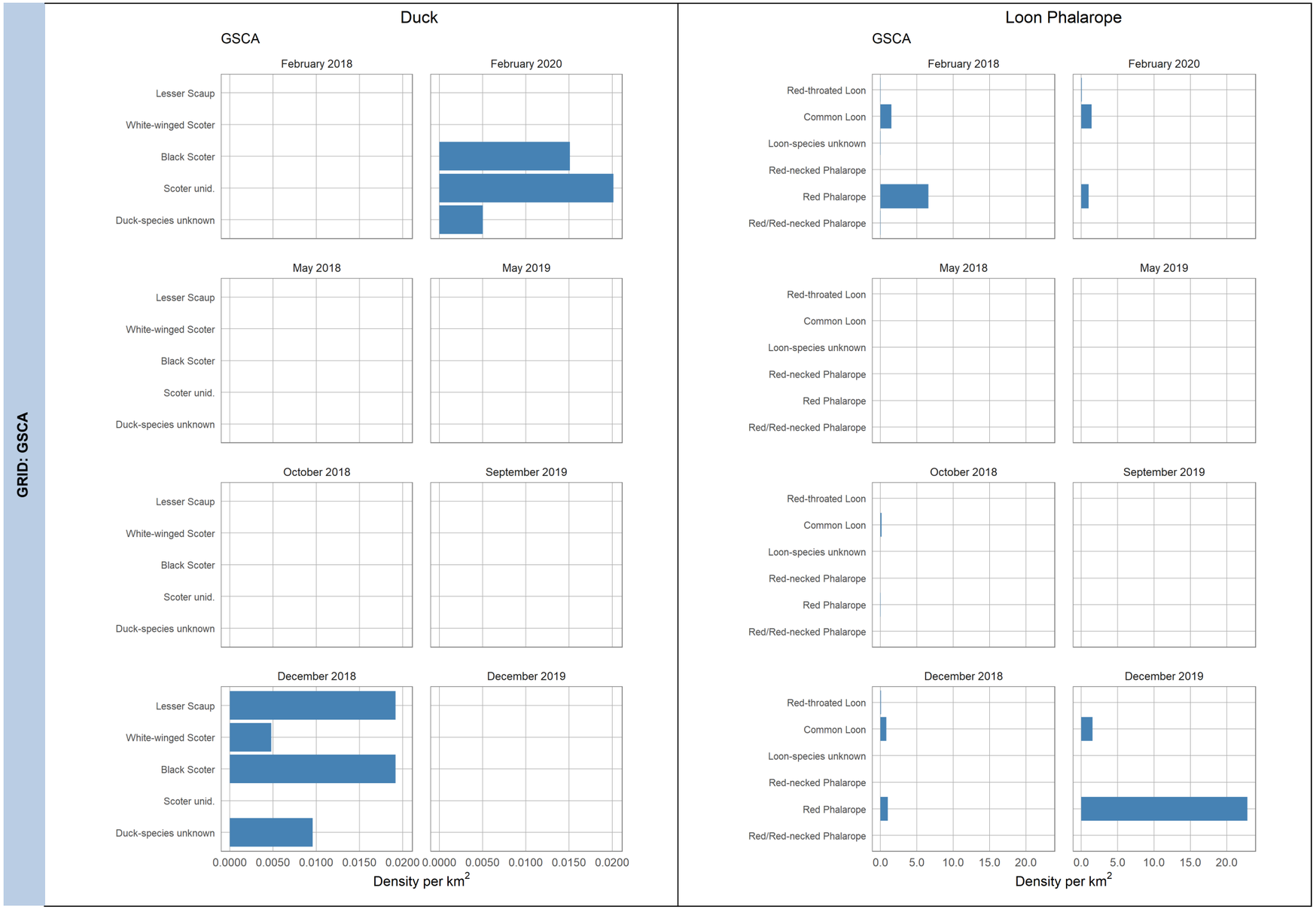
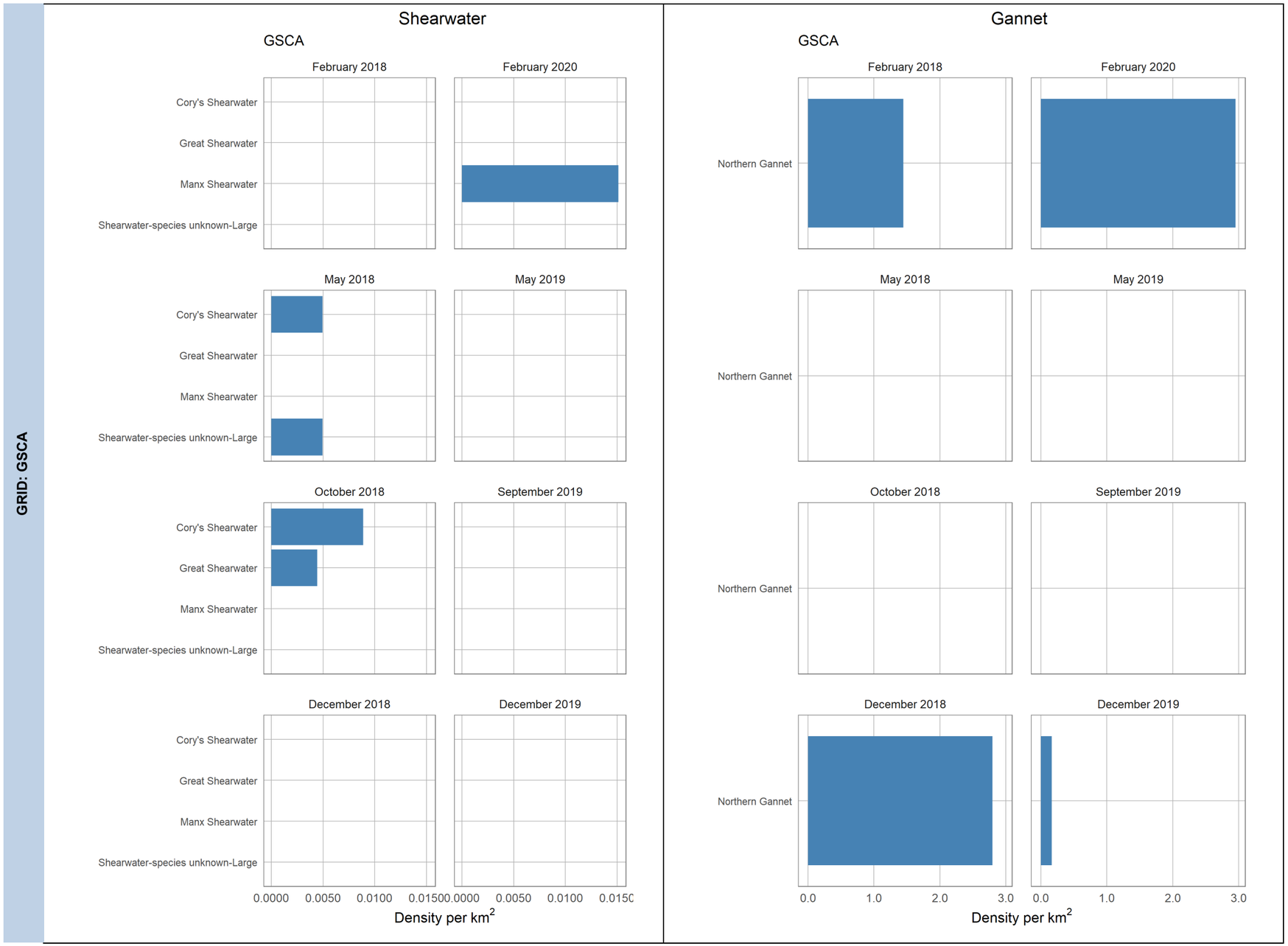


Figure C–17. Density (per km^2) of species (by species group) identified in the February 2018 through February 2020 surveys in the Grand Strand Call Area (GSCA; counts include part of WW) (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.
Species groups with minimal observation numbers were not included.



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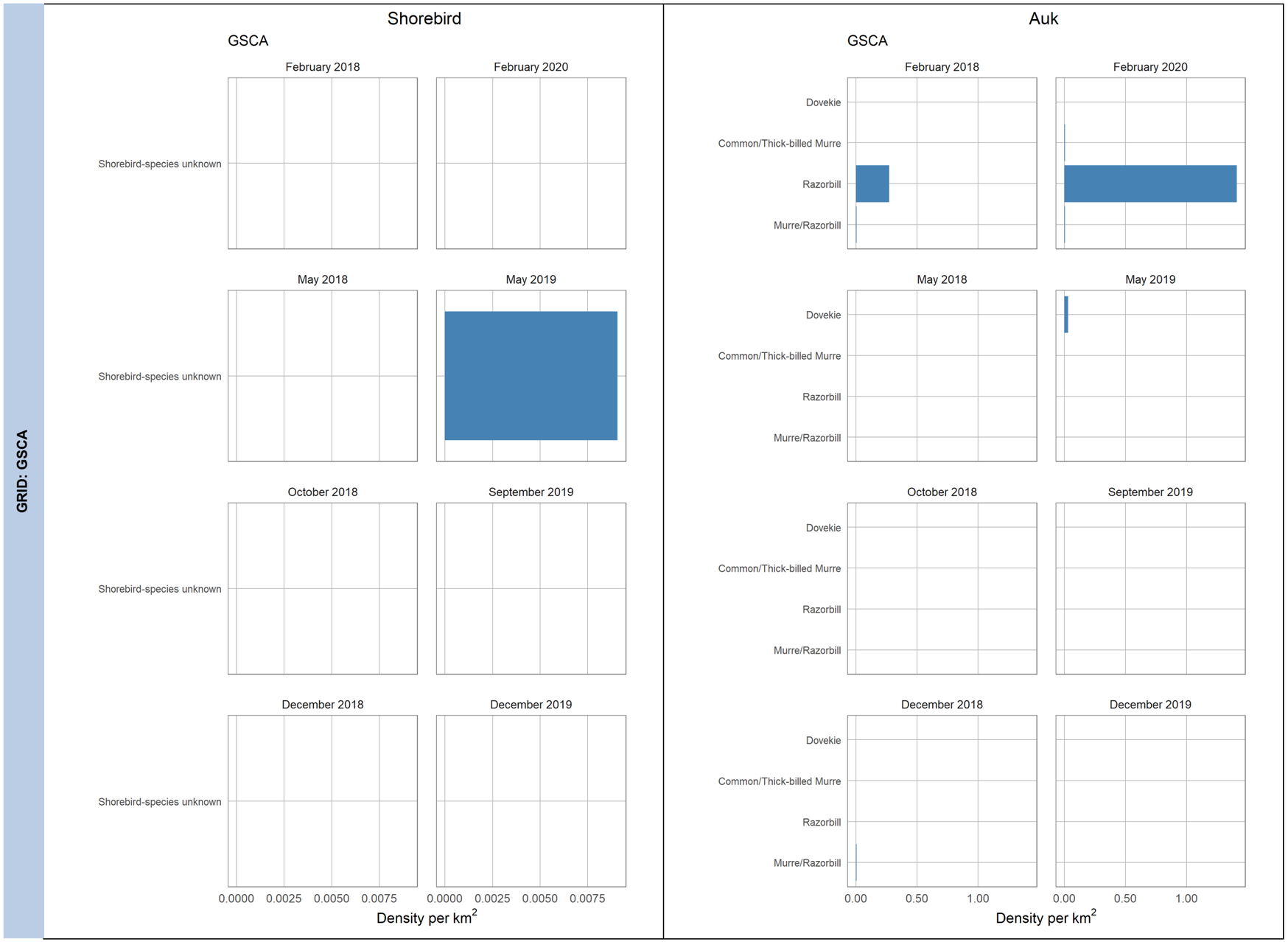

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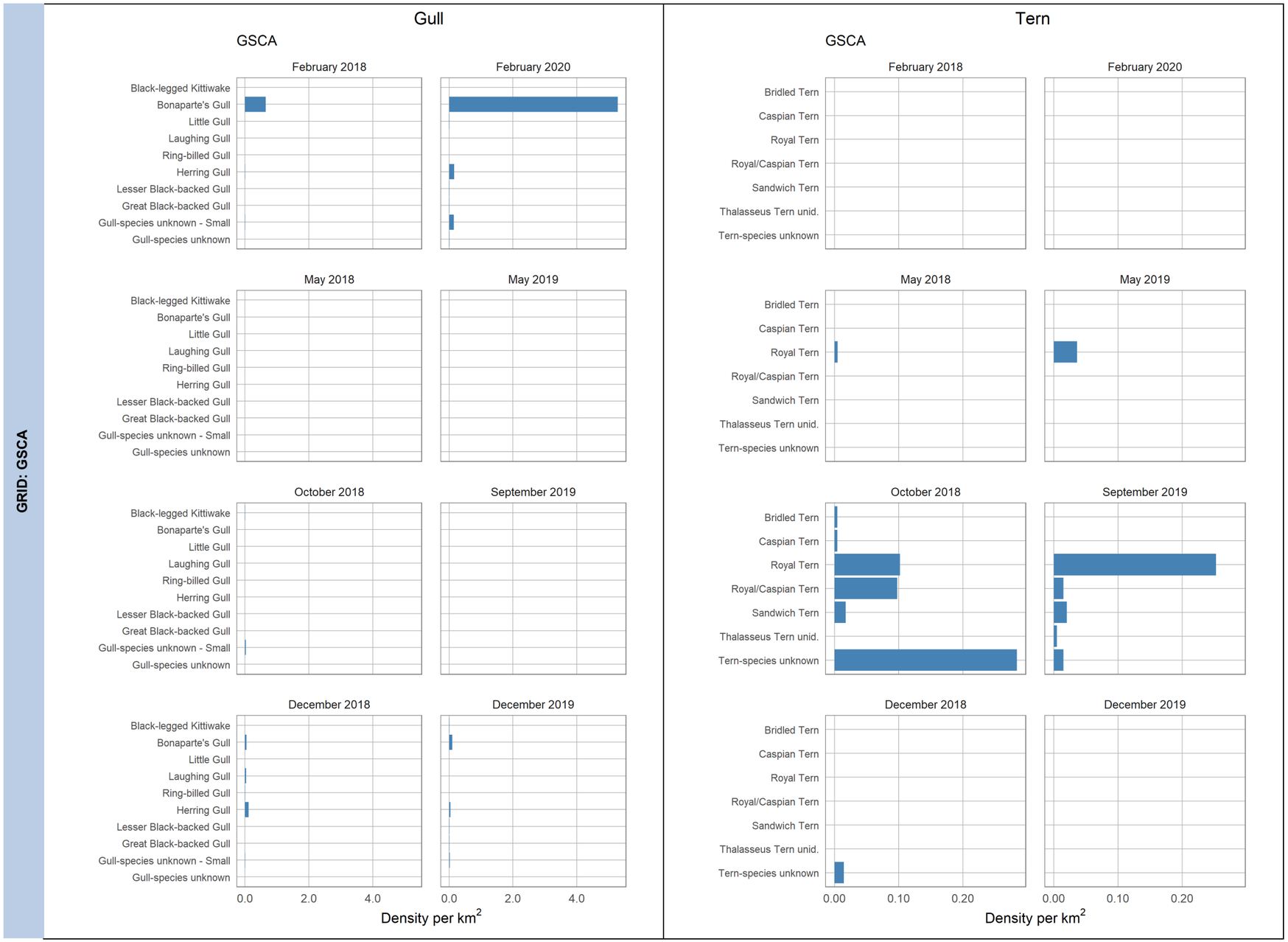
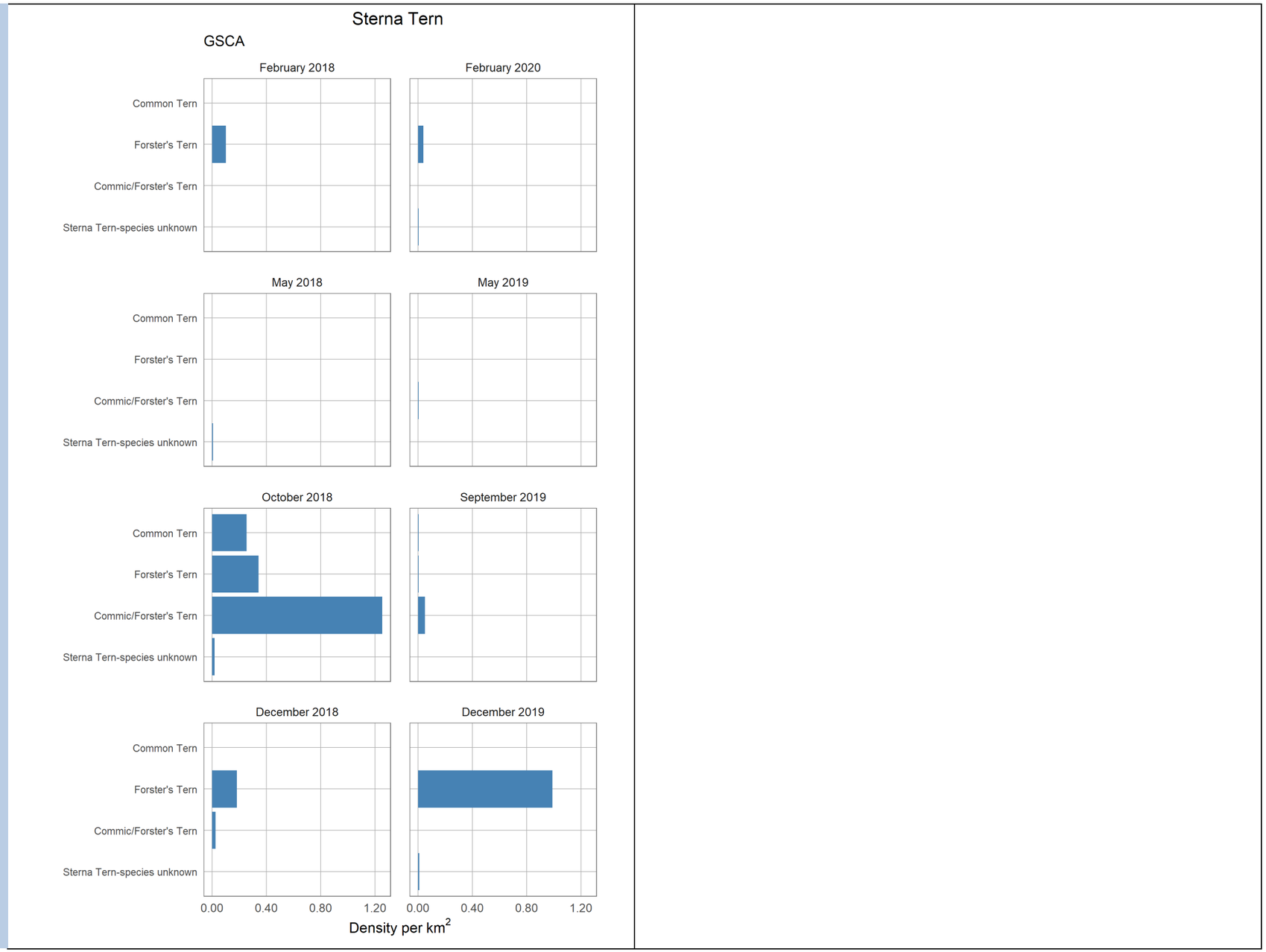


Figure C–17. (Continued)

GRID: GSCA



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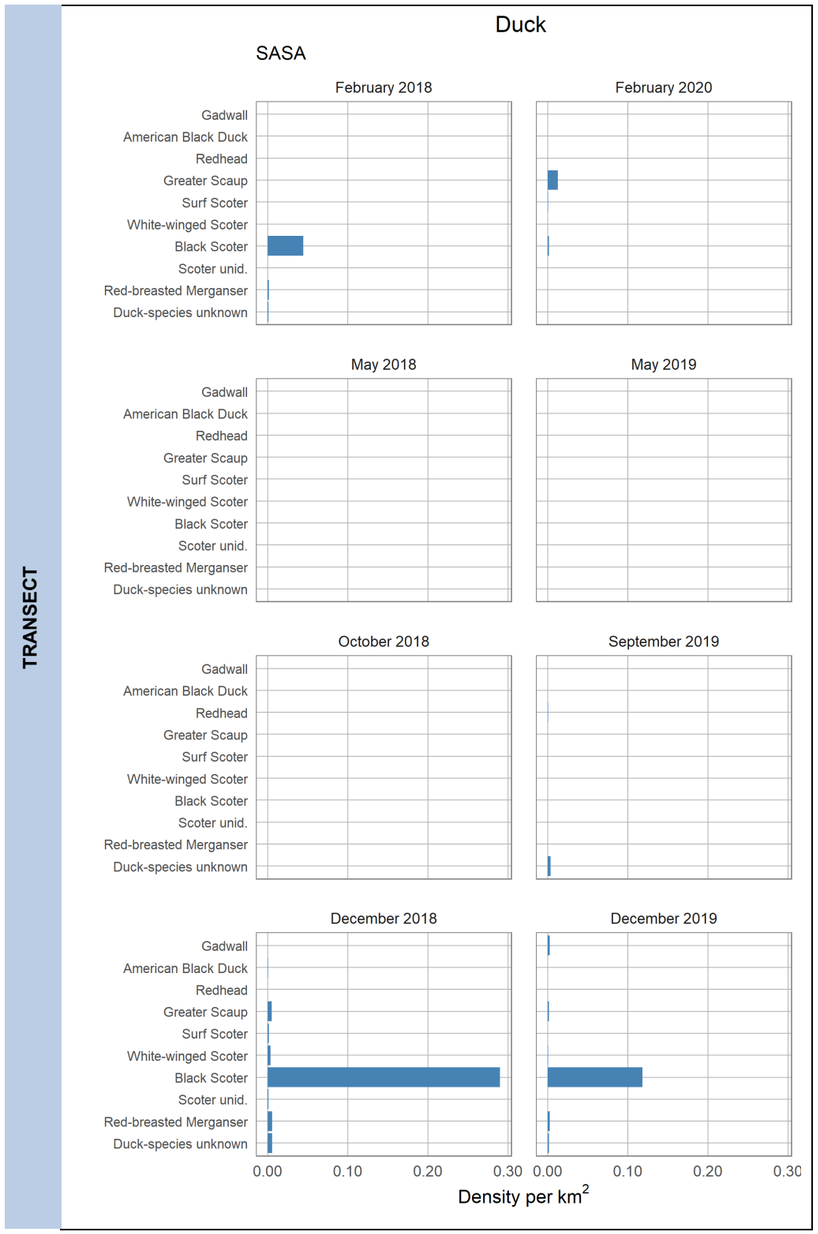
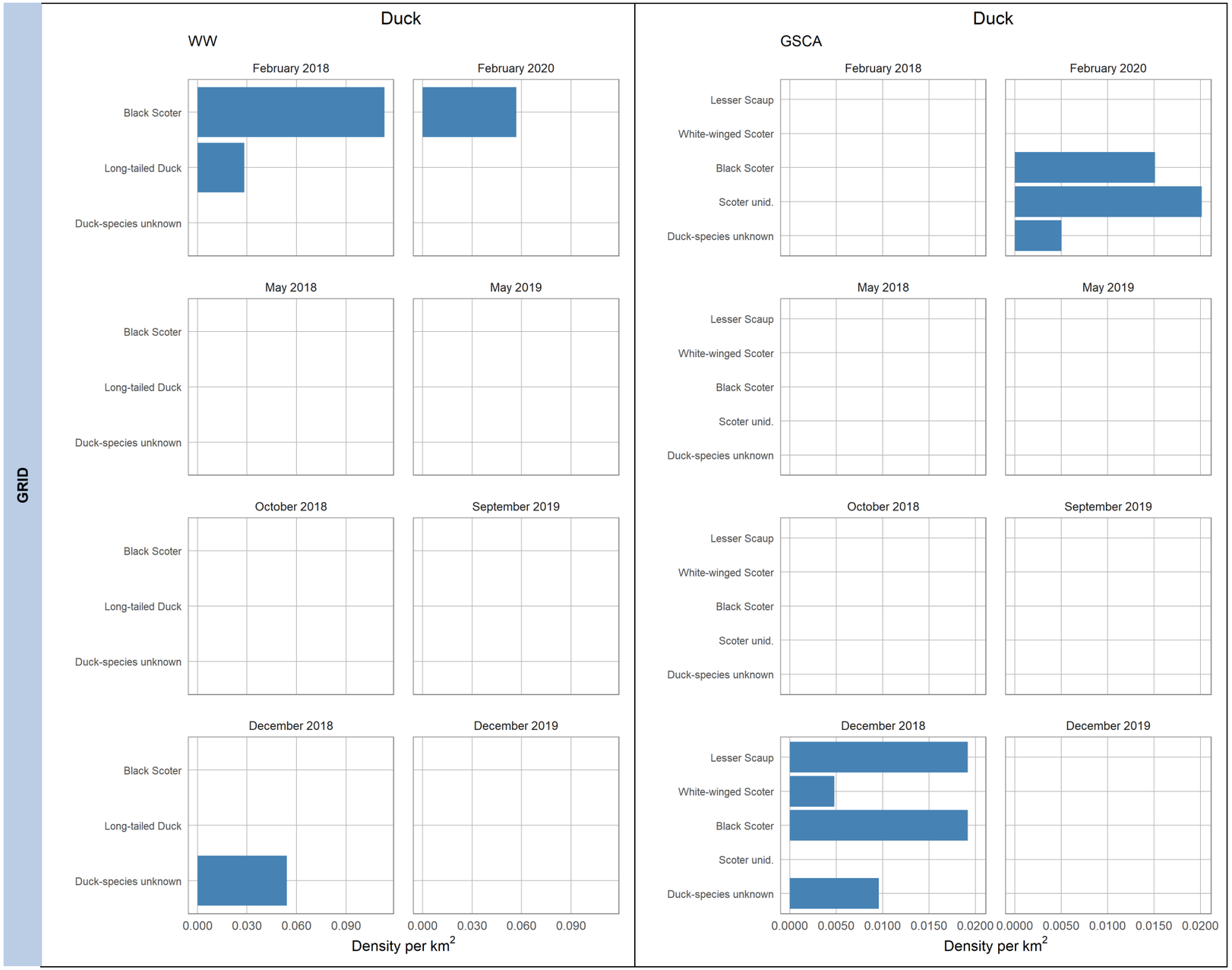


Figure C–18. Density (per km^2) of duck species found during the February 2018 through February 2020 surveys for each area during each survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.



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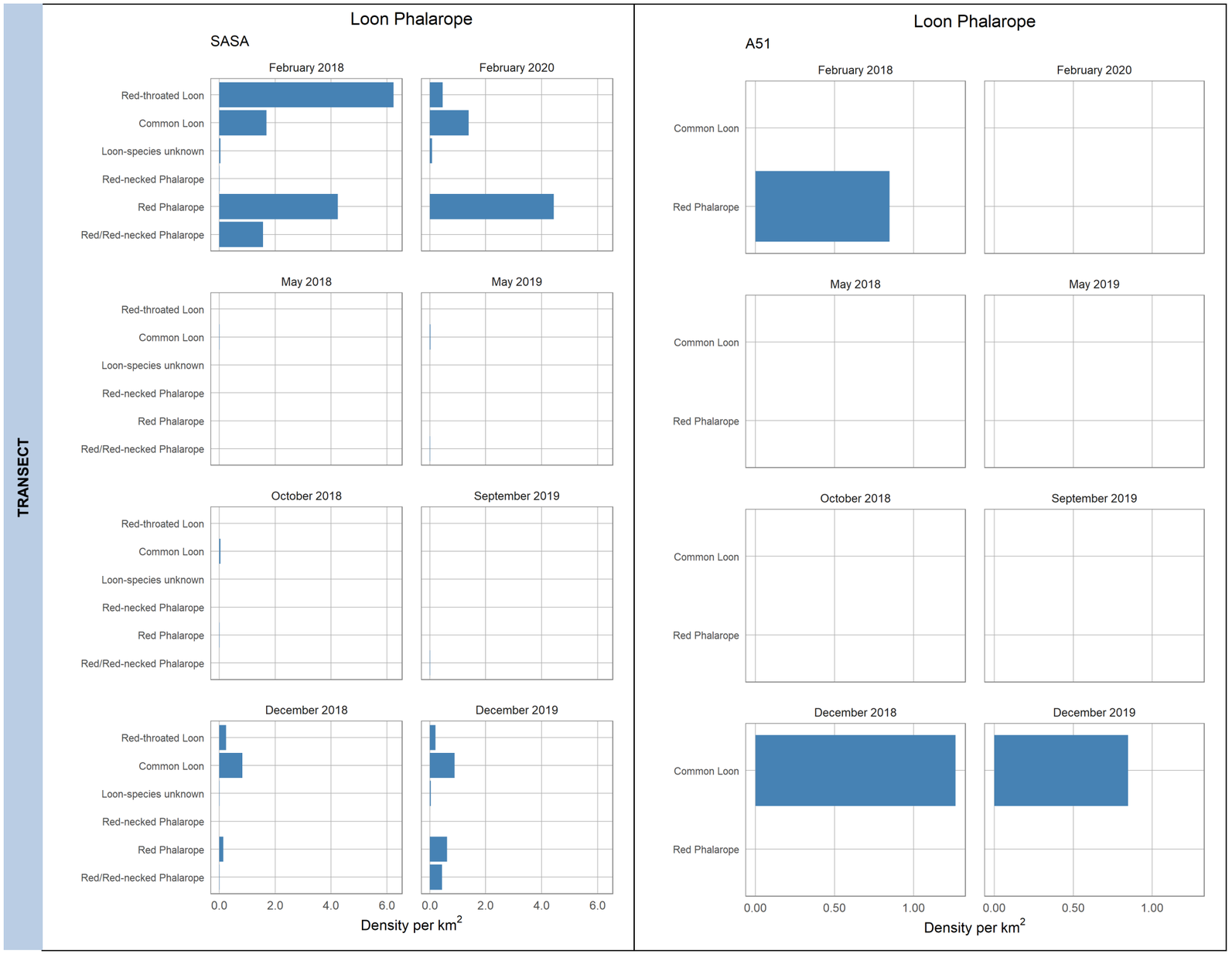
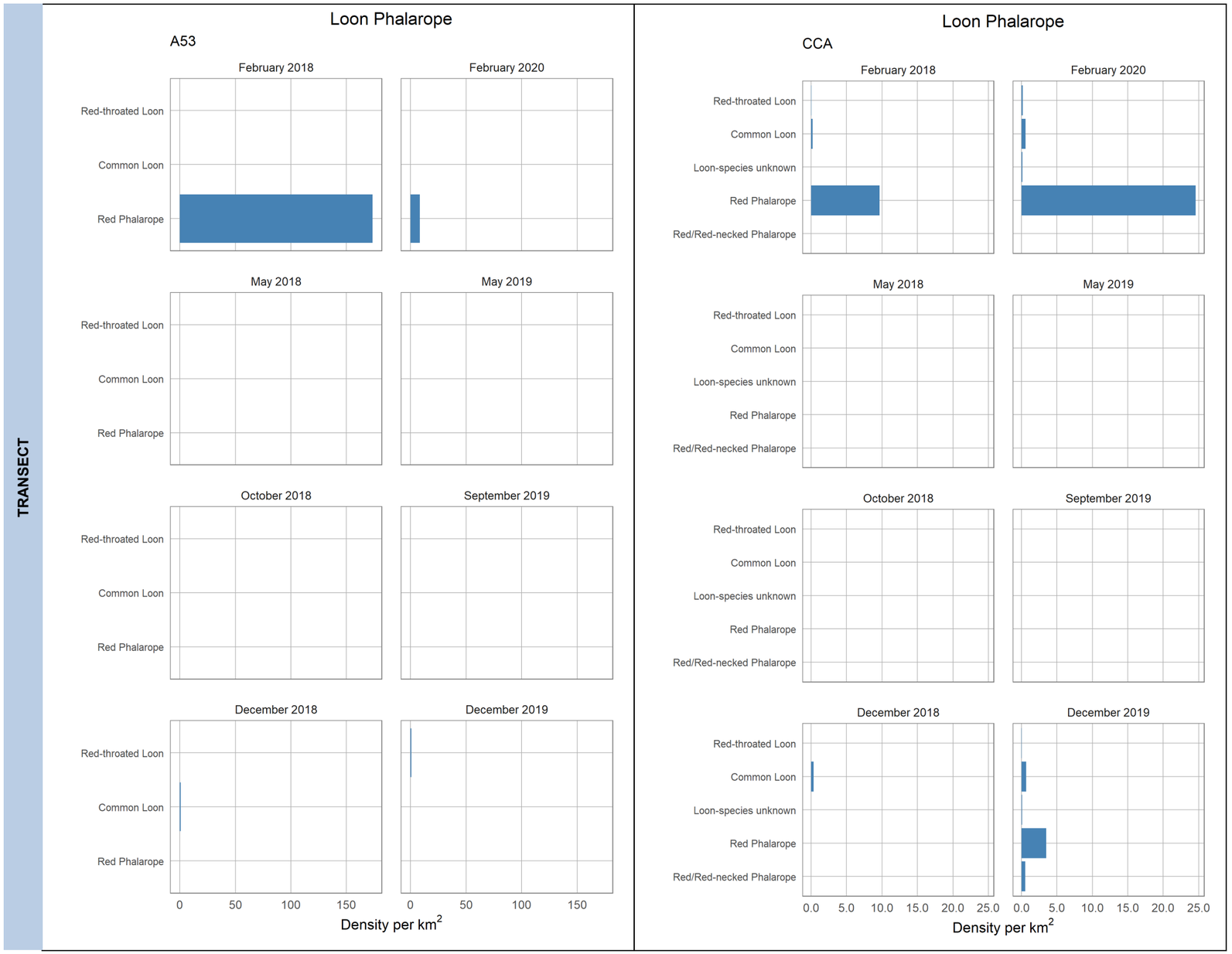


Figure C–19. Density (per km^2) of loon and phalarope species found during the February 2018 through February 2020 surveys for each area during each survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.



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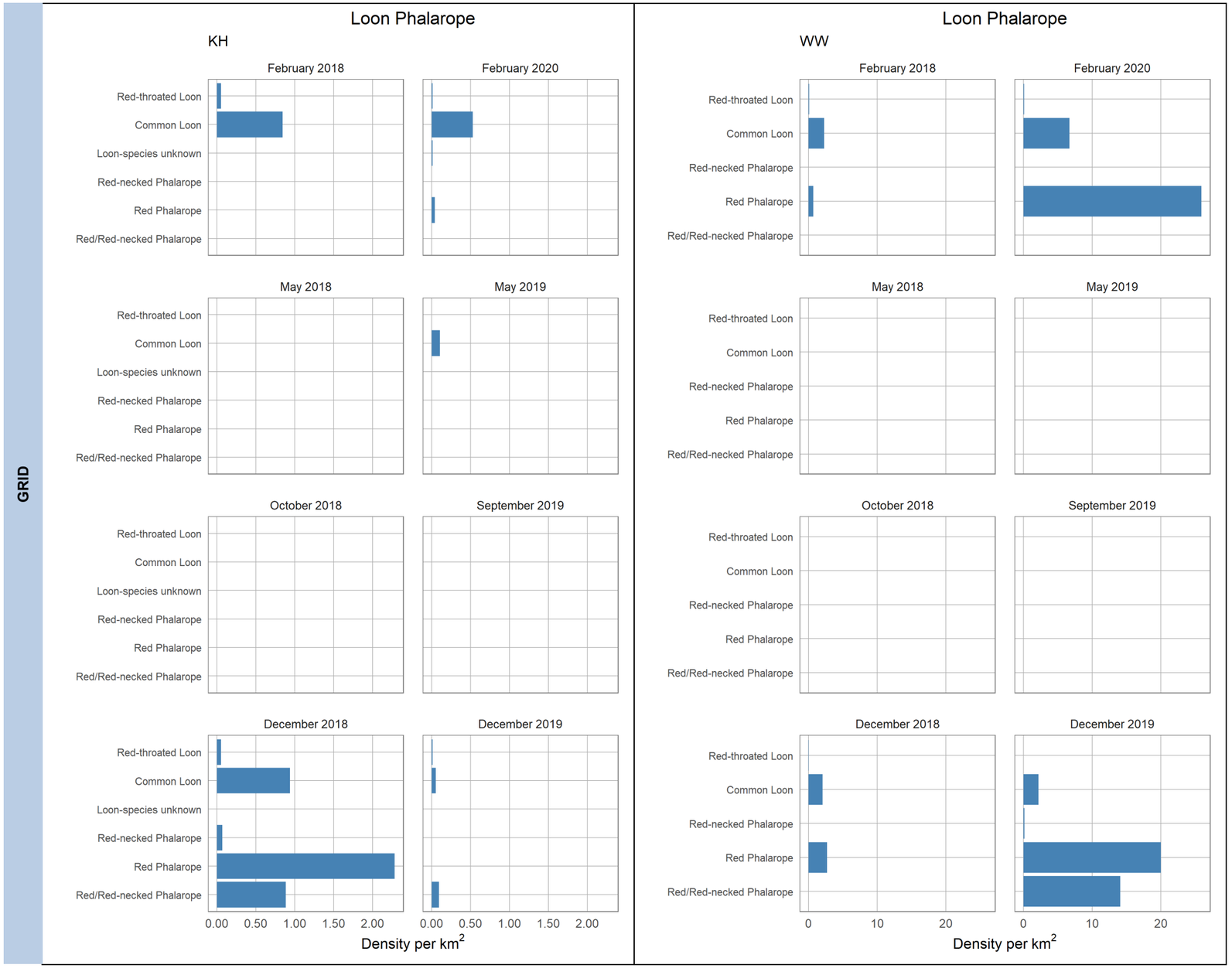

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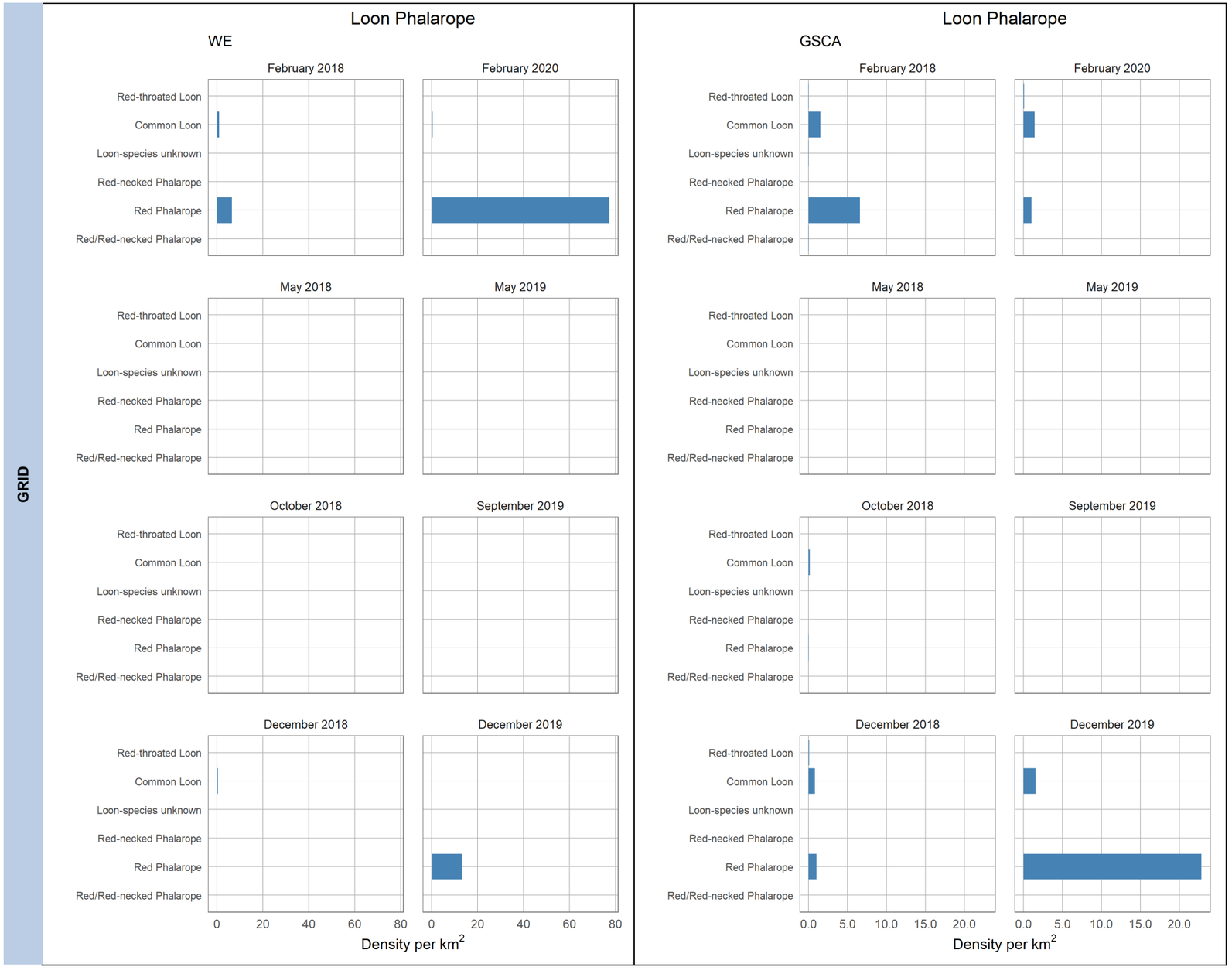

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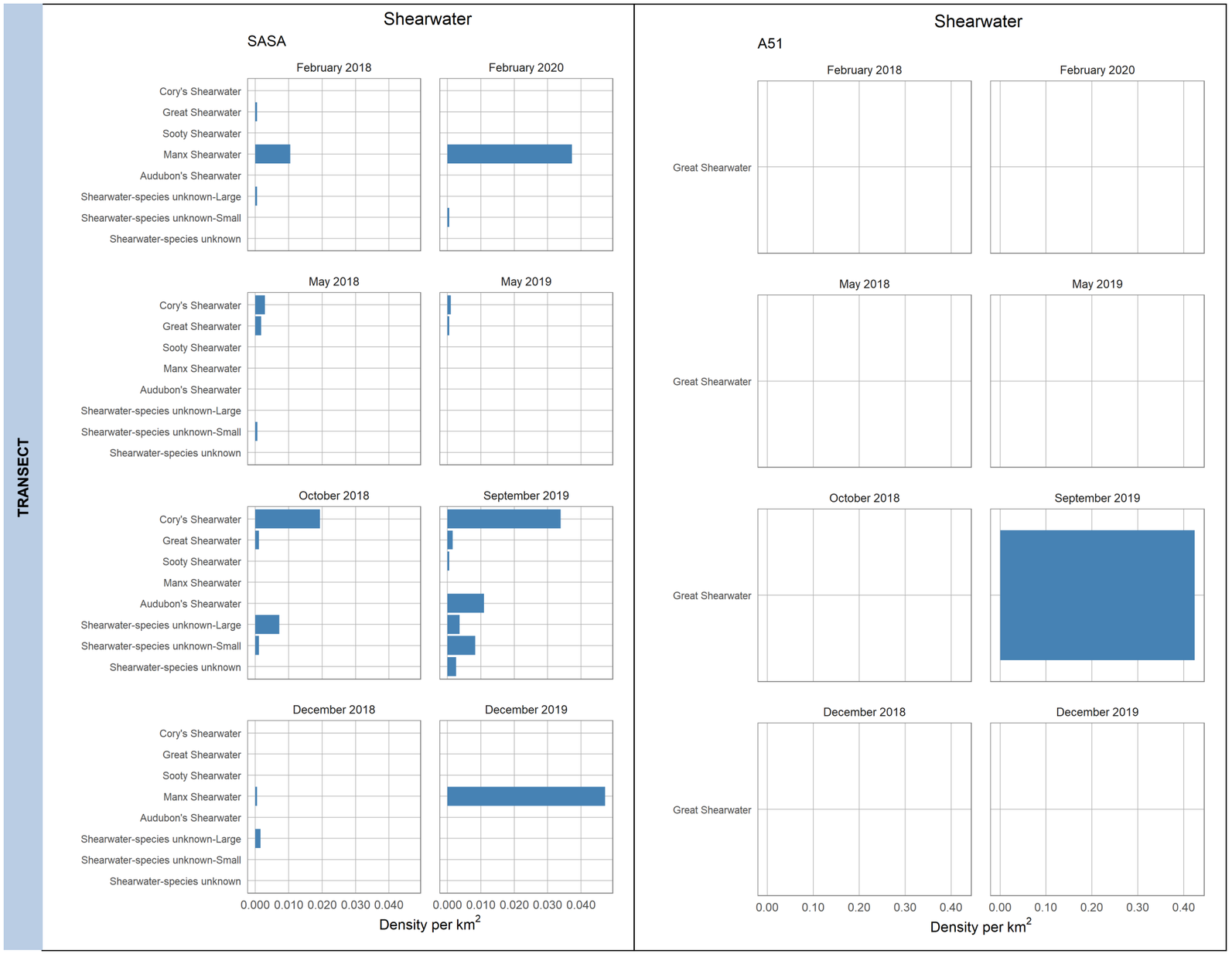


Figure C–20. Density (per km^2) of shearwater species found during the February 2018 through February 2020 surveys for each area during each survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

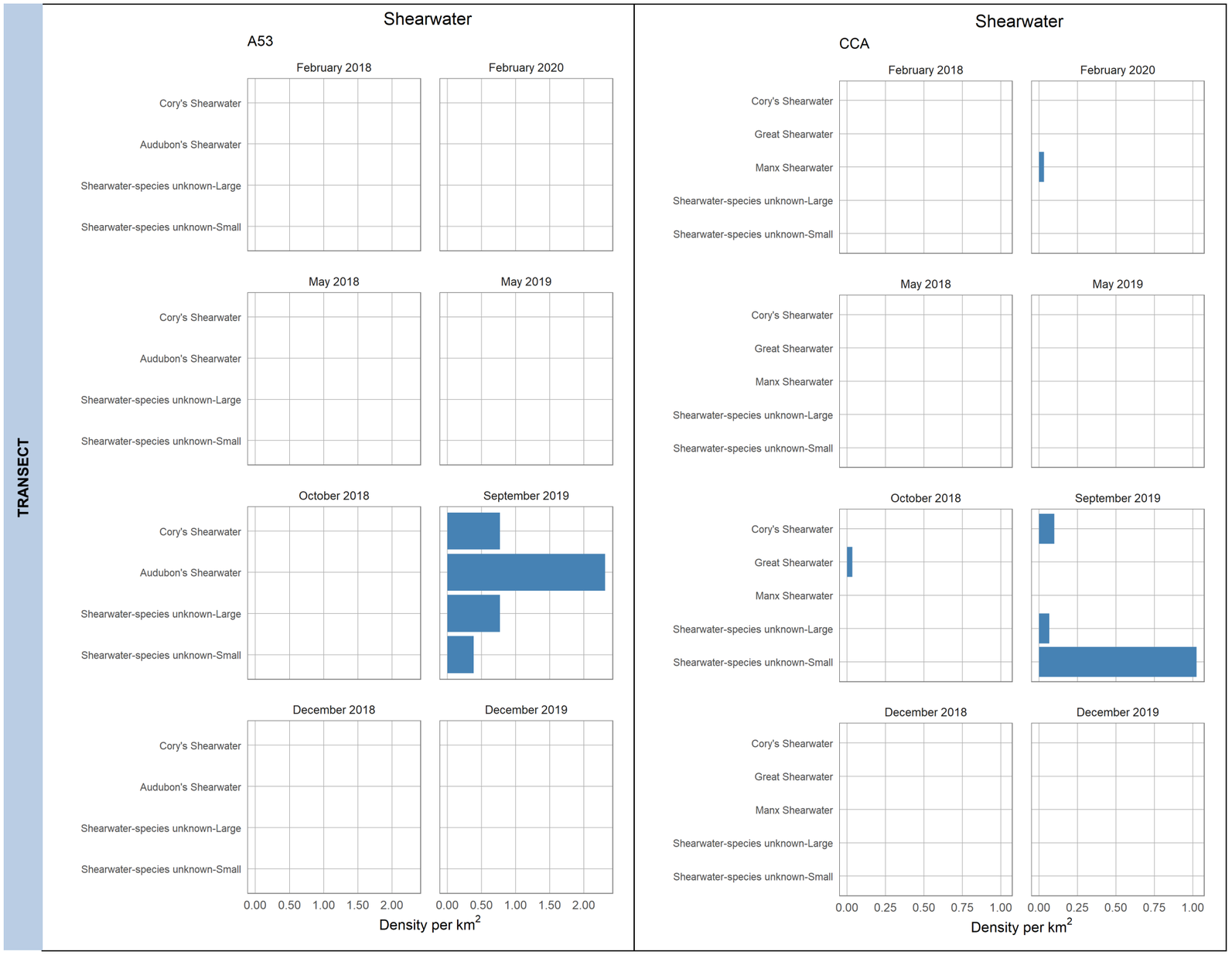
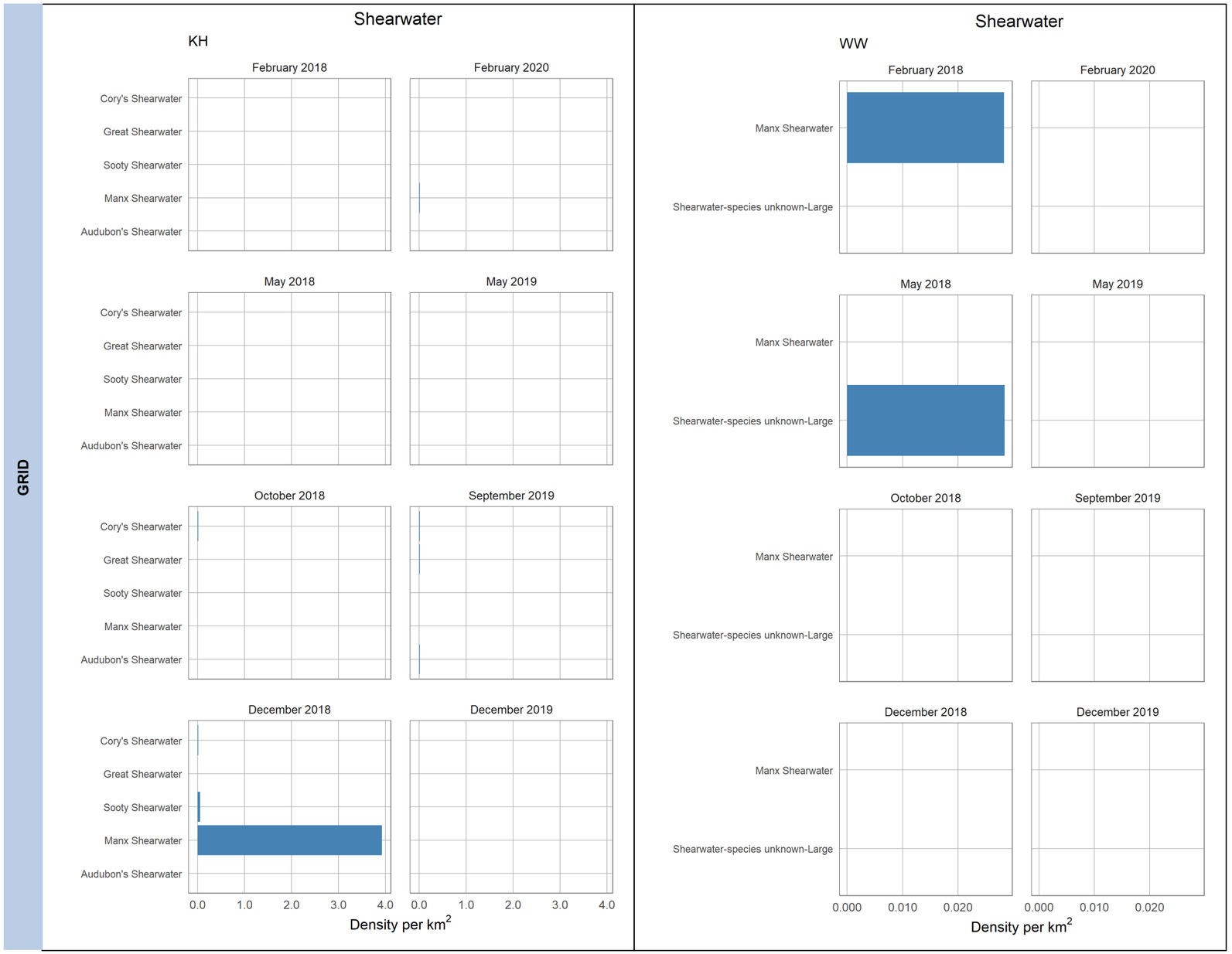


Figure C–20. (Continued)



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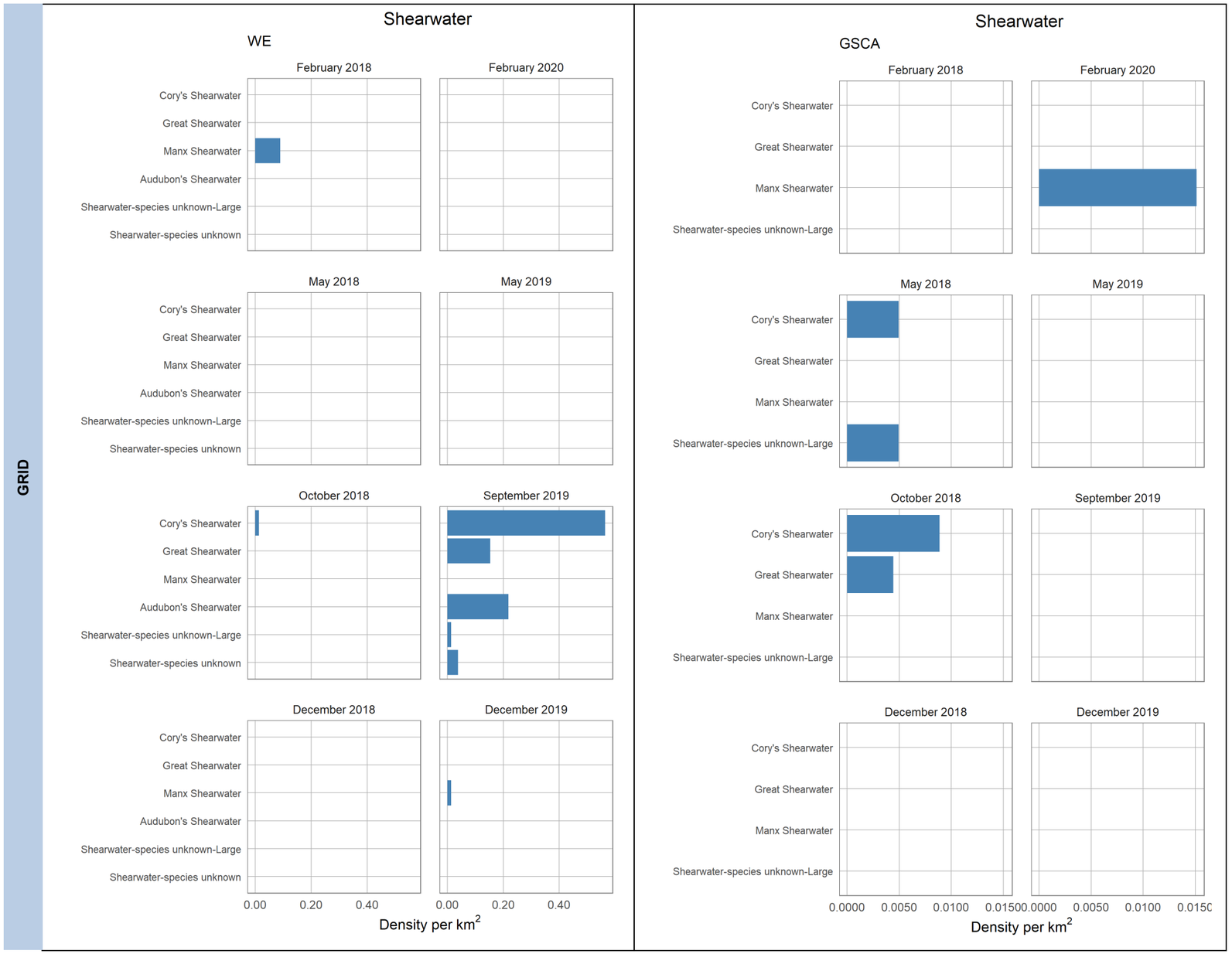

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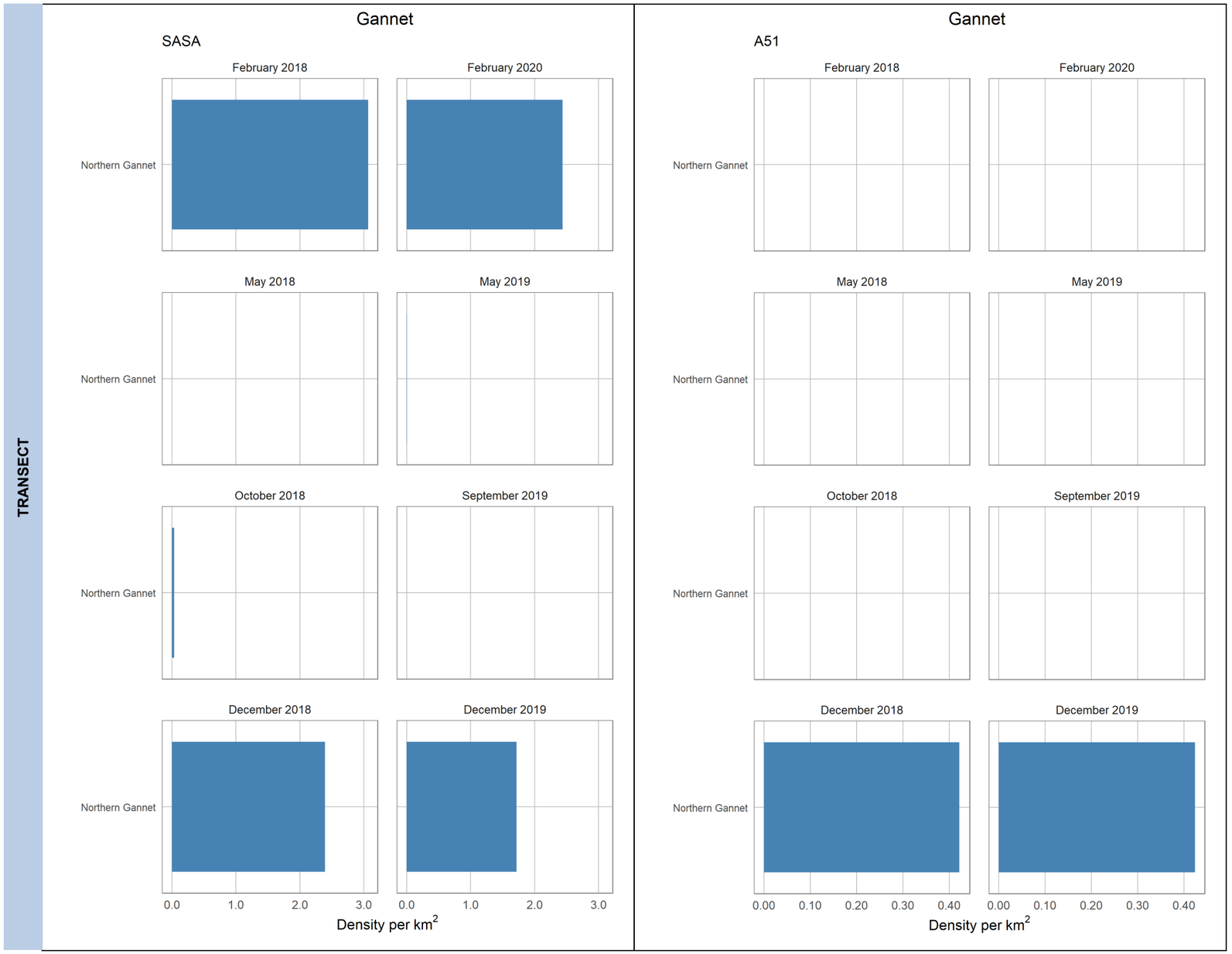
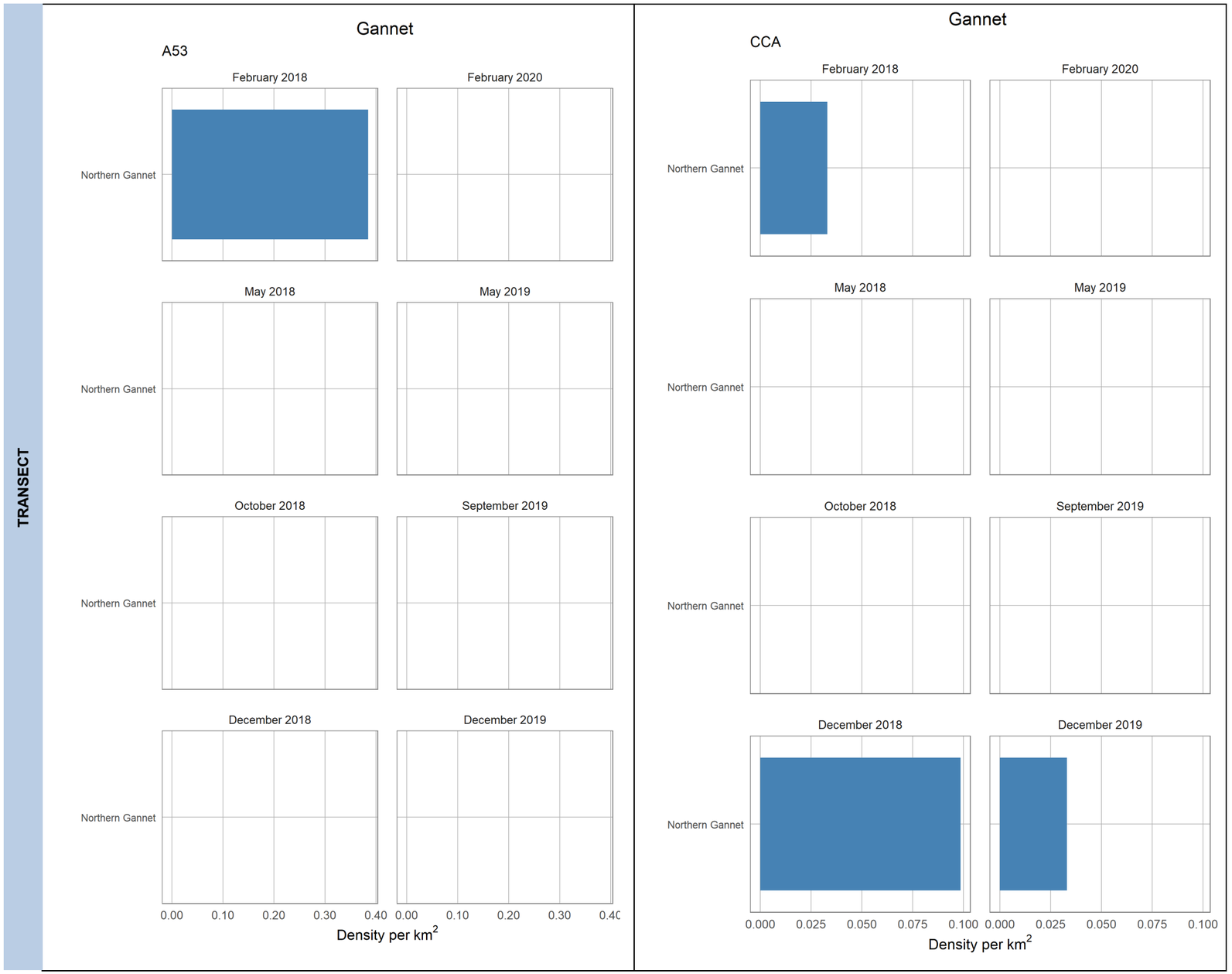


Figure C–21. Density (per km^2) of gannet species found during the February 2018 through February 2020 surveys for each area during each survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.



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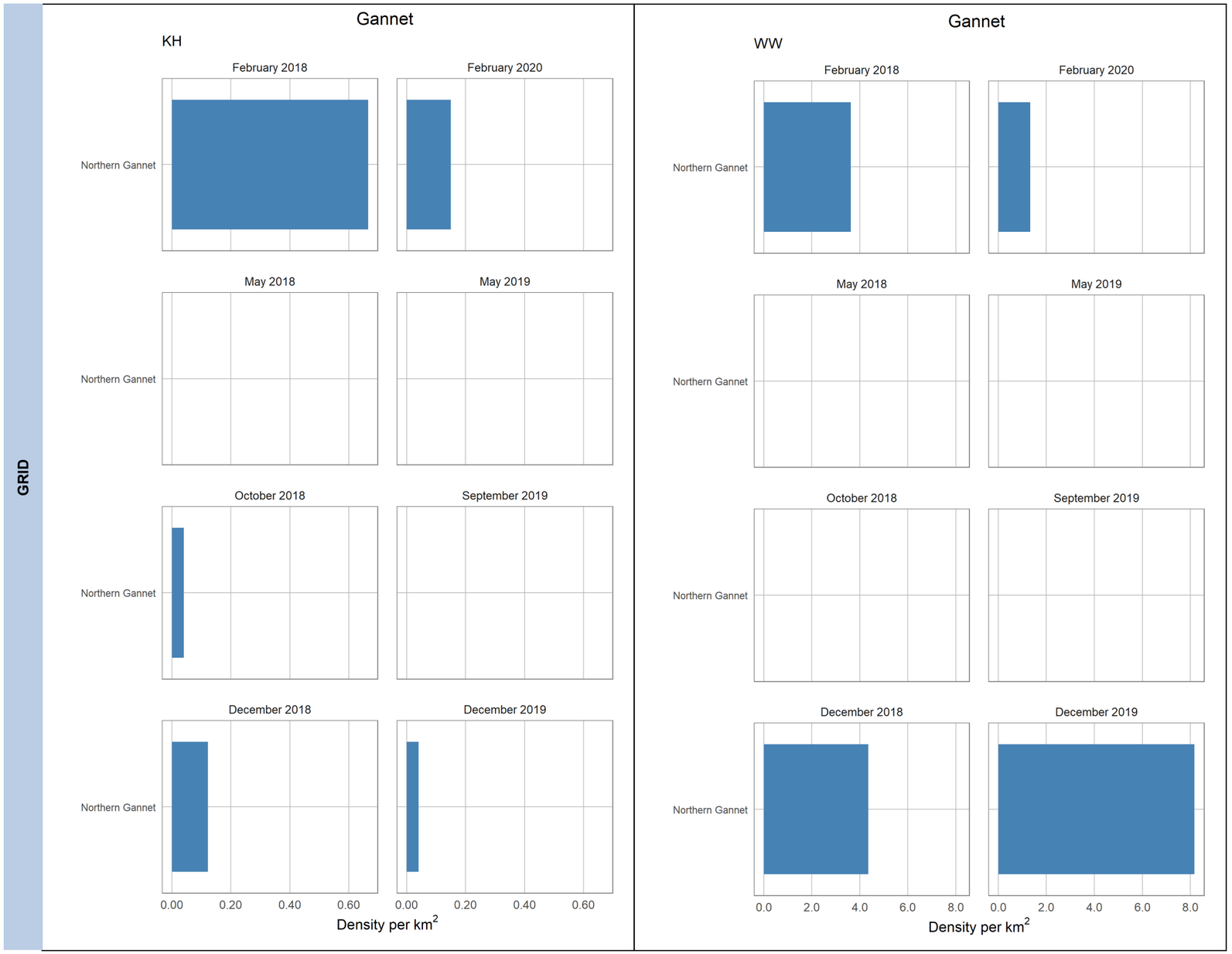

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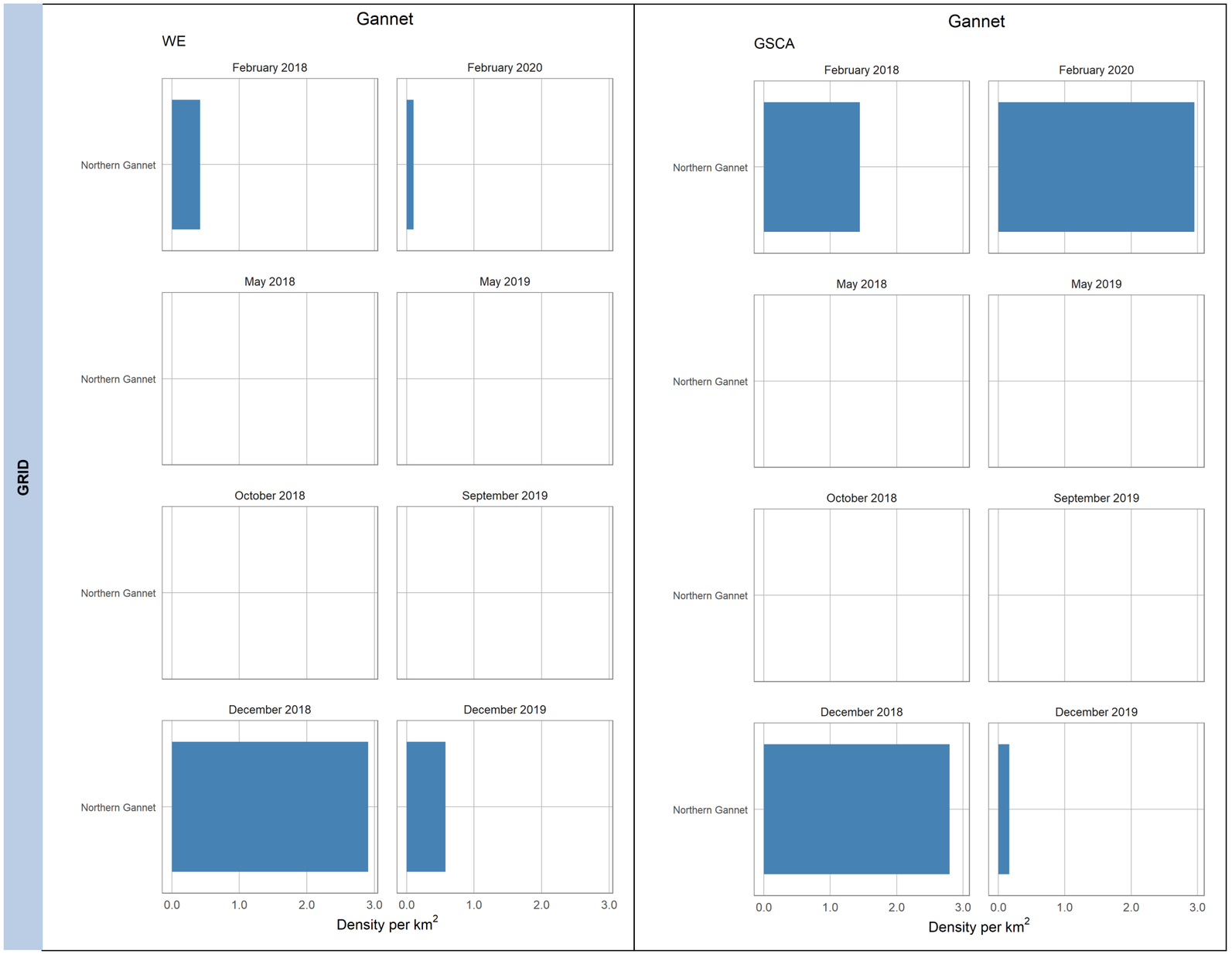

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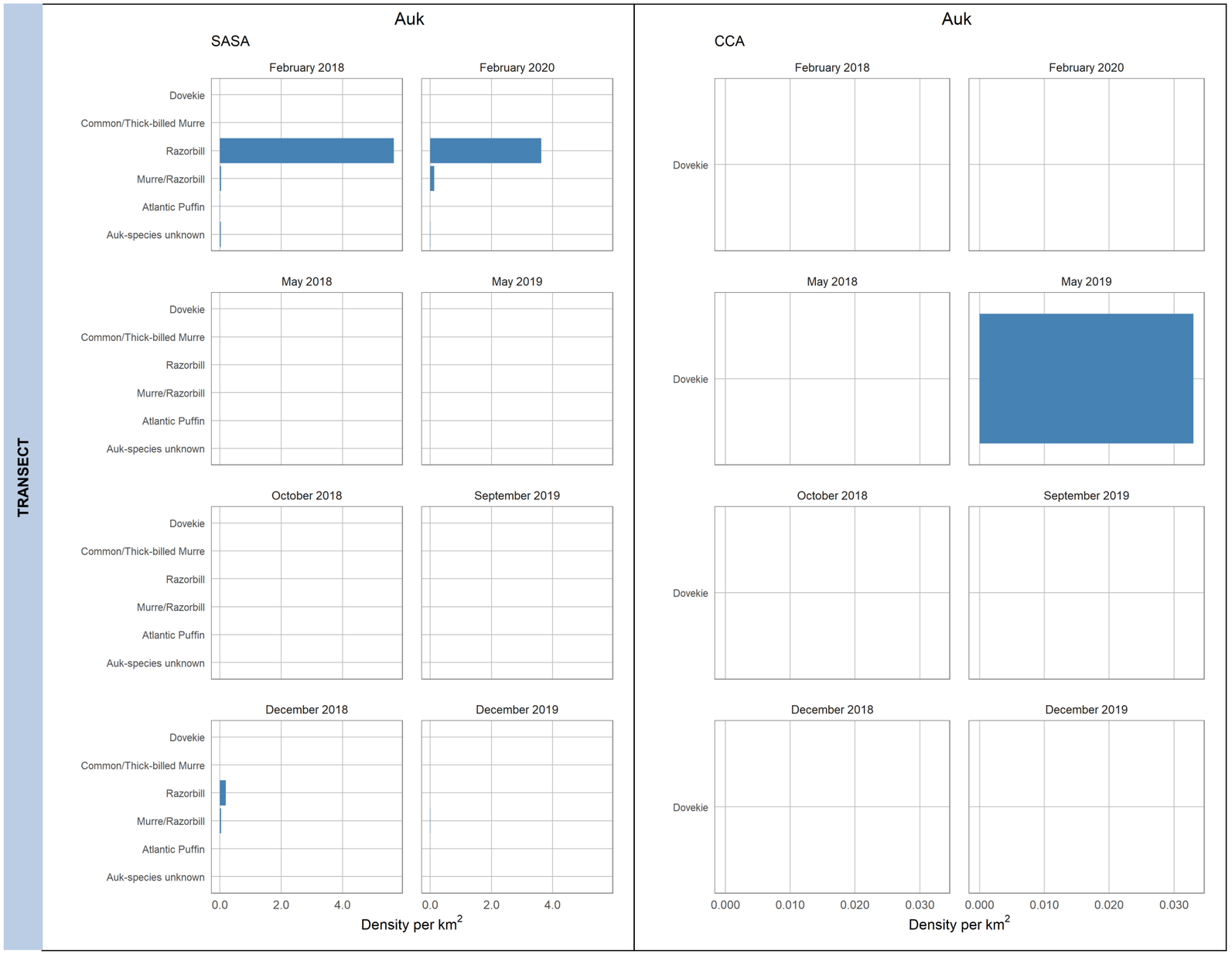
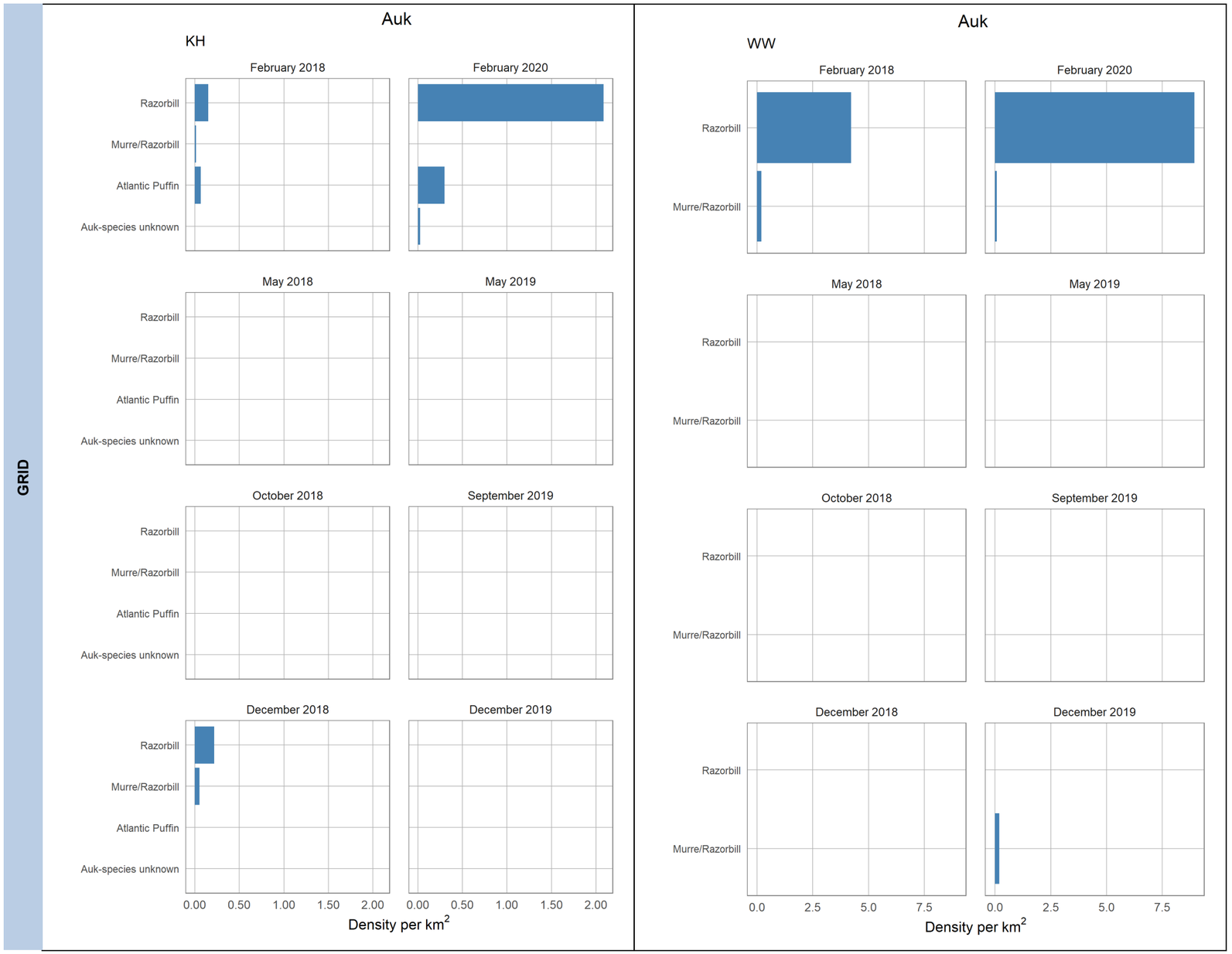


Figure C–22. Density (per km^2) of auk species found during the February 2018 through February 2020 surveys for each area during each survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.



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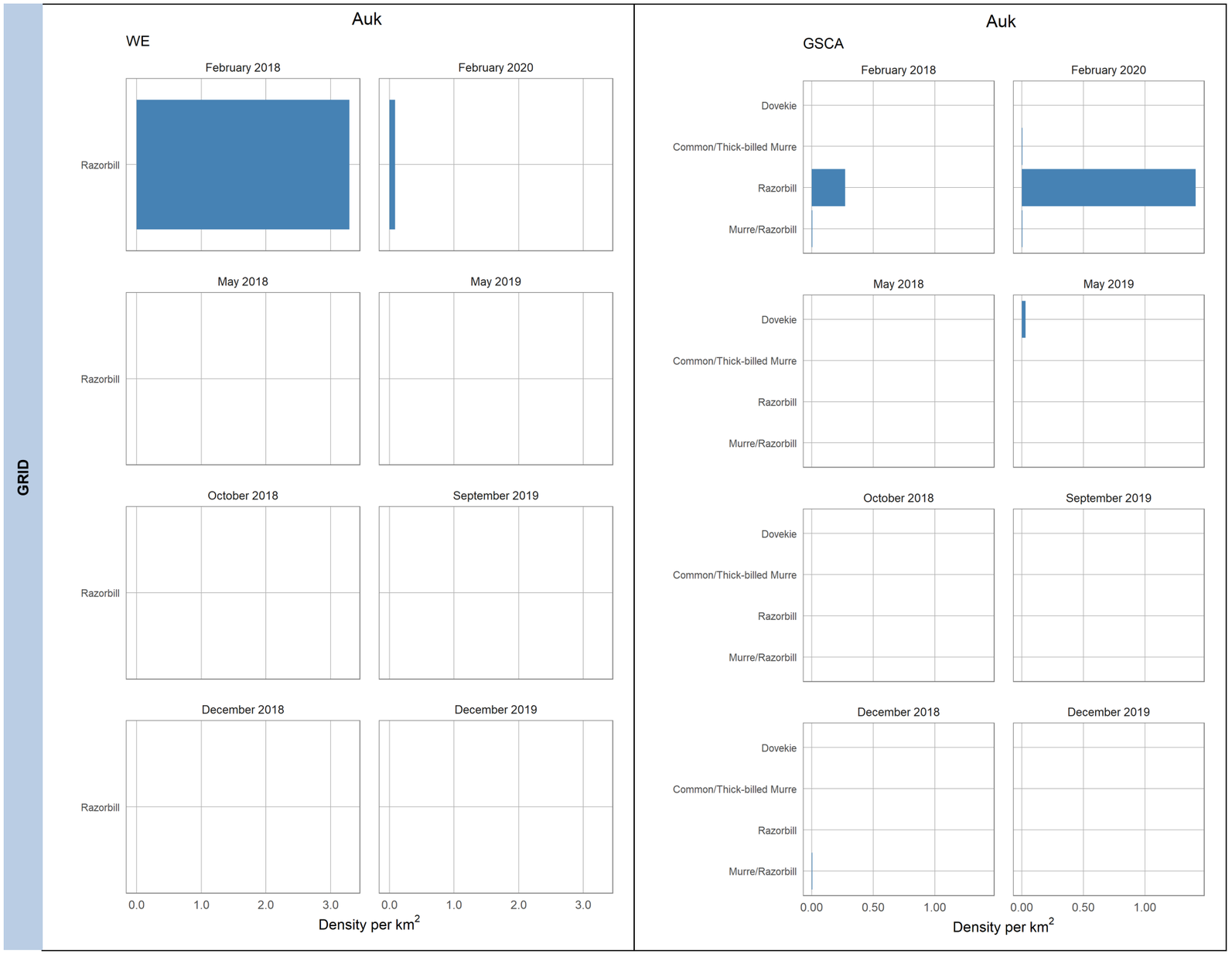

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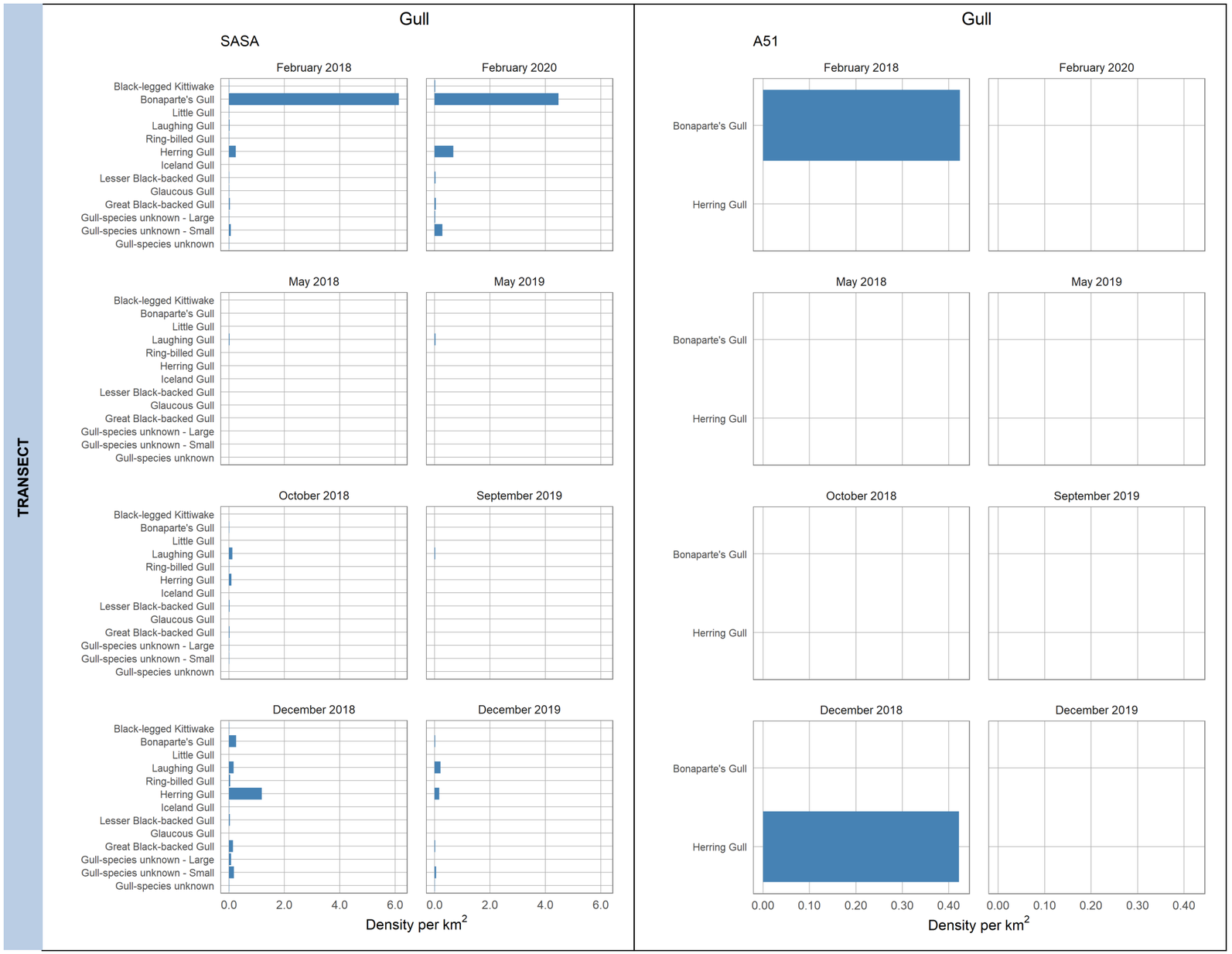
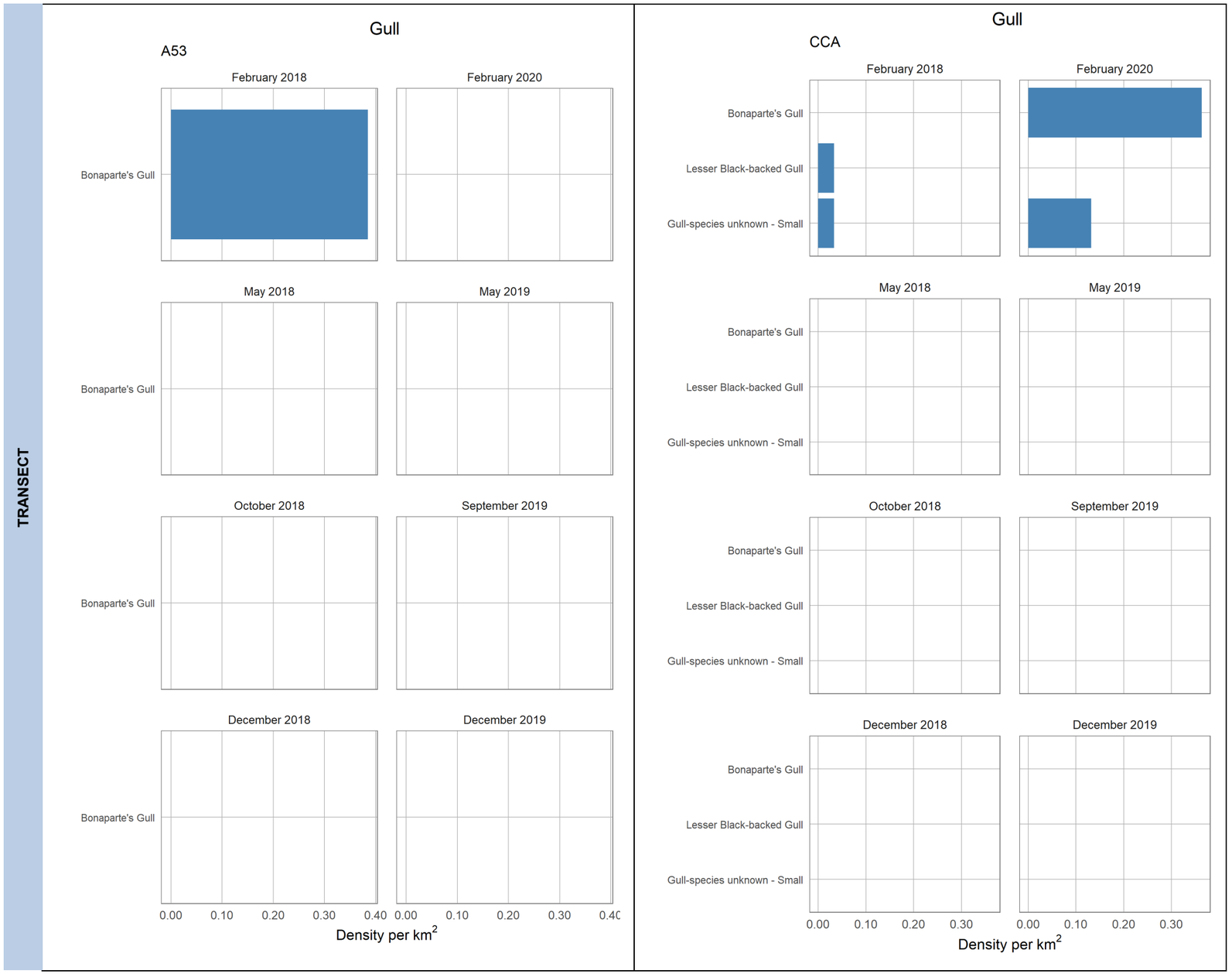


Figure C–23. Density (per km^2) of gull species found during the February 2018 through February 2020 surveys for each area during each survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.



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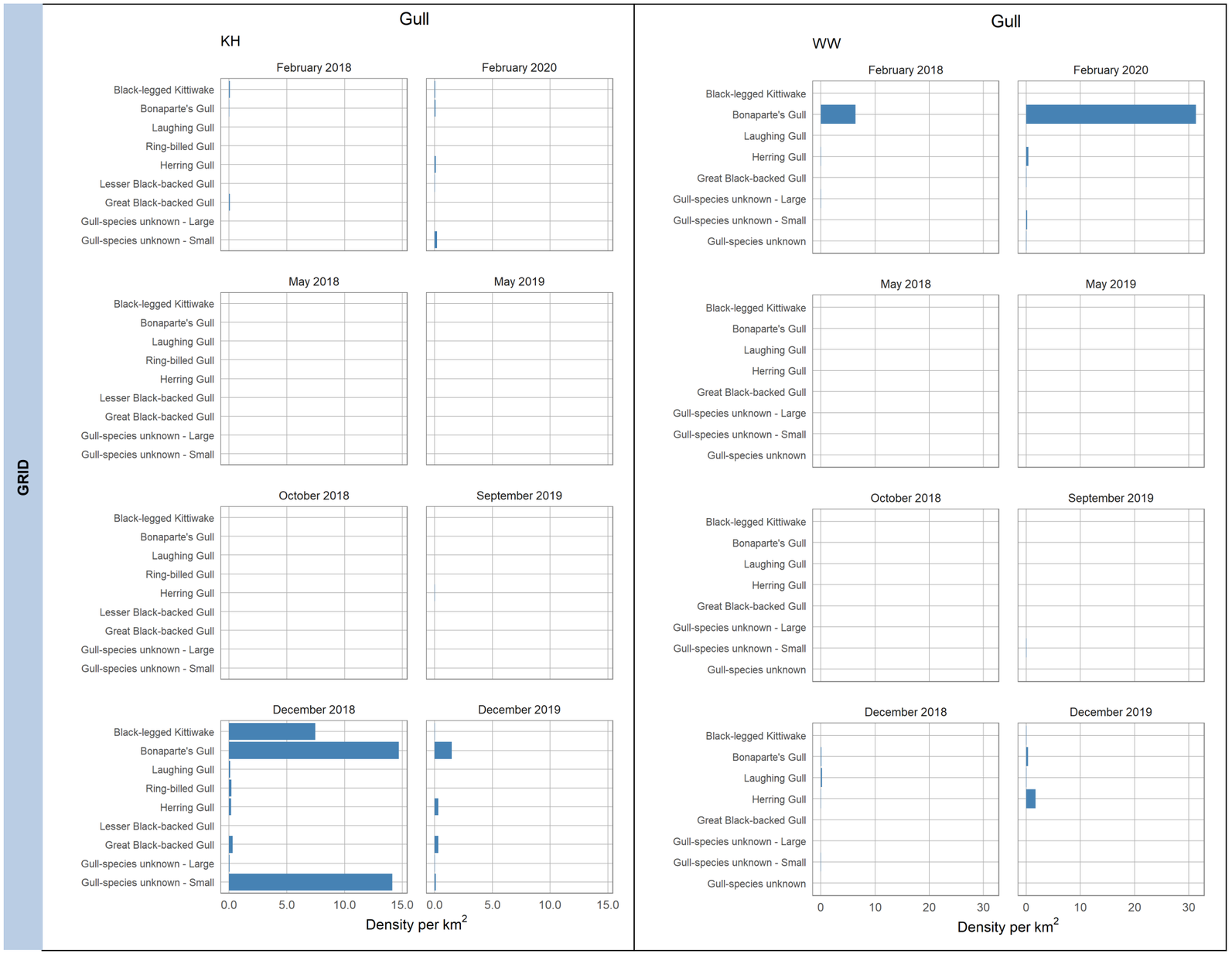

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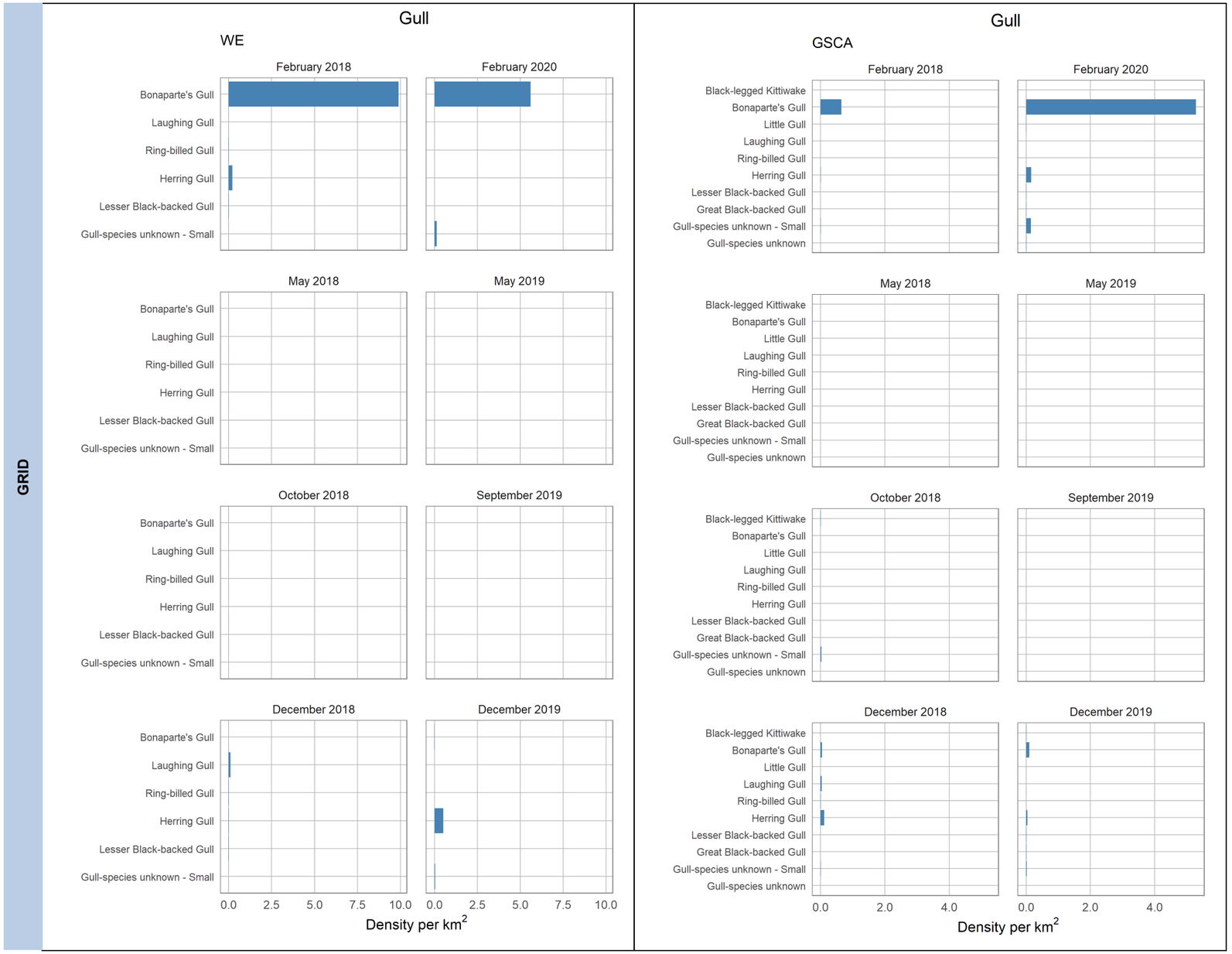


Figure C–23. (Continued)

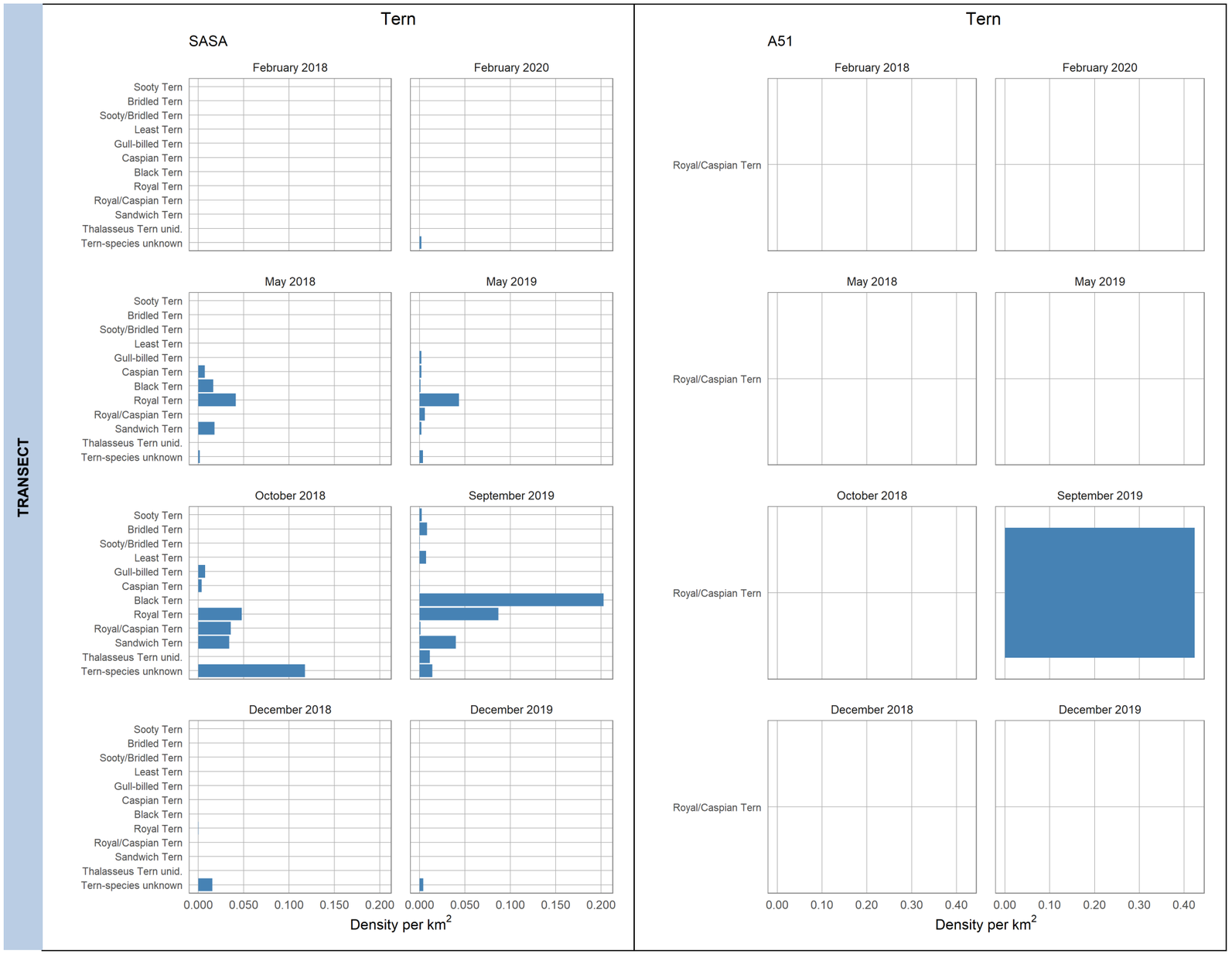
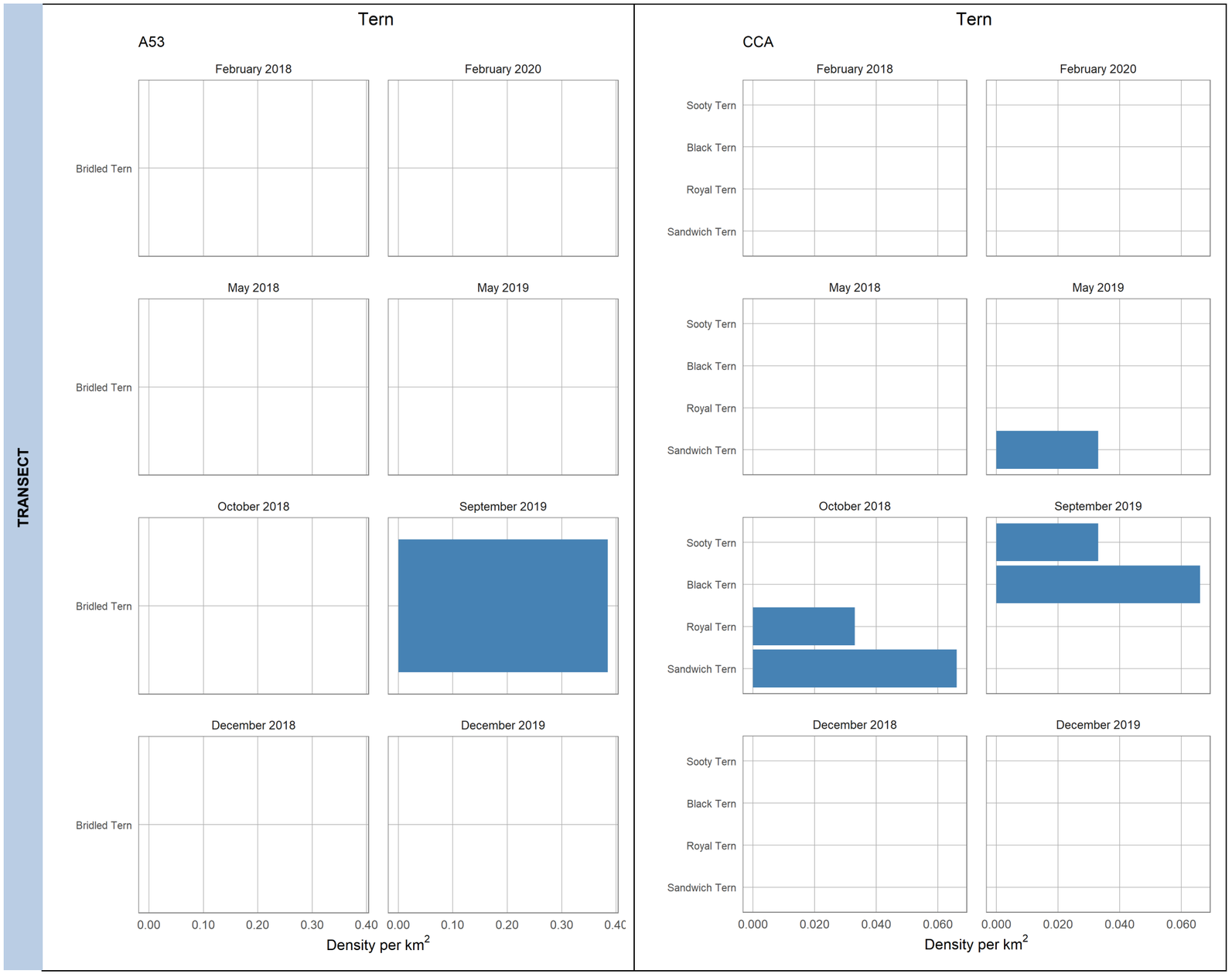


Figure C–24. Density (per km^2) of tern species found during the February 2018 through February 2020 surveys for each area during each survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.



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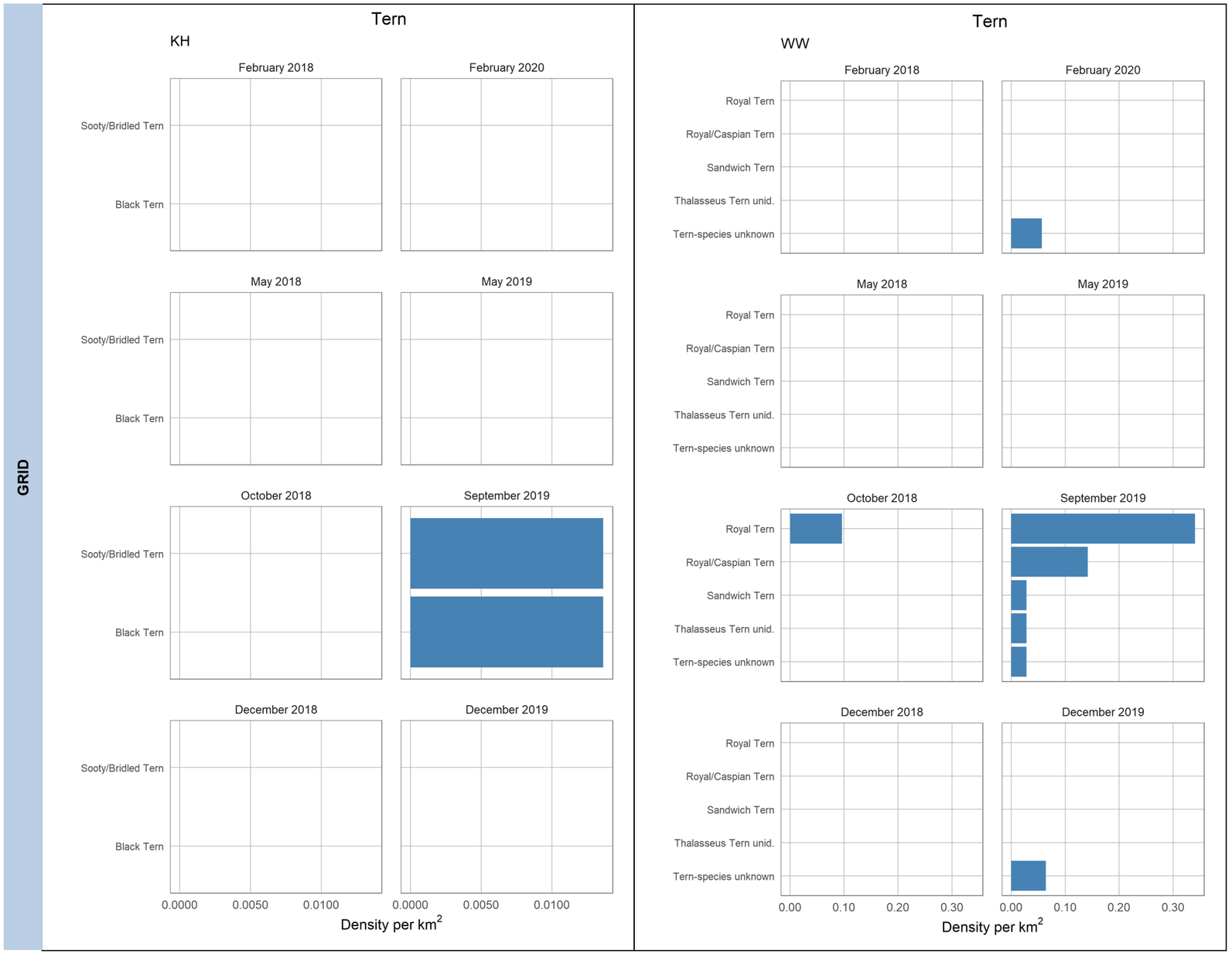

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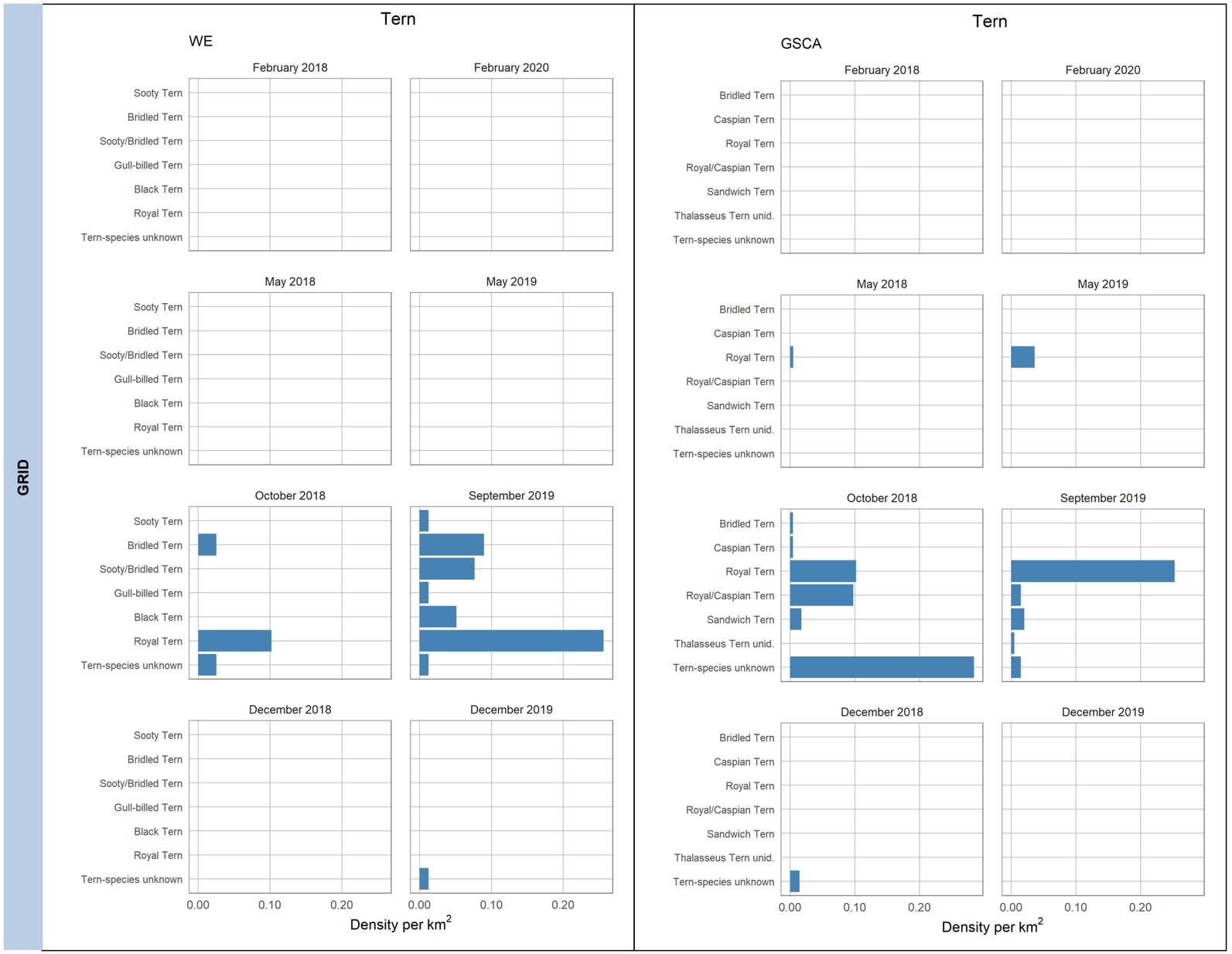


Figure C–24. (Continued)

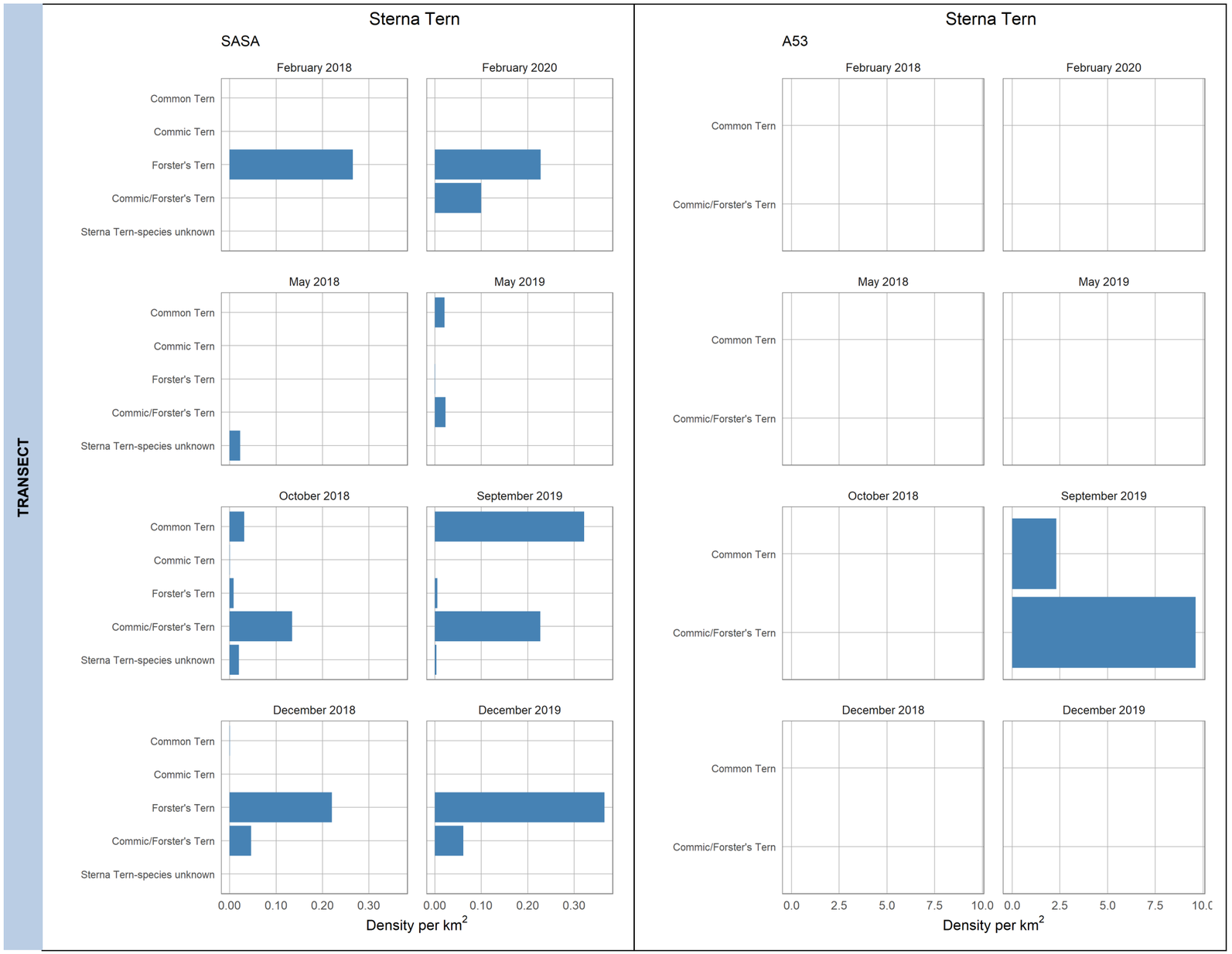
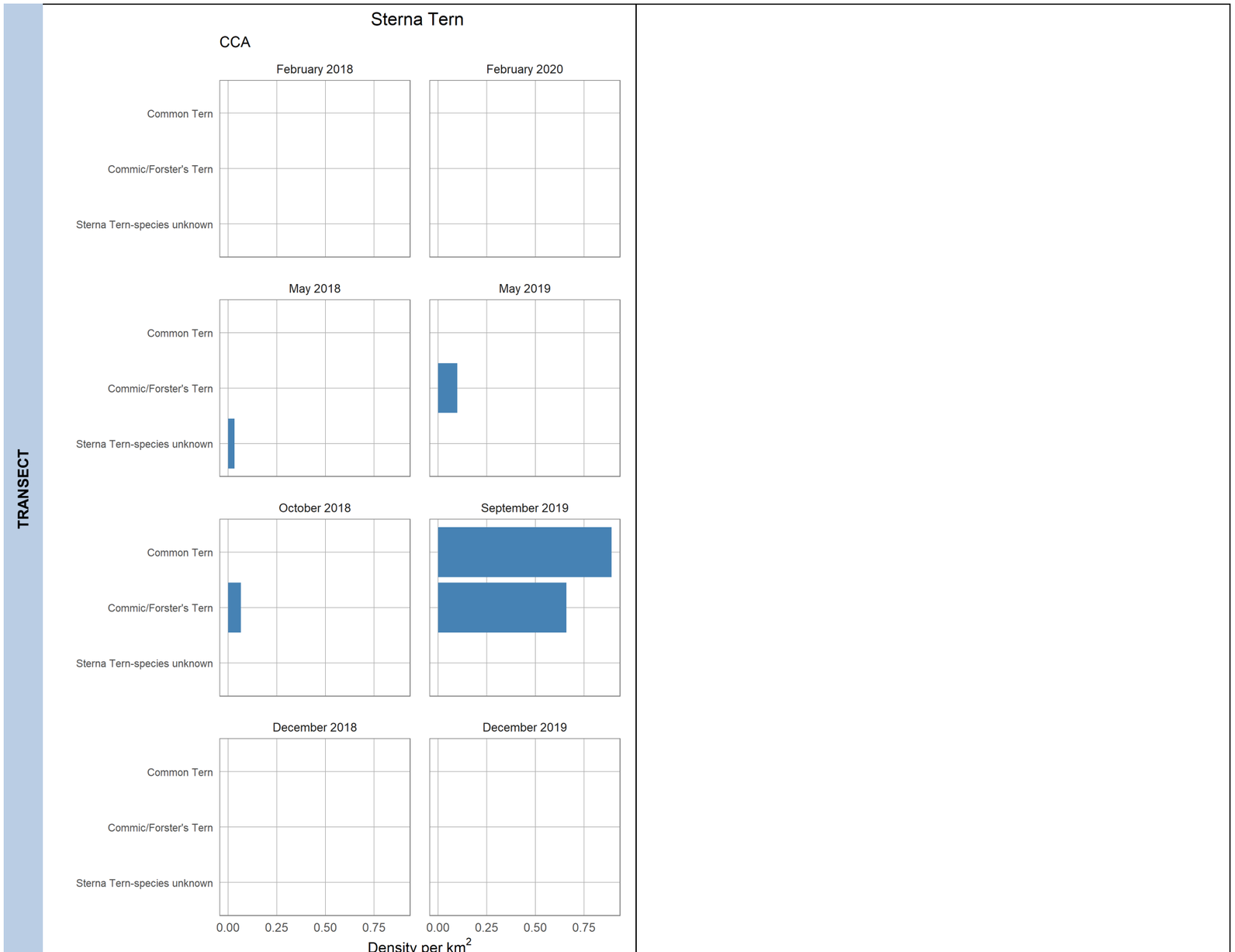


Figure C–25. Density (per km^2) of *Sterna* tern species found during the February 2018 through February 2020 surveys for each area during each survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.



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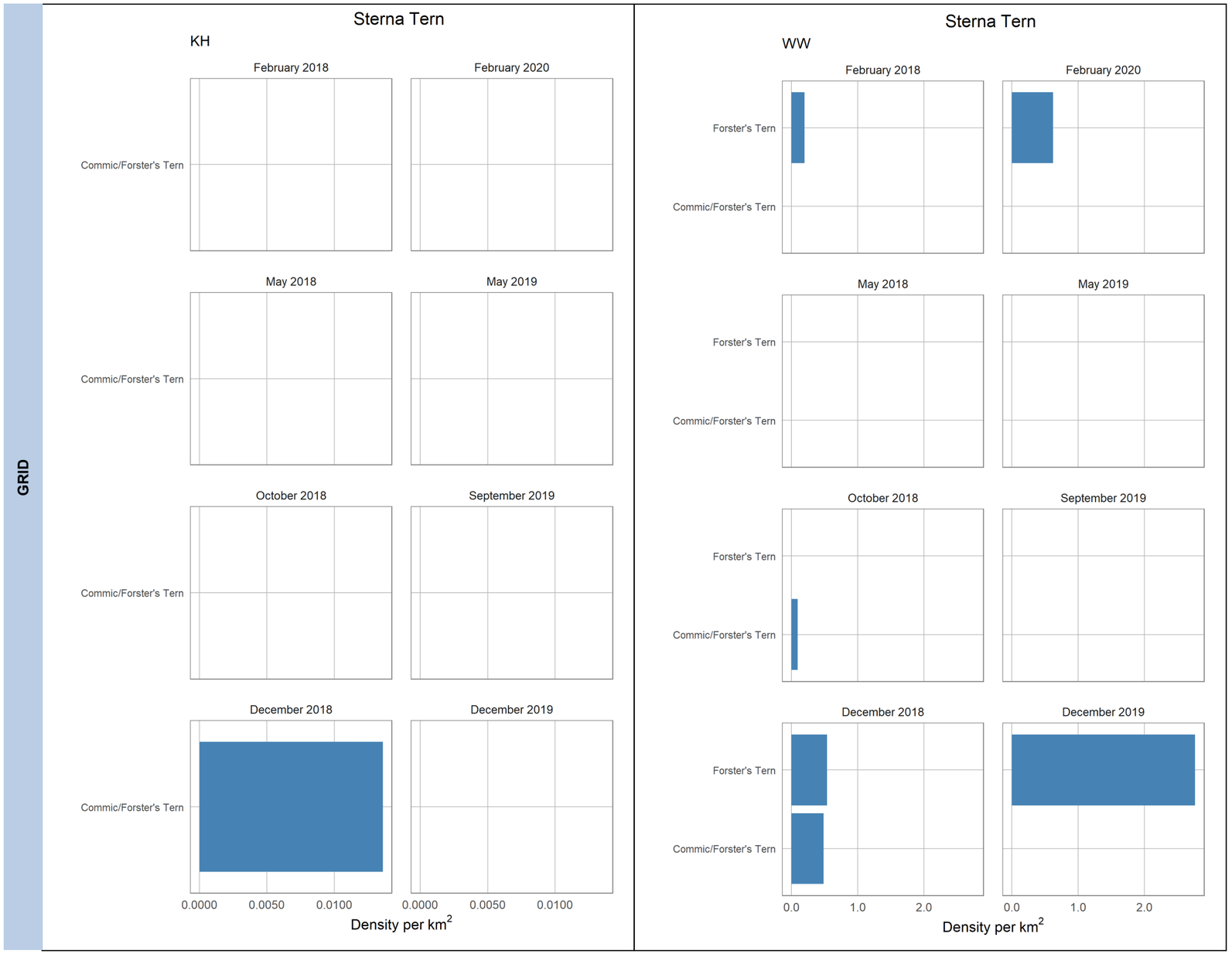


Figure C–25. (Continued)

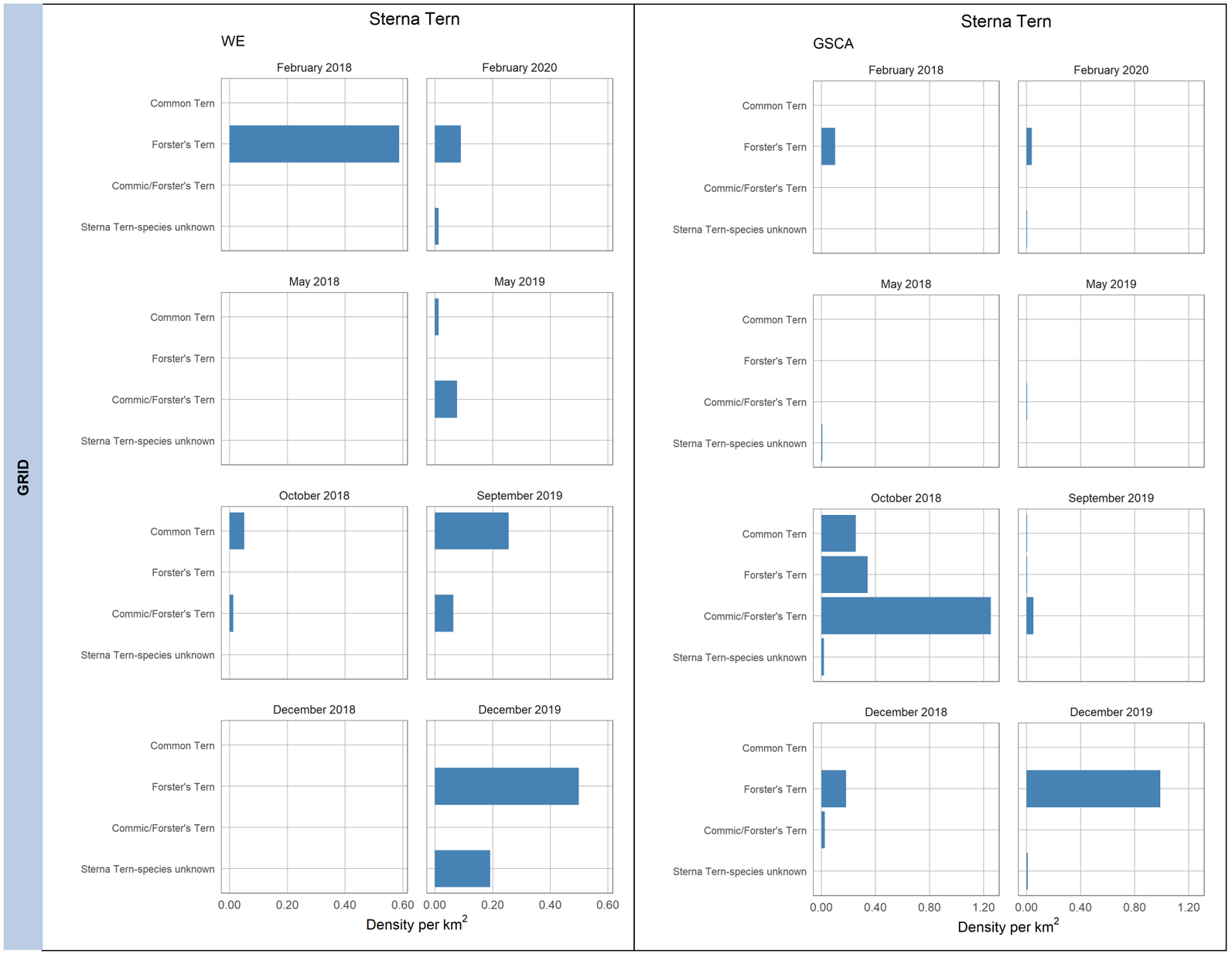
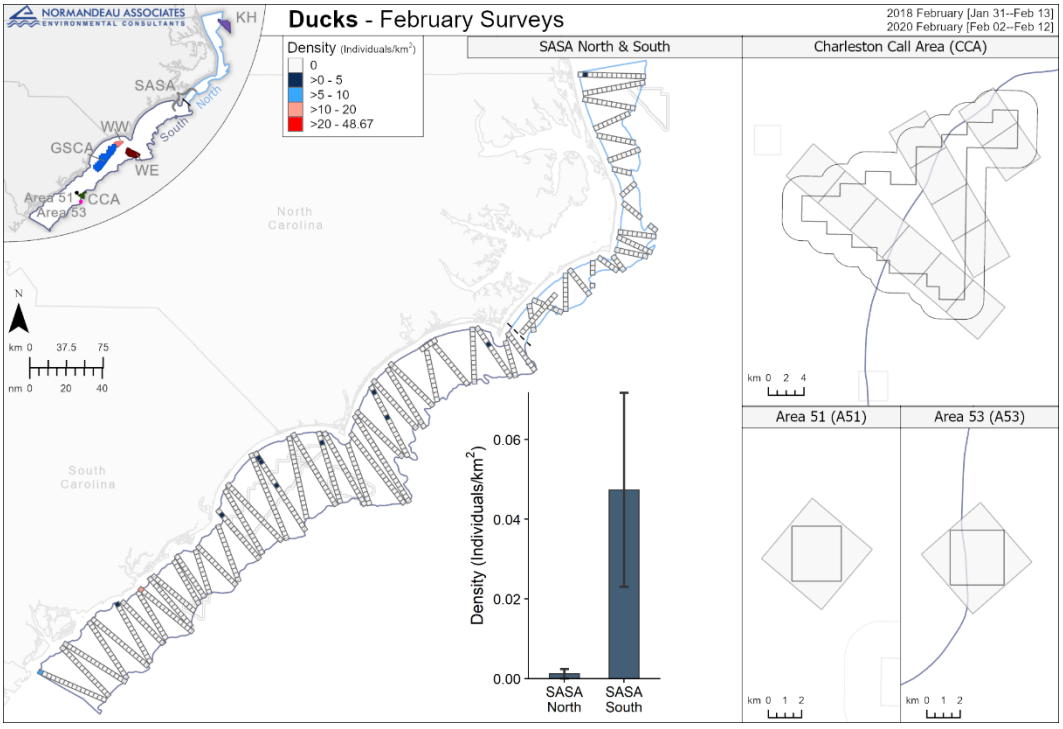


Figure C–25. (Continued)

C.4 Avian Species Spatial Distribution Maps

C.4.1 Duck



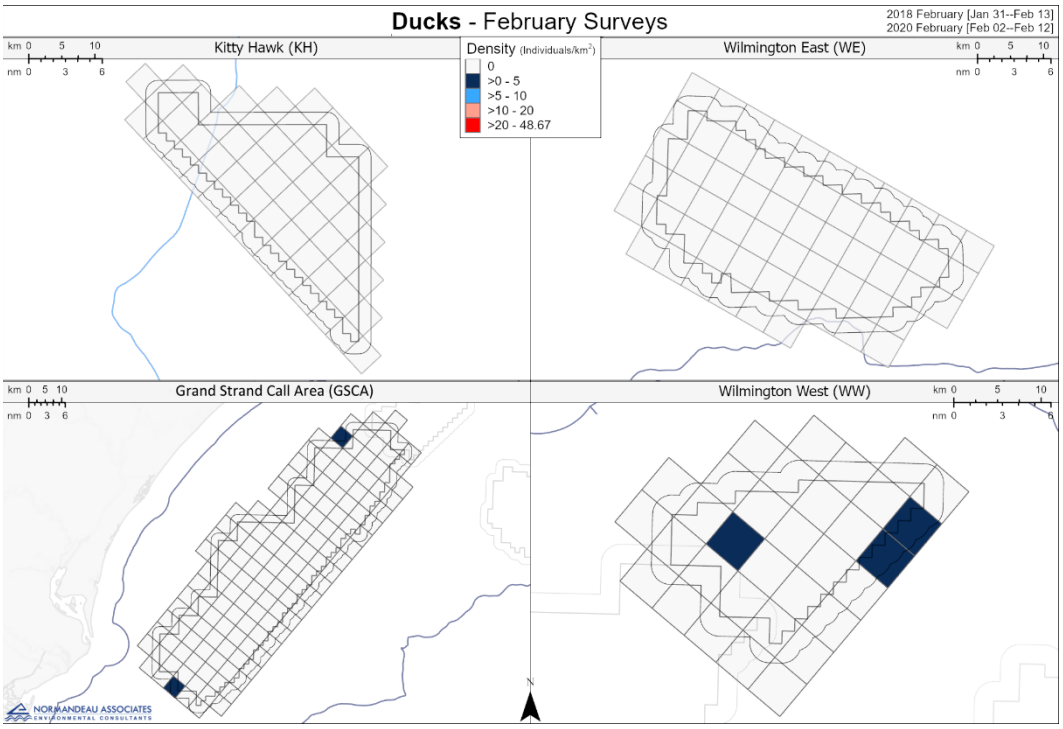


Figure C–26. Spatial distribution of all duck species during the February surveys for all areas

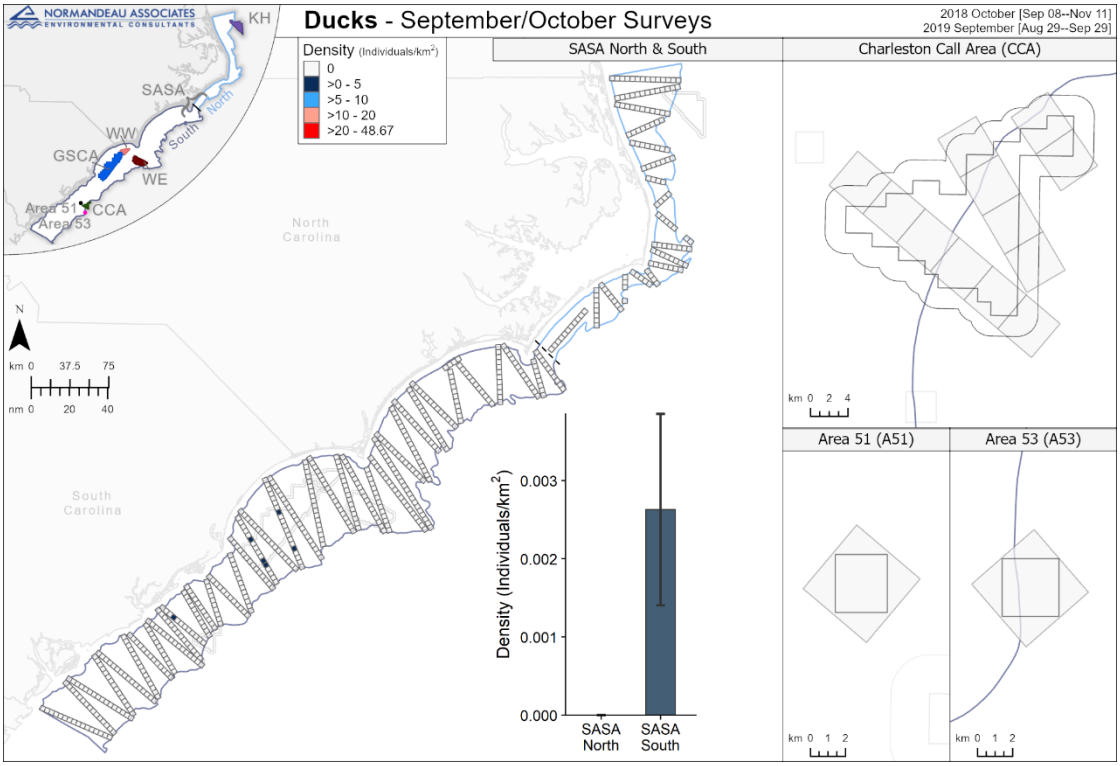


Figure C–27. Spatial distribution of all duck species during the September/October surveys for all areas

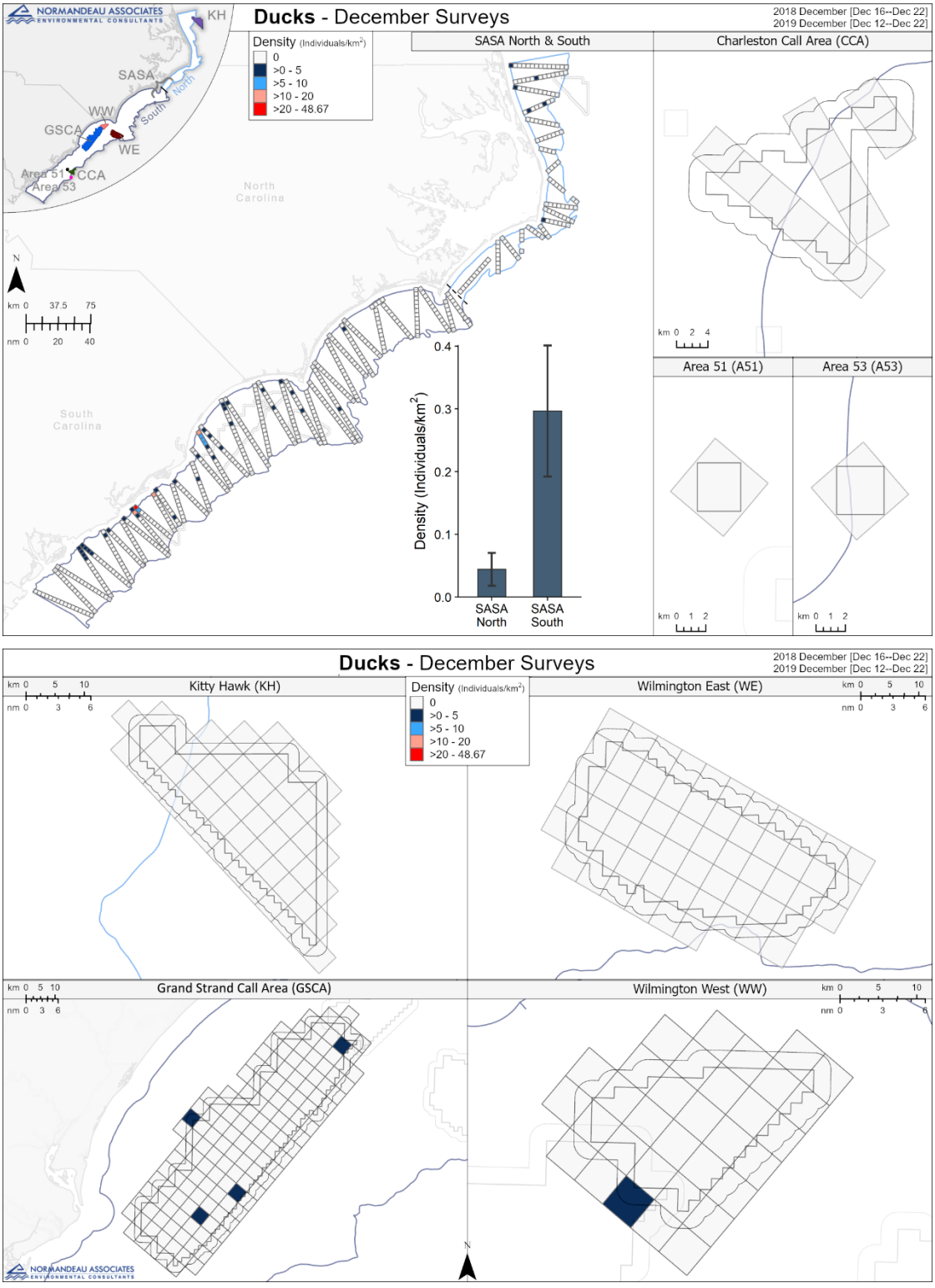


Figure C–28. Spatial distribution of all duck species during the December surveys for all areas

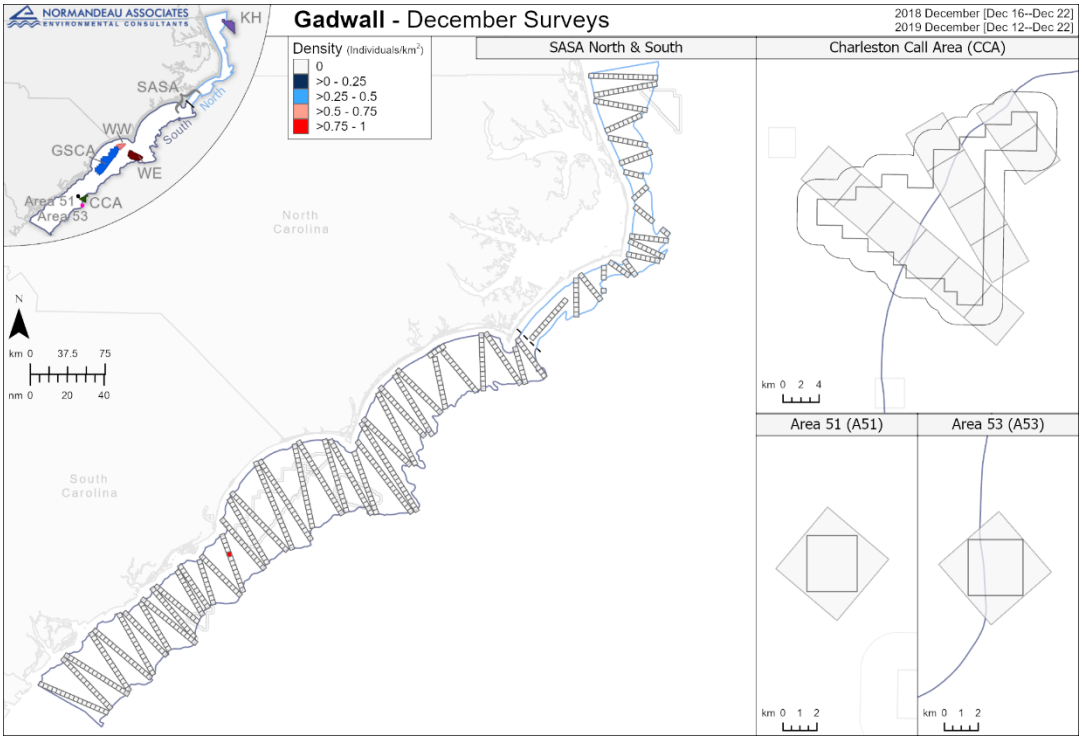


Figure C–29. Spatial distribution of gadwalls during the December surveys for all areas

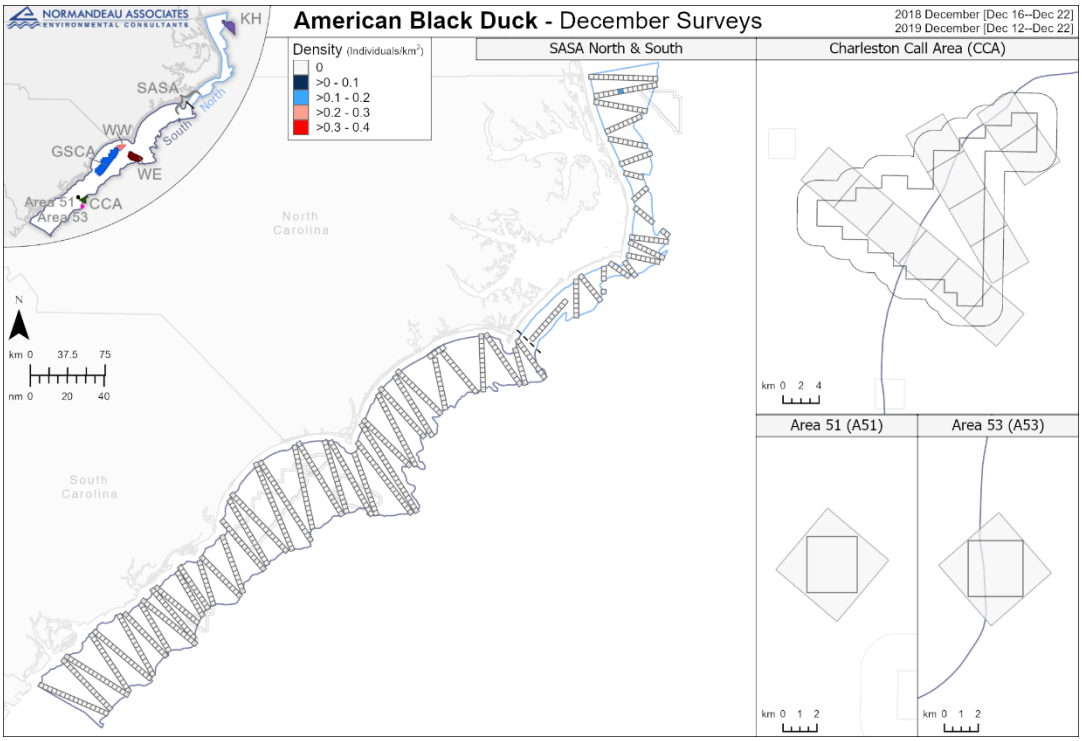


Figure C–30. Spatial distribution of American black ducks during the December surveys for all areas

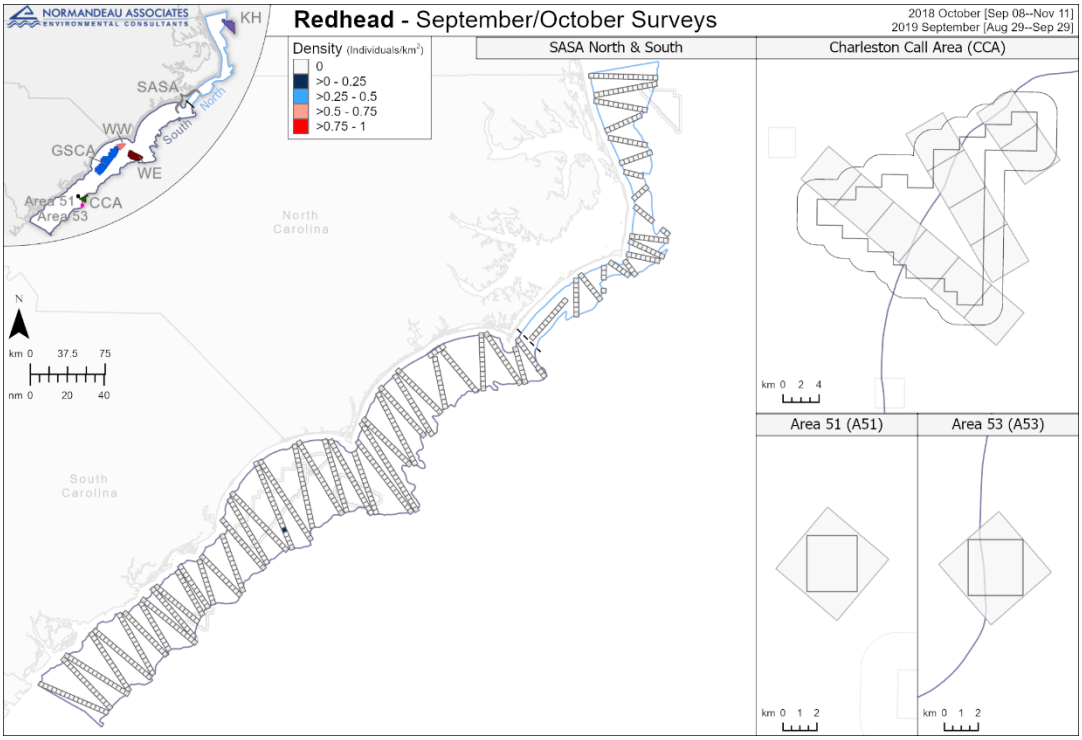


Figure C–31. Spatial distribution of redheads during the September/October surveys for all areas

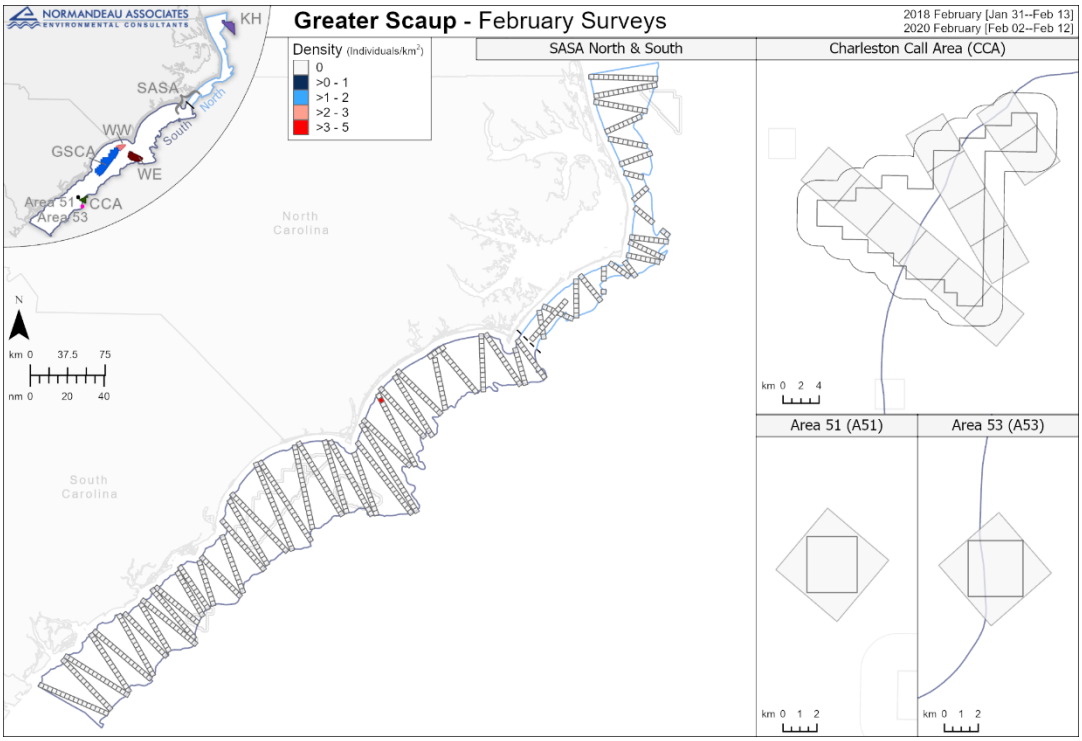


Figure C–32. Spatial distribution of greater scaups during the February surveys for all areas

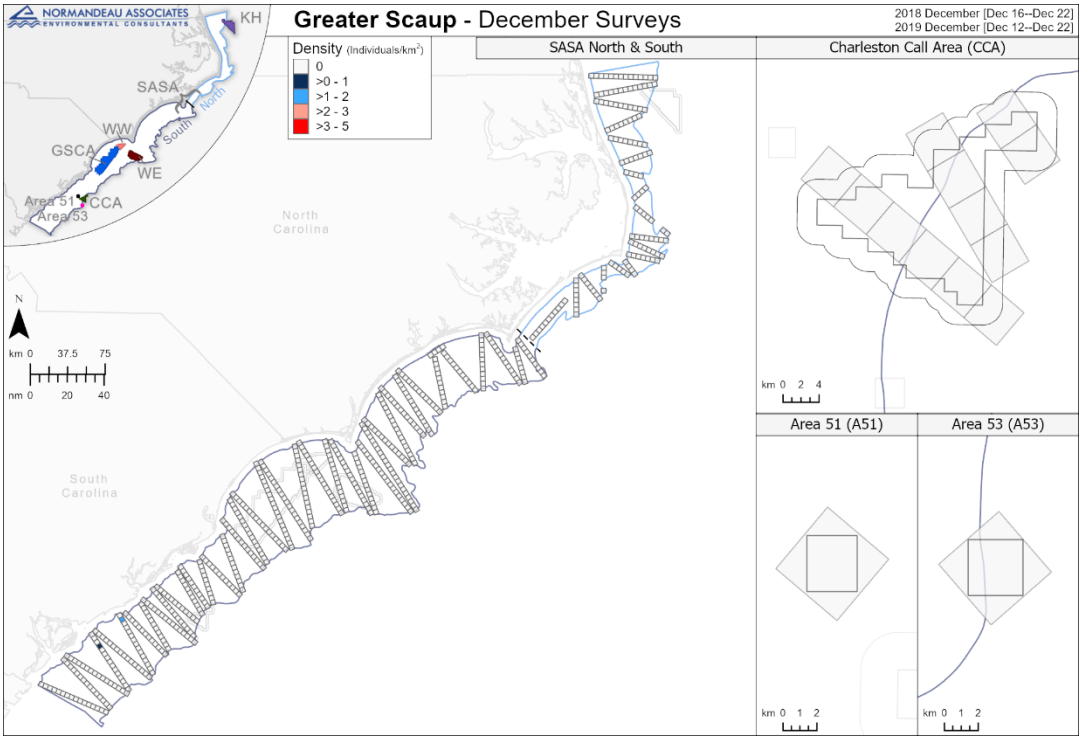


Figure C–33. Spatial distribution of greater scaups during the December surveys for all areas

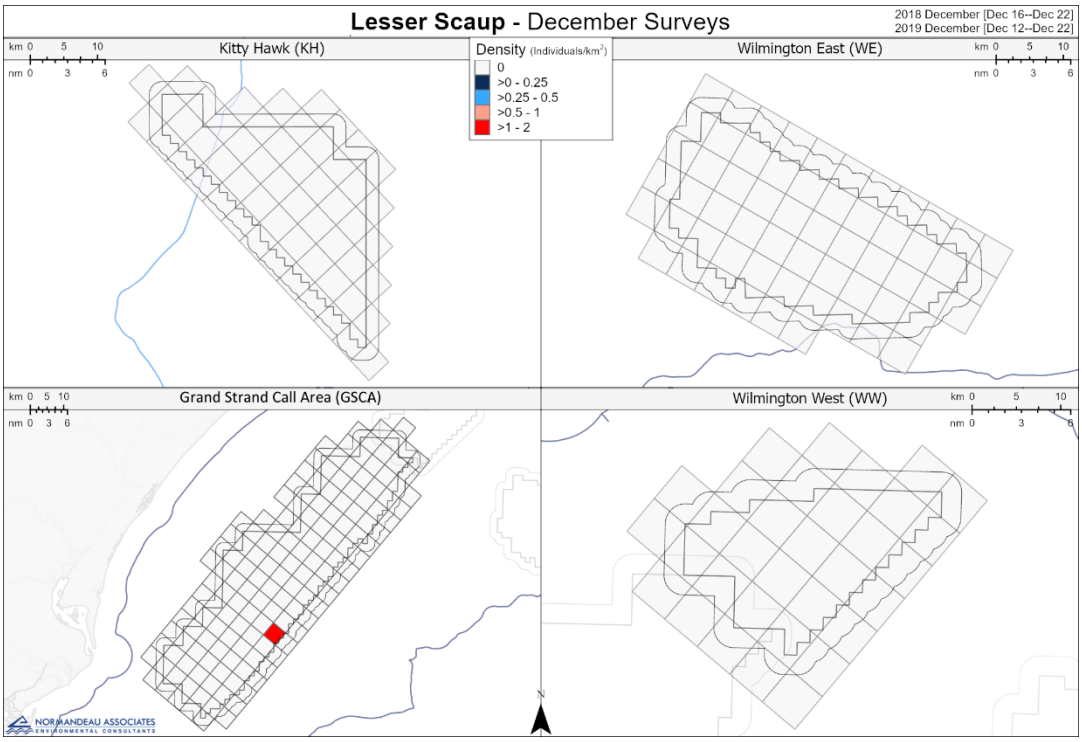


Figure C–34. Spatial distribution of lesser scaups during the December surveys for all areas

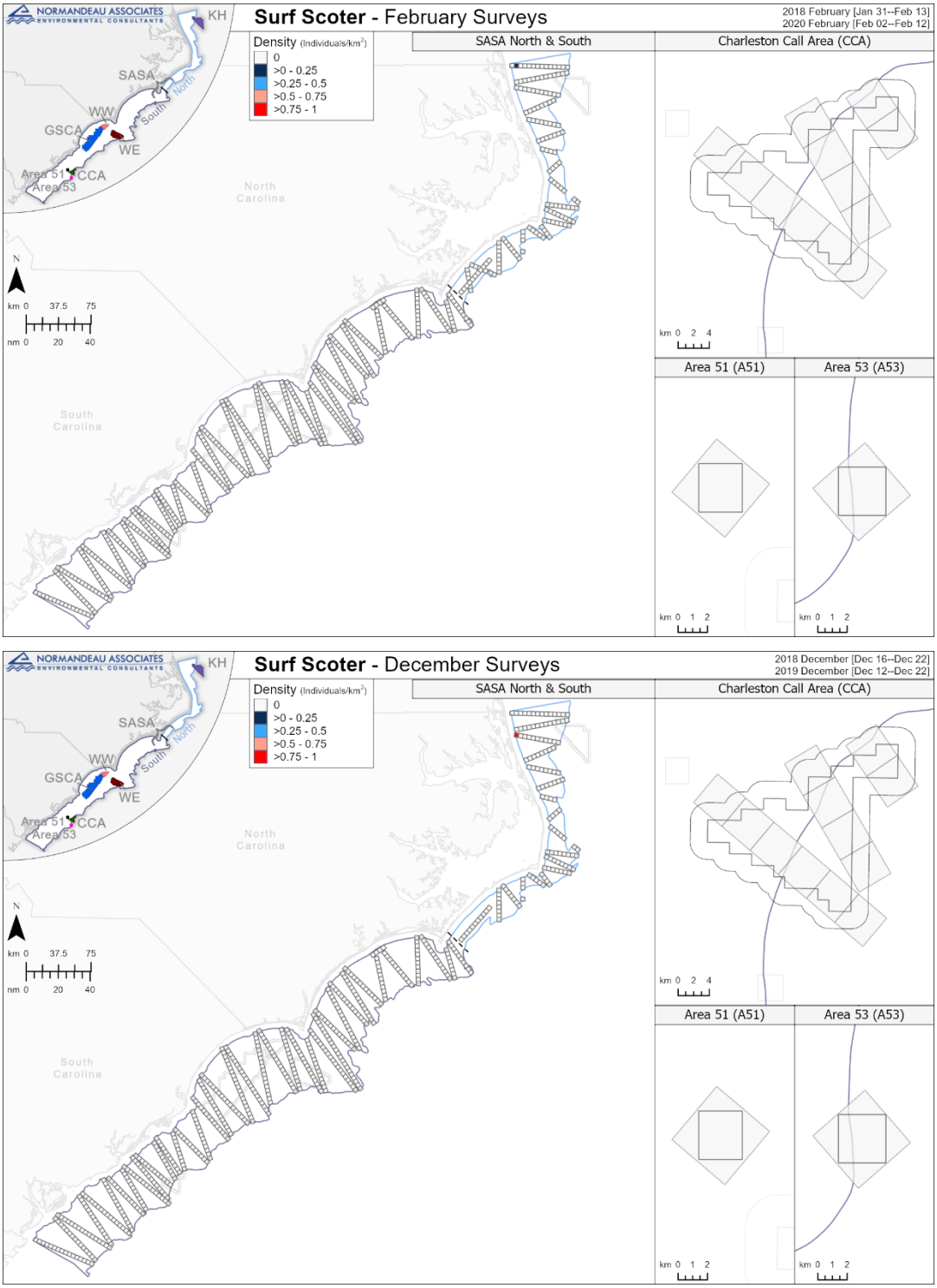


Figure C–35. Spatial distribution of surf scoters during the February (top) and December (bottom) surveys for all areas

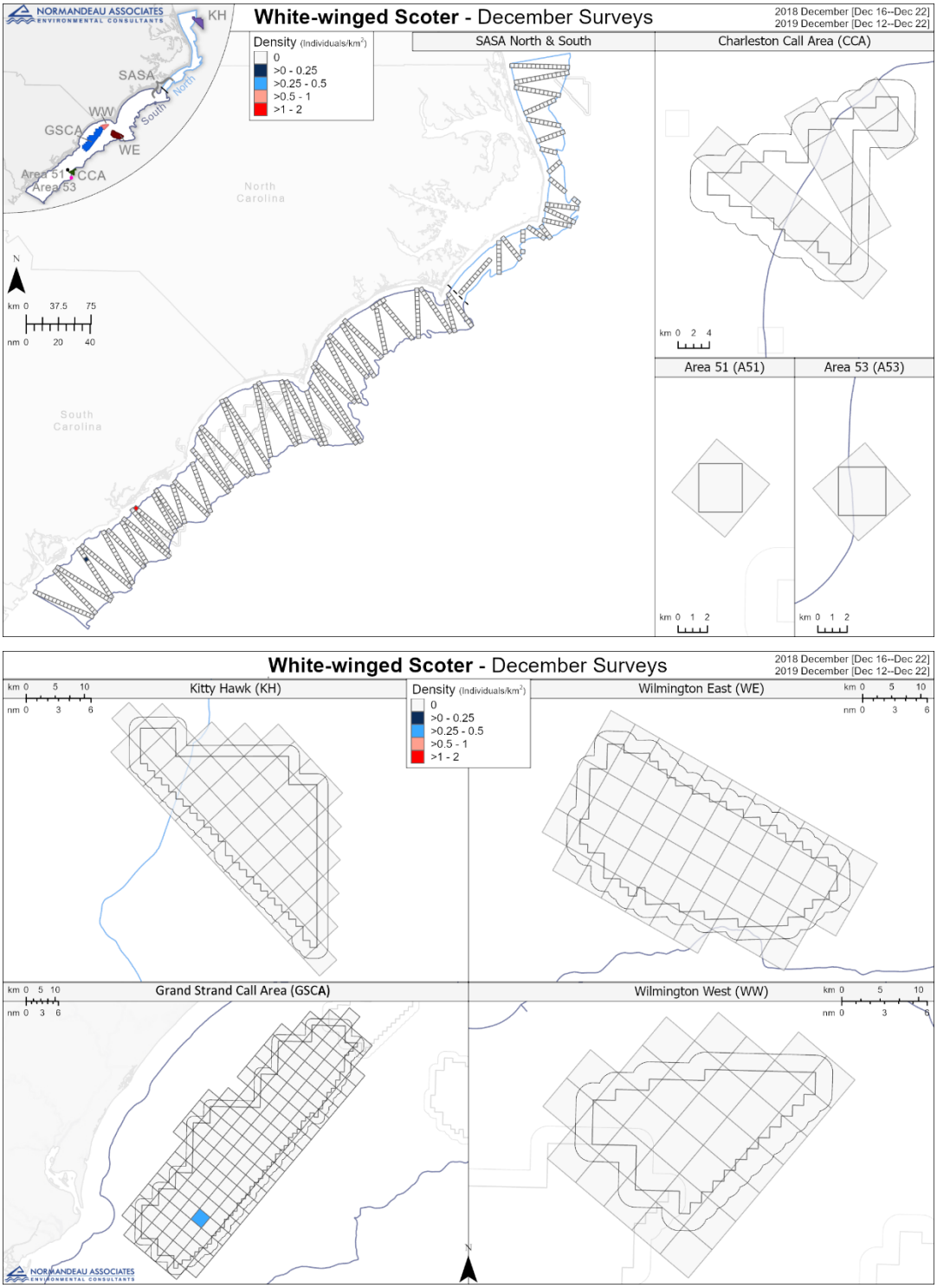


Figure C–36. Spatial distribution of white-winged scoters during the December surveys for all areas

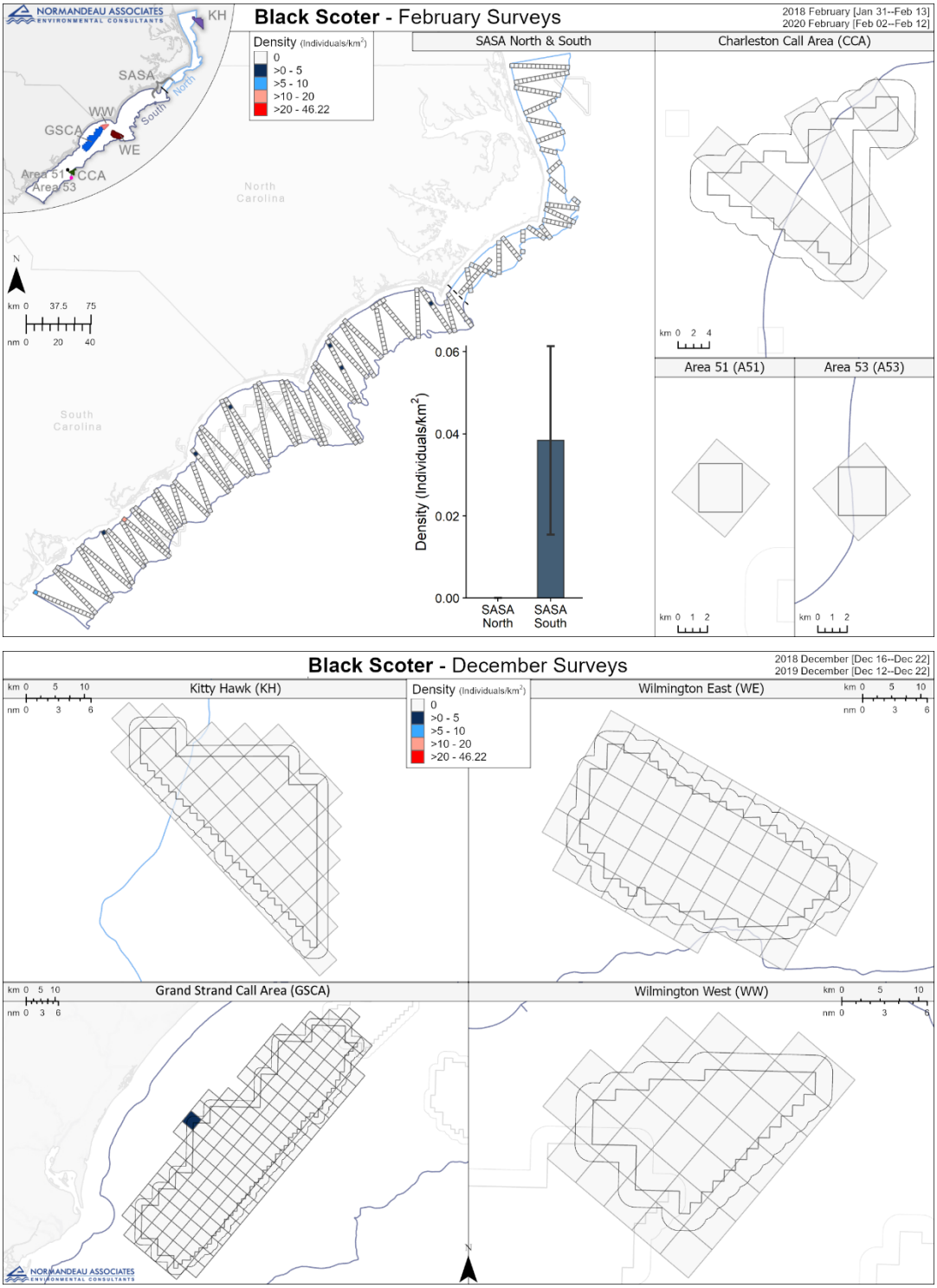


Figure C–37. Spatial distribution of black scoters during the February surveys for all areas

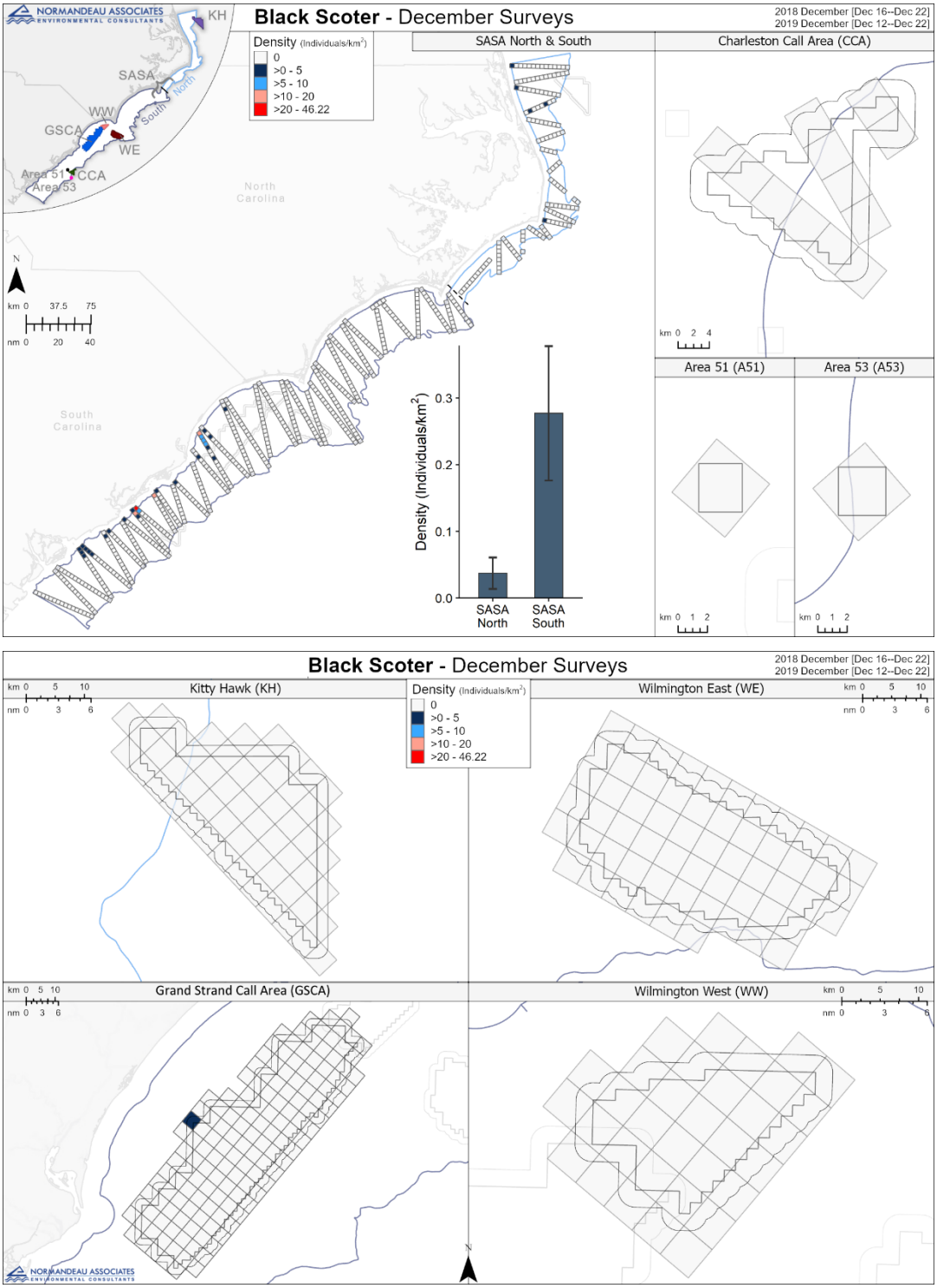


Figure C–38. Spatial distribution of black scoters during the December surveys for all areas

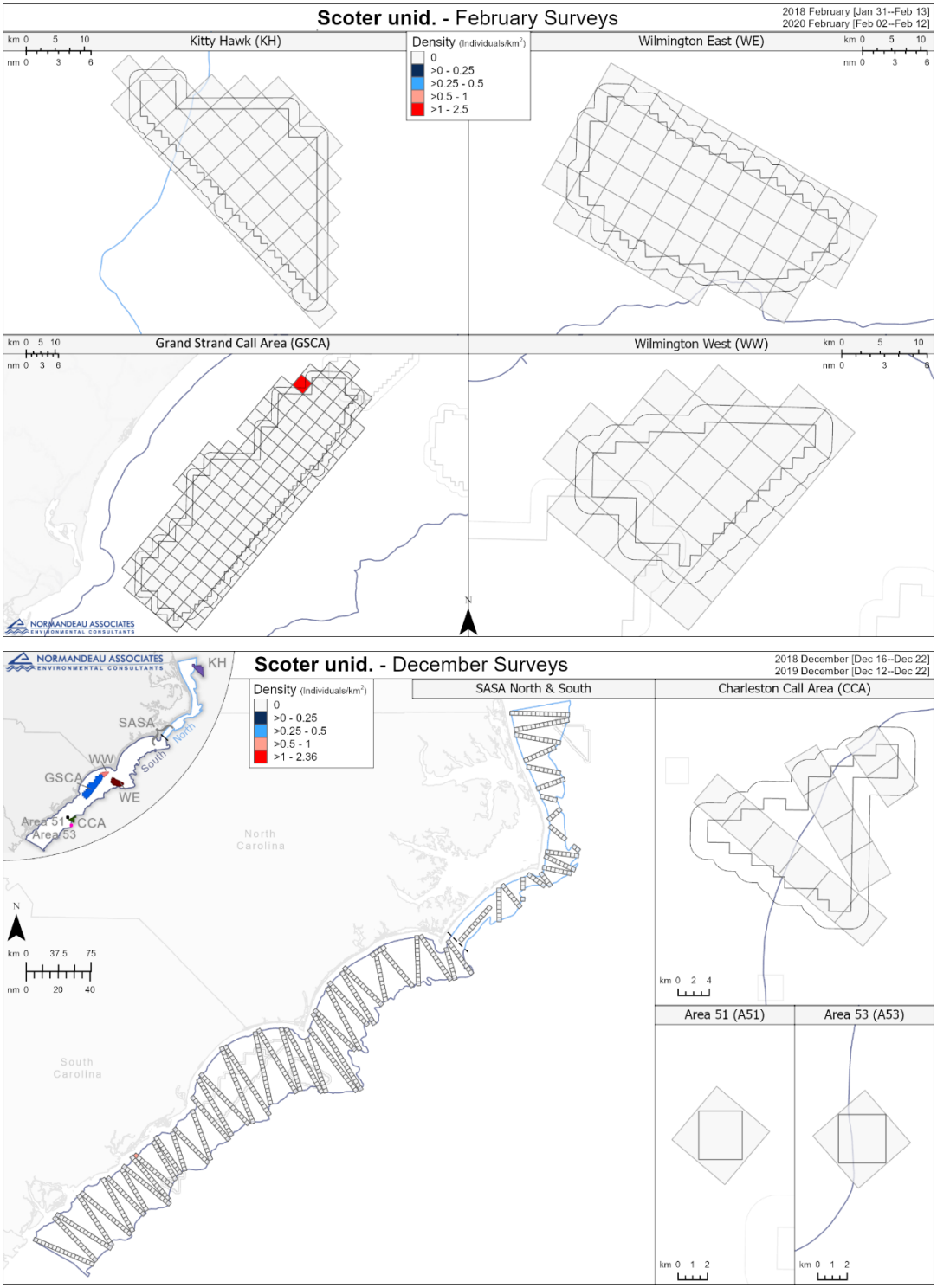


Figure C–39. Spatial distribution of scoters (unid.) during the February (top) and December (bottom) surveys for all areas

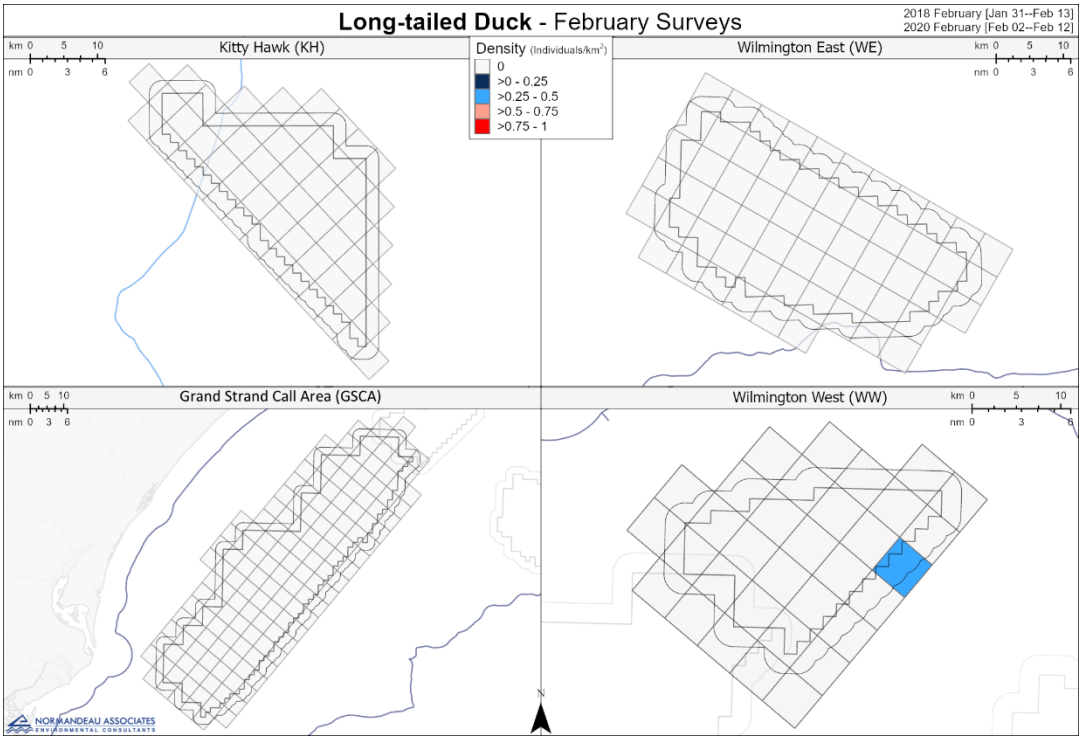


Figure C–40. Spatial distribution of long-tailed ducks during the February surveys for all areas

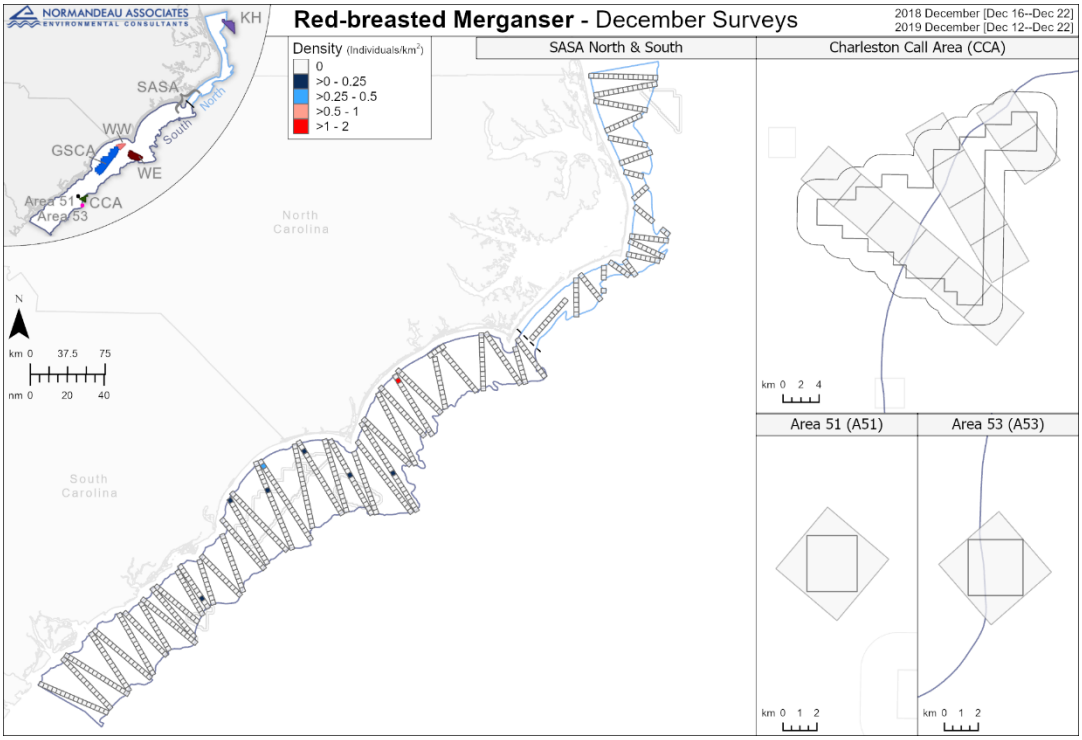


Figure C–41. Spatial distribution of red-breasted mergansers during the December surveys for all areas

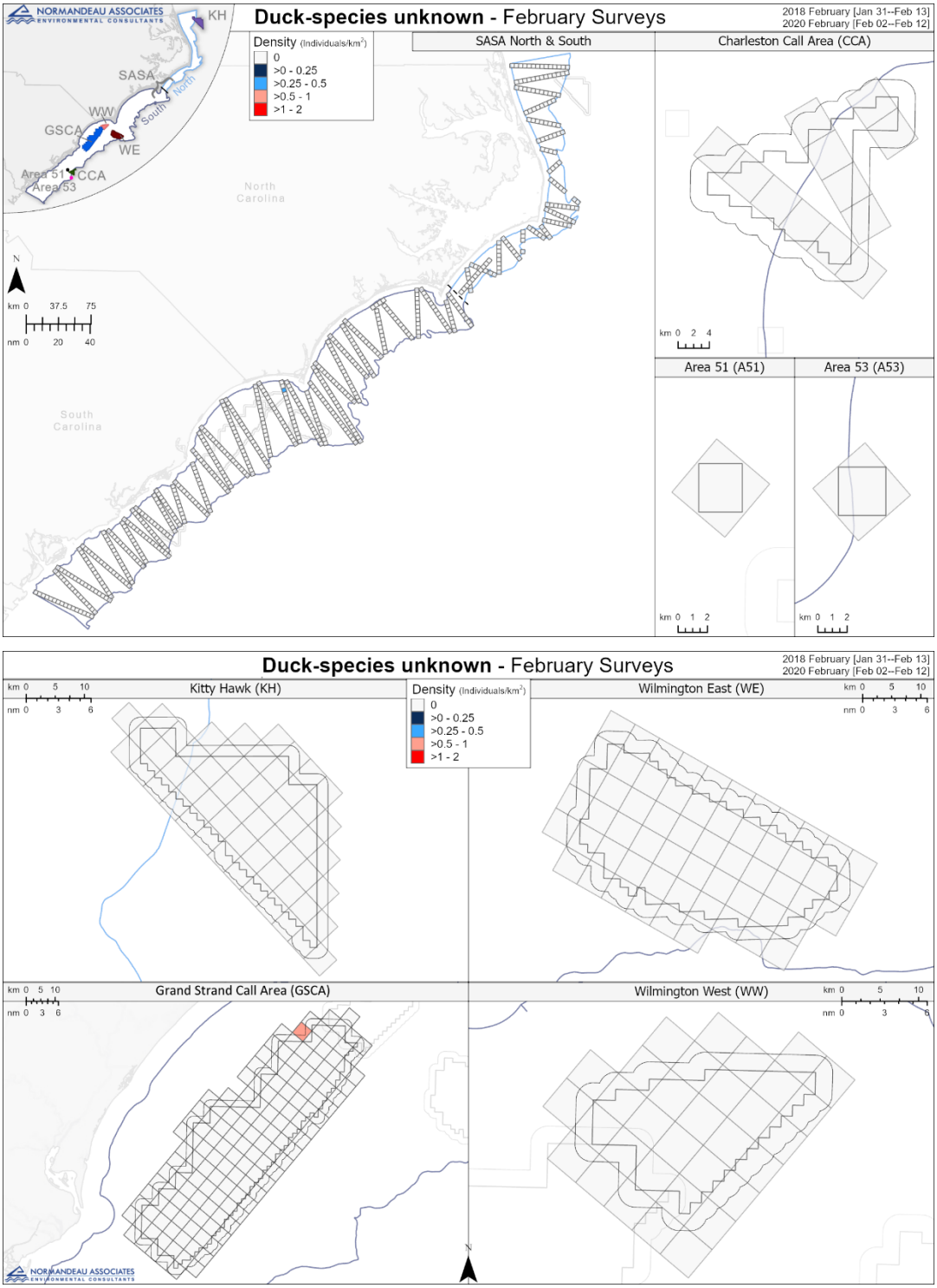


Figure C–42. Spatial distribution of duck-species unknown during the February surveys for all areas

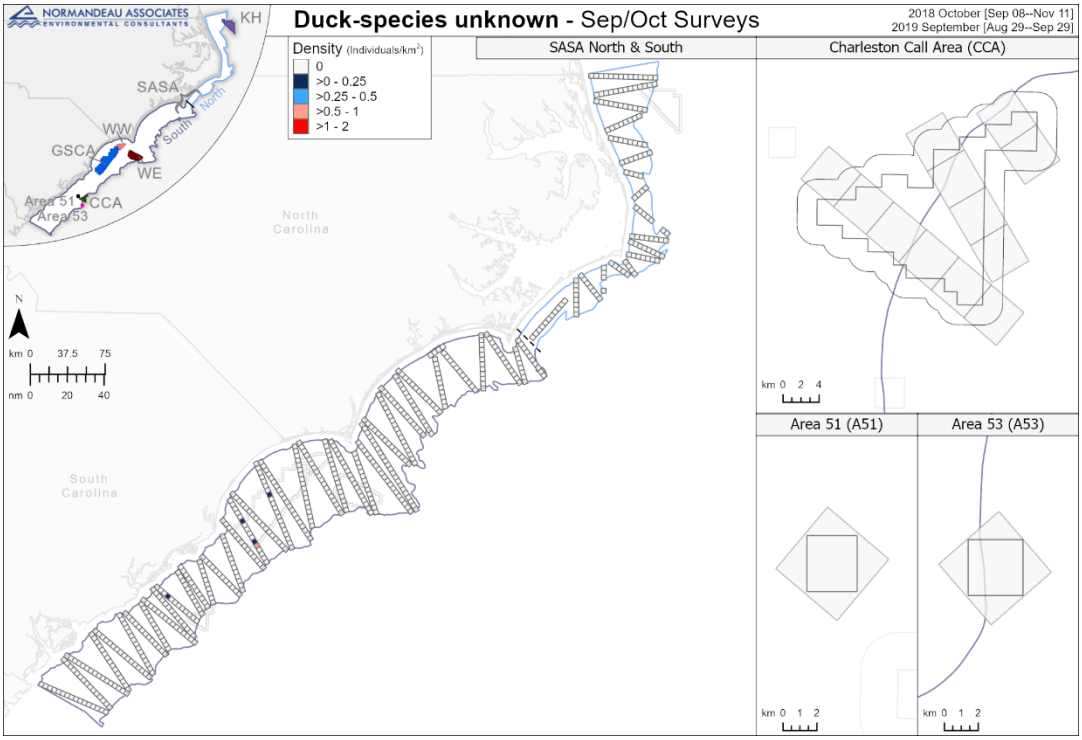


Figure C–43. Spatial distribution of duck-species unknown during the September/October surveys for all areas

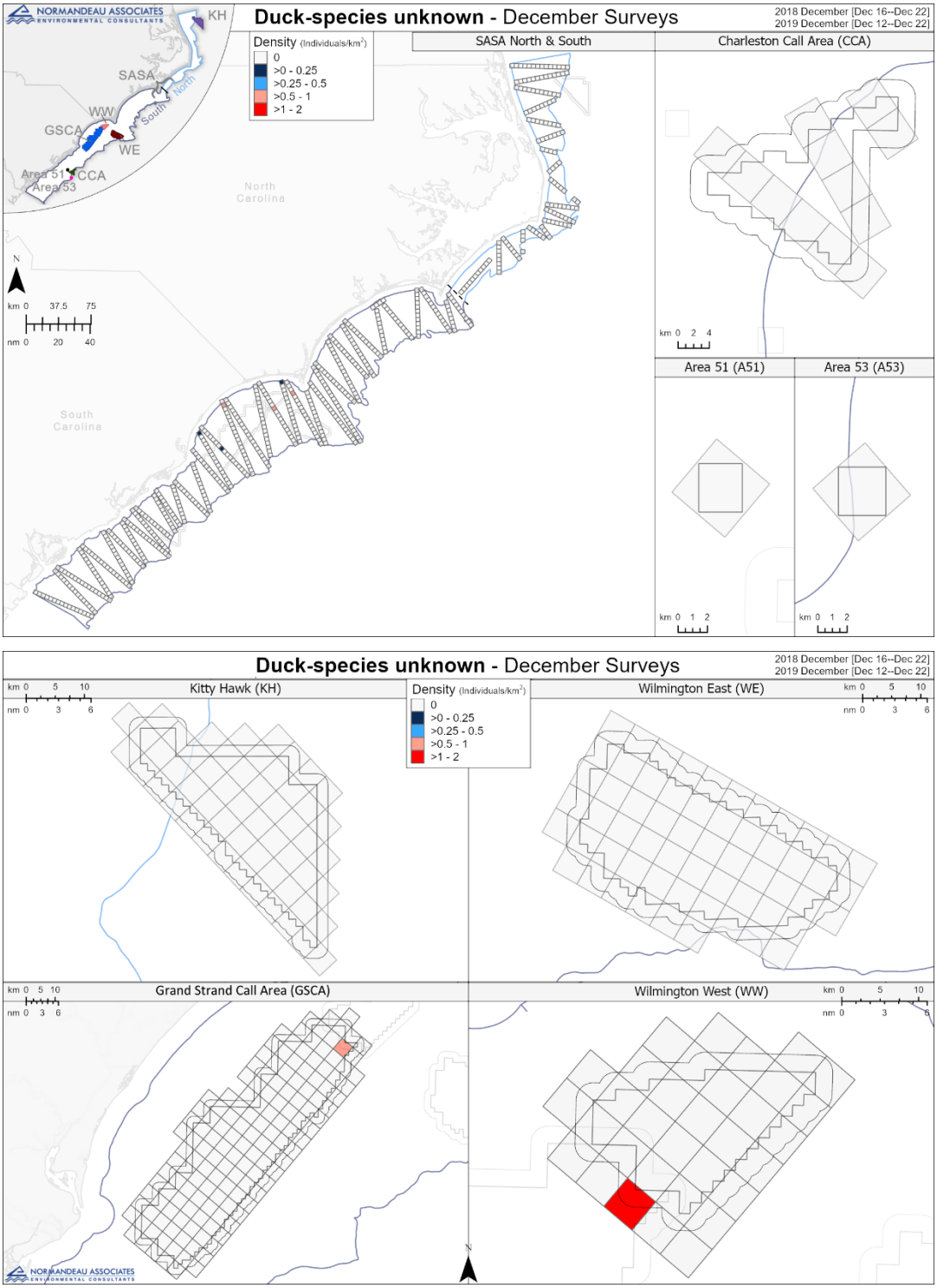


Figure C–44. Spatial distribution of duck-species unknown during the December surveys for all areas

C.4.2 Loon

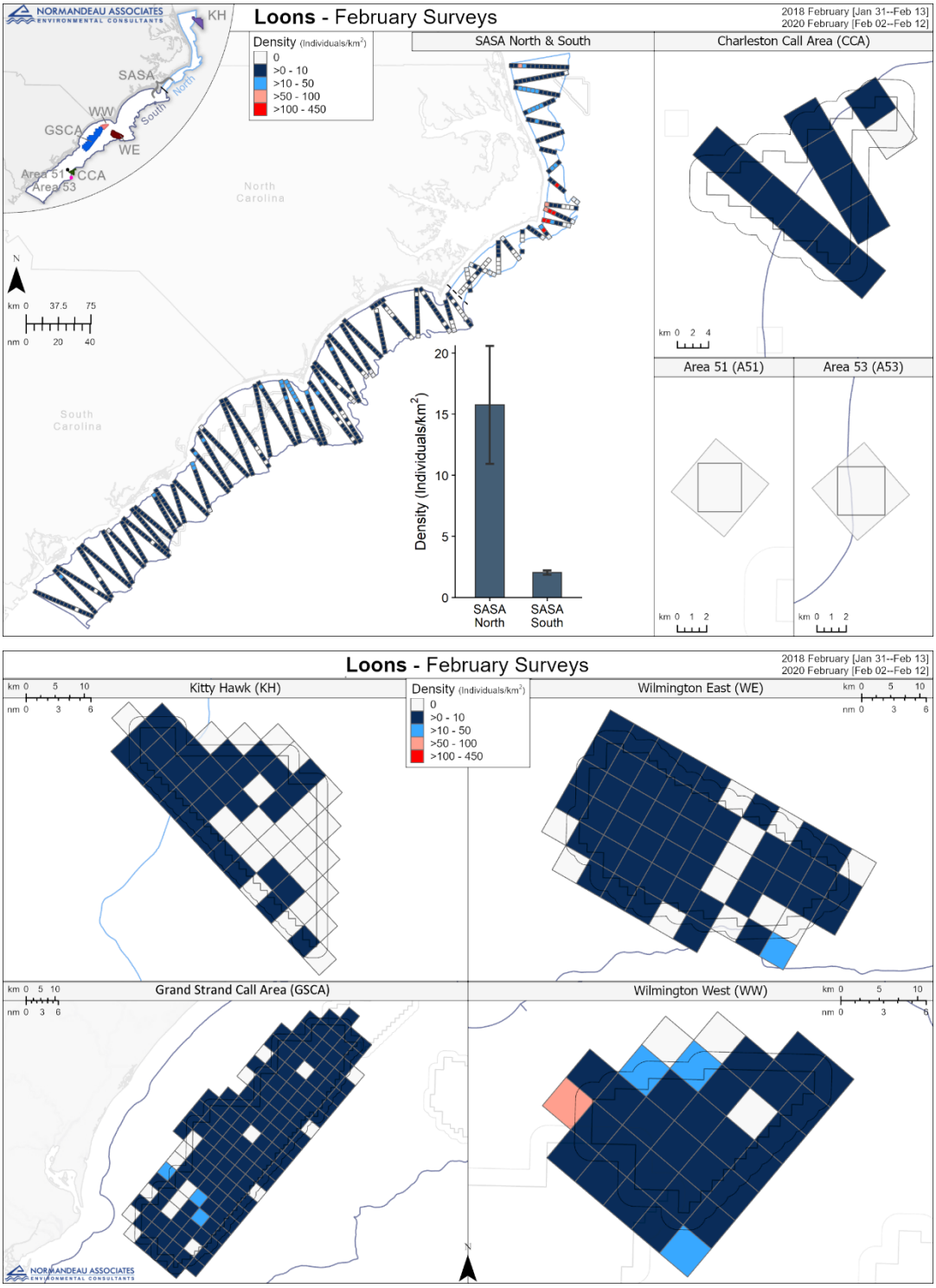


Figure C–45. Spatial distribution of all loon species during the February surveys for all areas

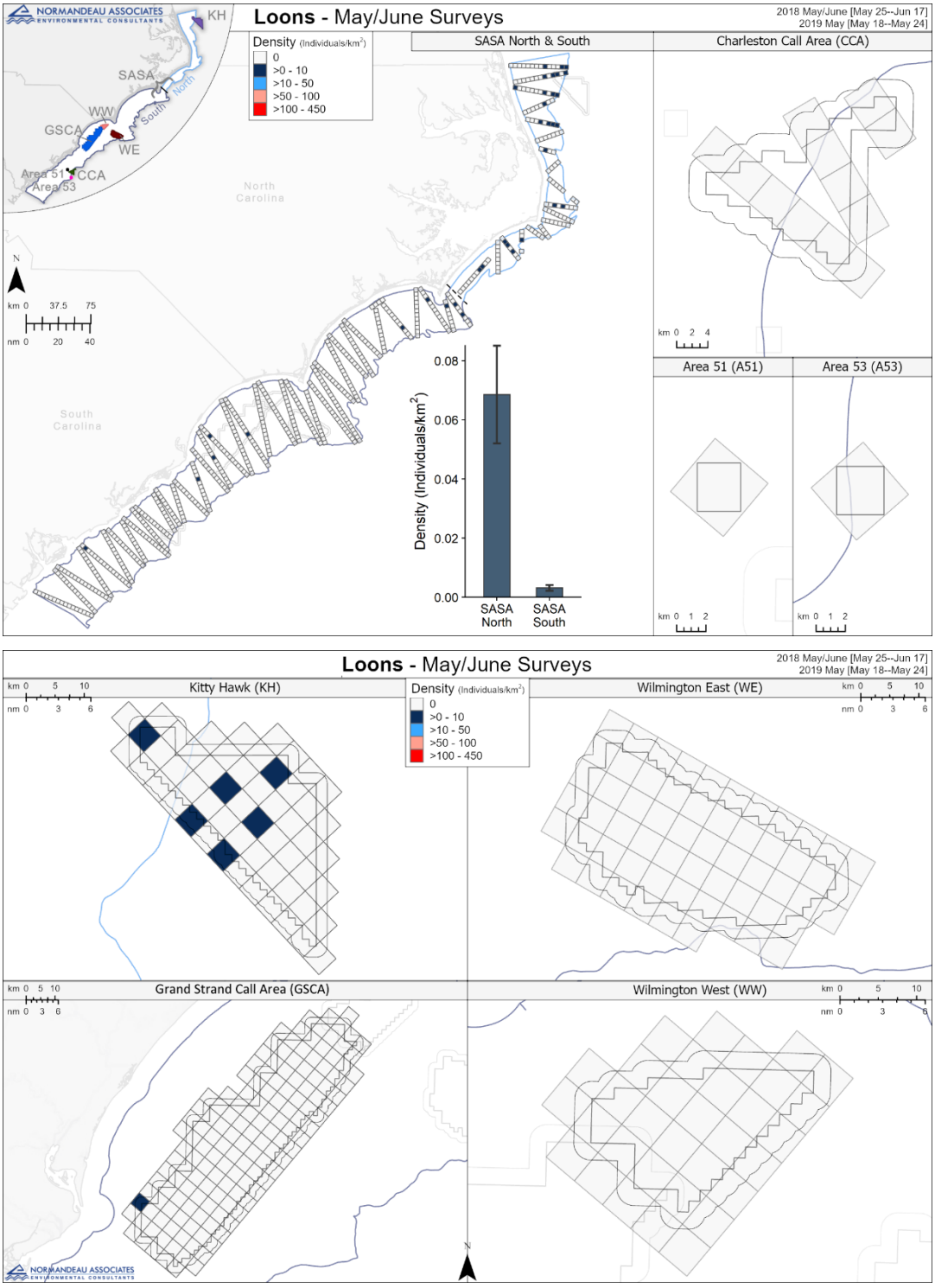


Figure C–46. Spatial distribution of all loon species during the May/June surveys for all areas

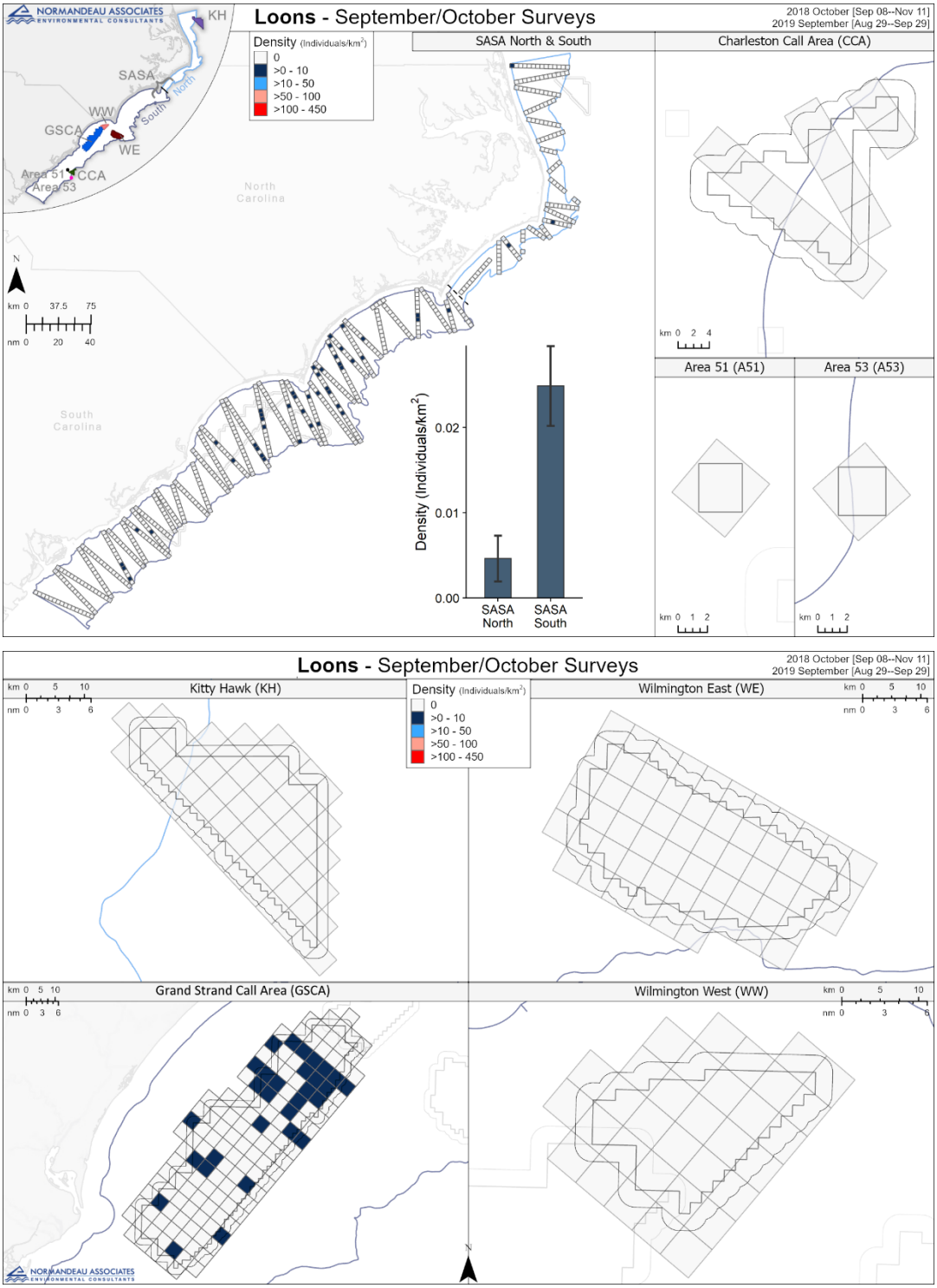


Figure C–47. Spatial distribution of all loon species during the September/October surveys for all areas

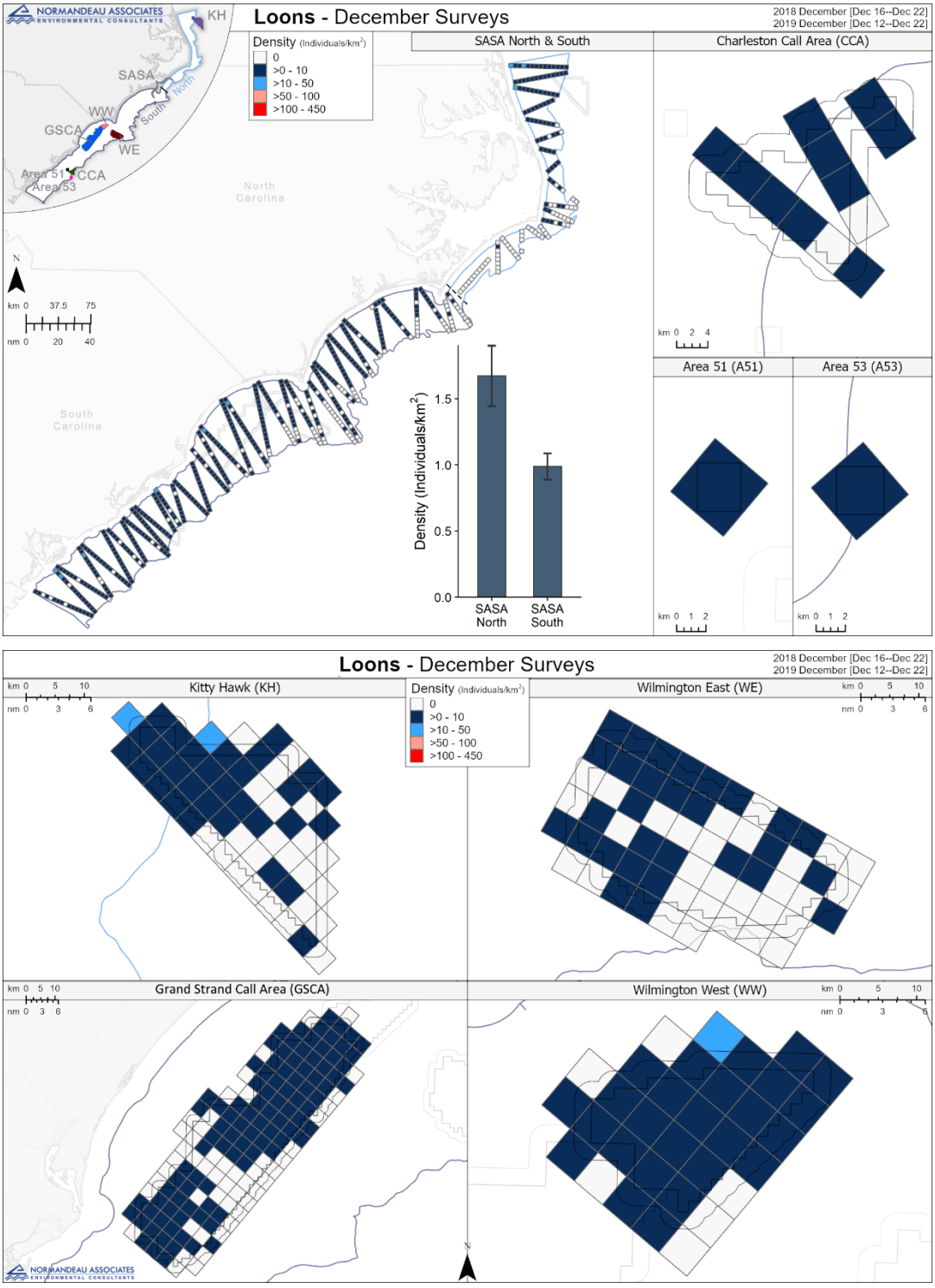


Figure C–48. Spatial distribution of all loon species during the December surveys for all areas

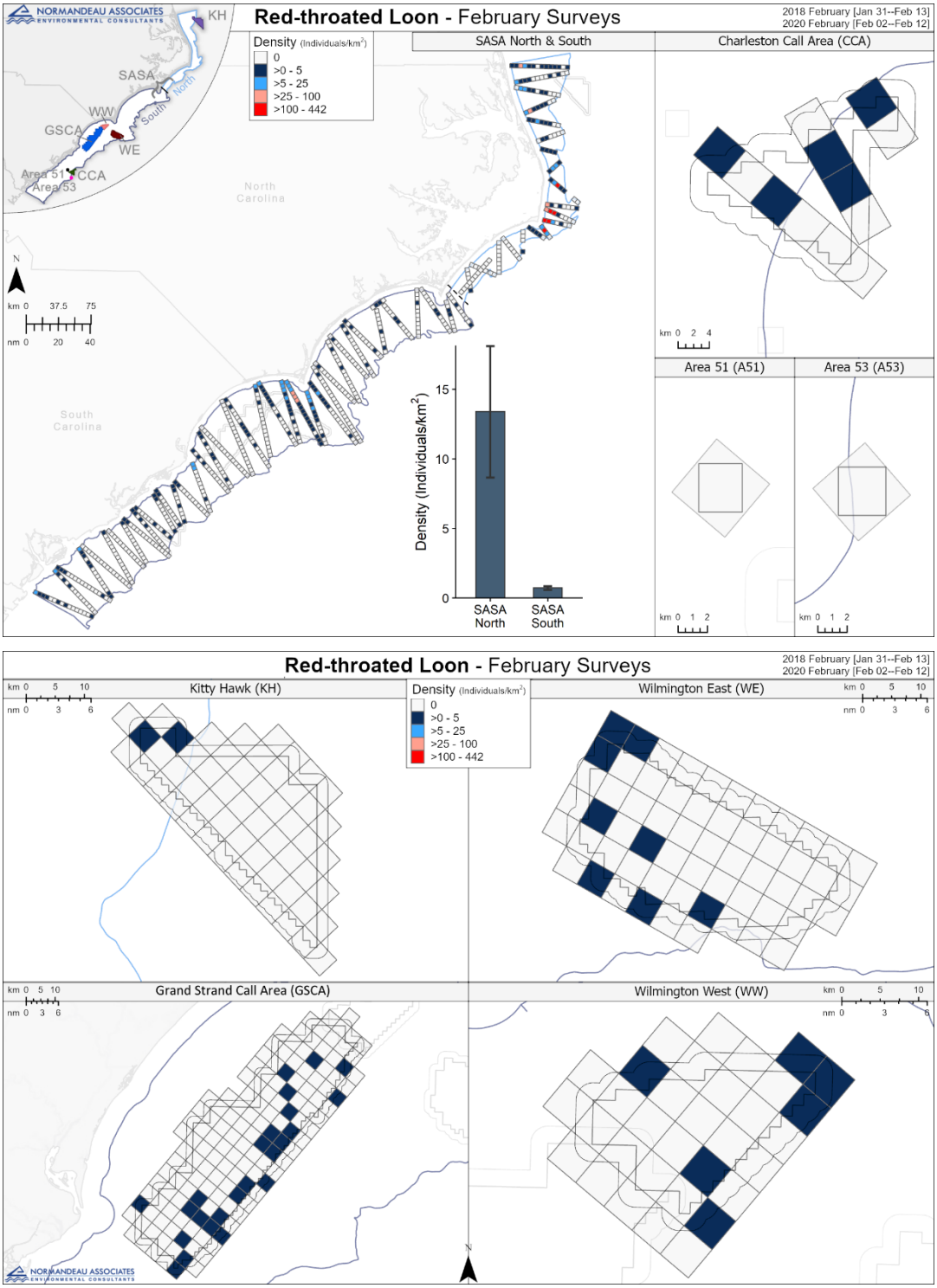


Figure C–49. Spatial distribution of red-throated loons during the February surveys for all areas

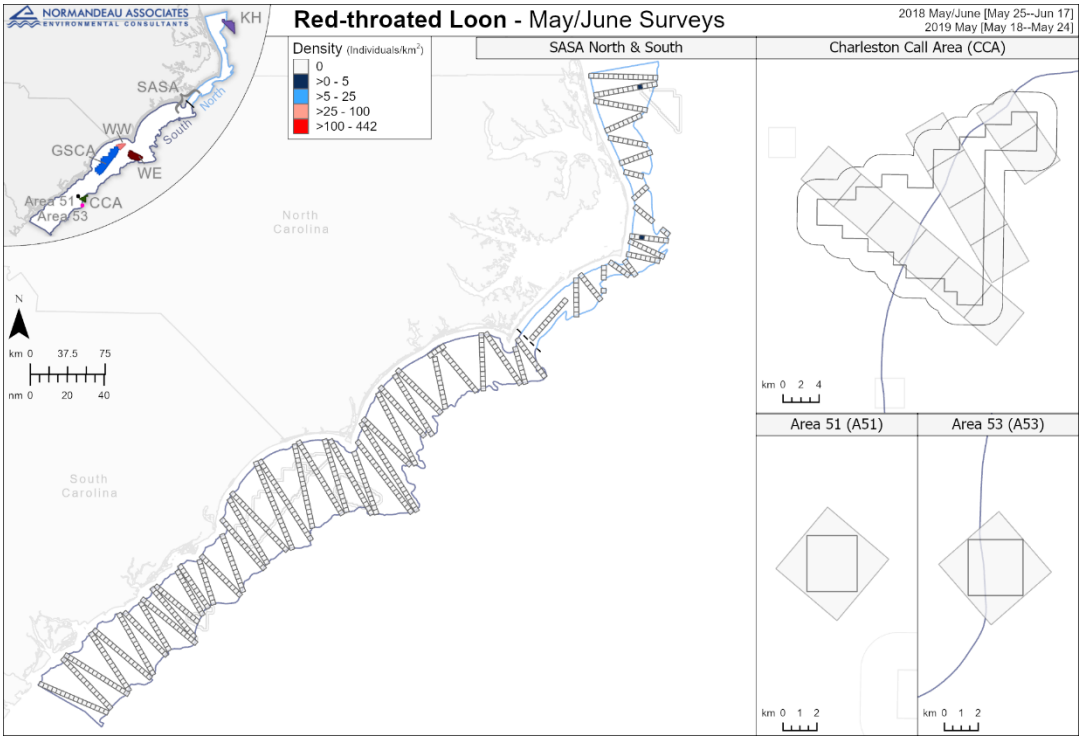


Figure C–50. Spatial distribution of red-throated loons during the May/June surveys for all areas

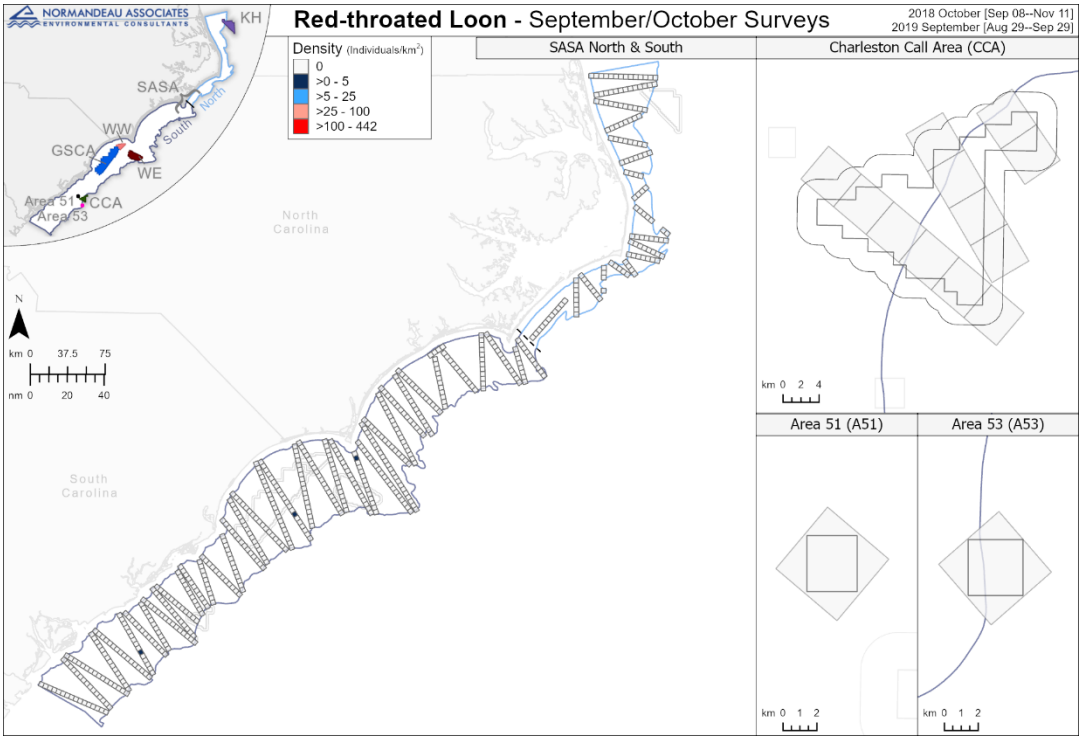


Figure C–51. Spatial distribution of red-throated loons during the September/ October surveys for all areas

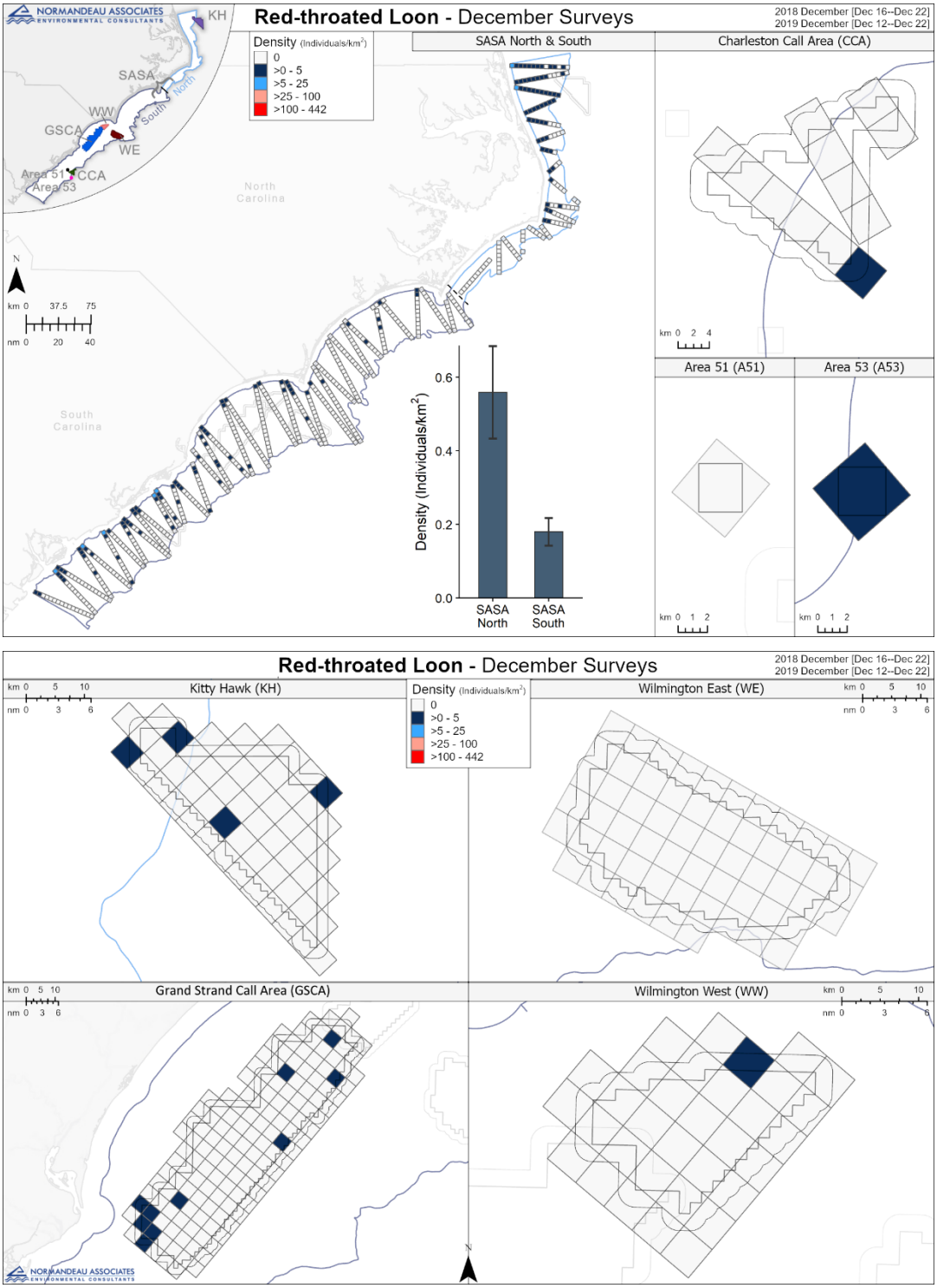


Figure C–52. Spatial distribution of red-throated loons during the December surveys for all areas

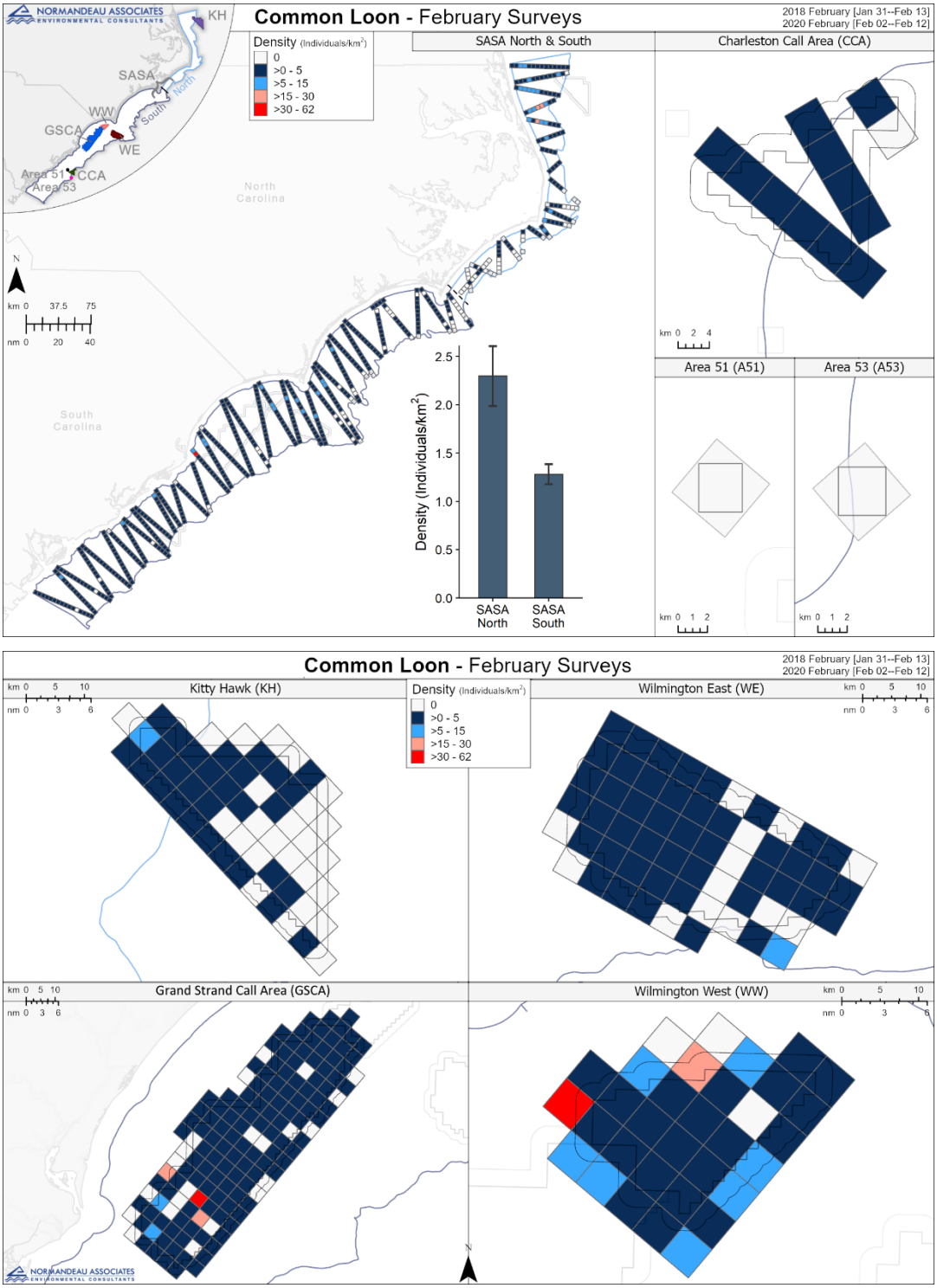


Figure C–53. Spatial distribution of common loons during the February surveys for all areas

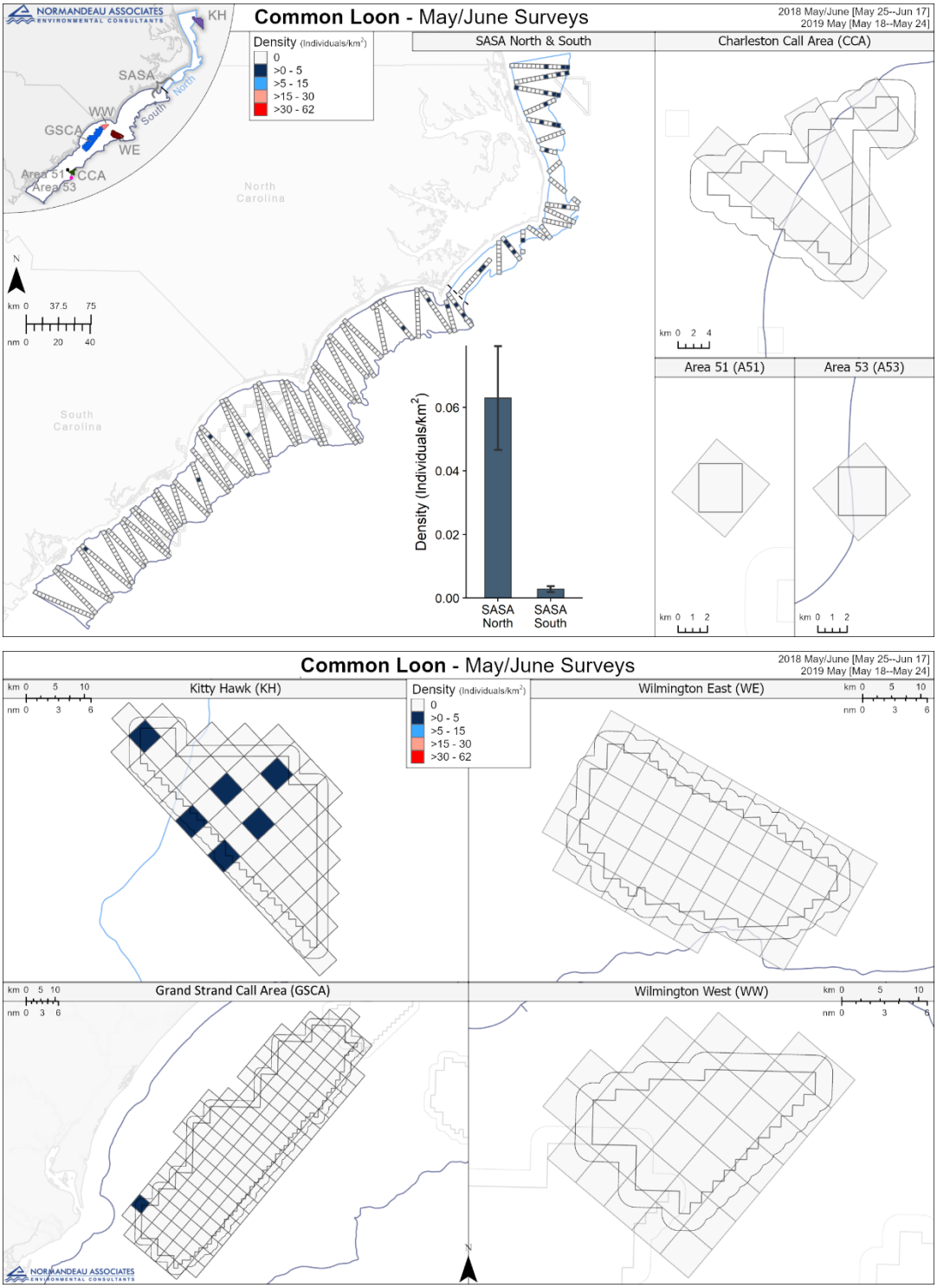


Figure C–54. Spatial distribution of common loons during the May/June surveys for all areas

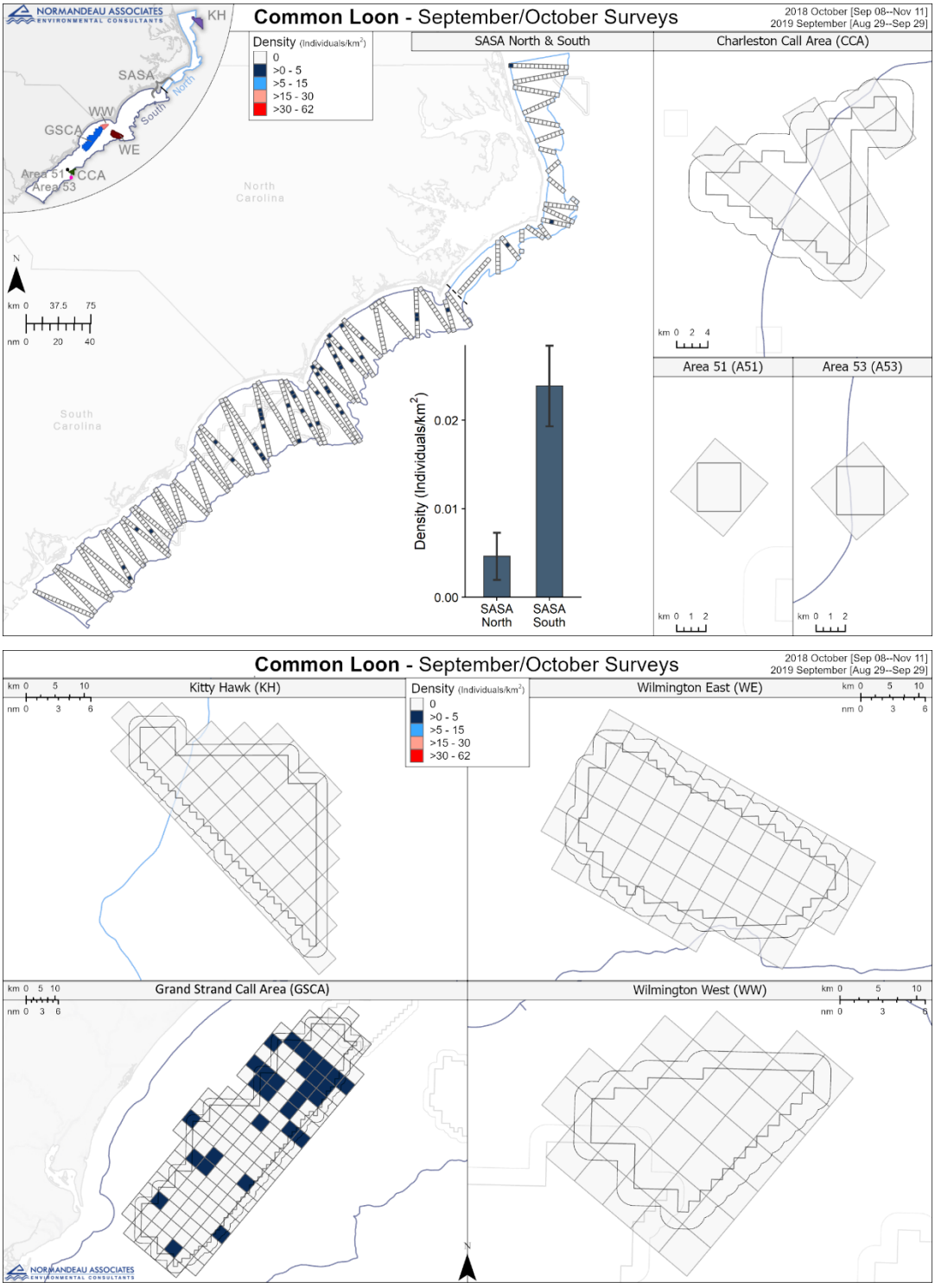


Figure C–55. Spatial distribution of common loons during the September/October surveys for all areas

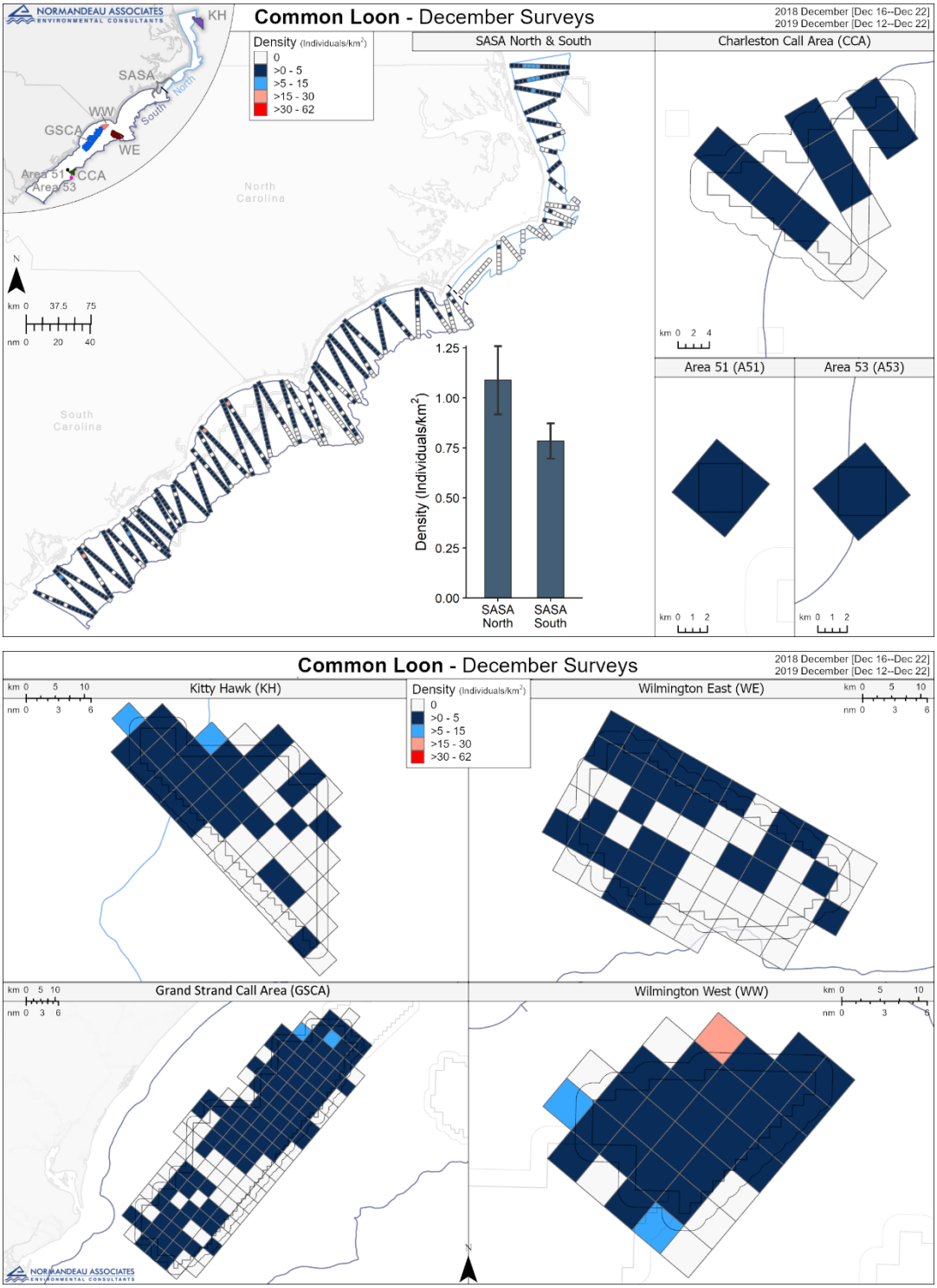


Figure C–56. Spatial distribution of common loons during the December surveys for all areas

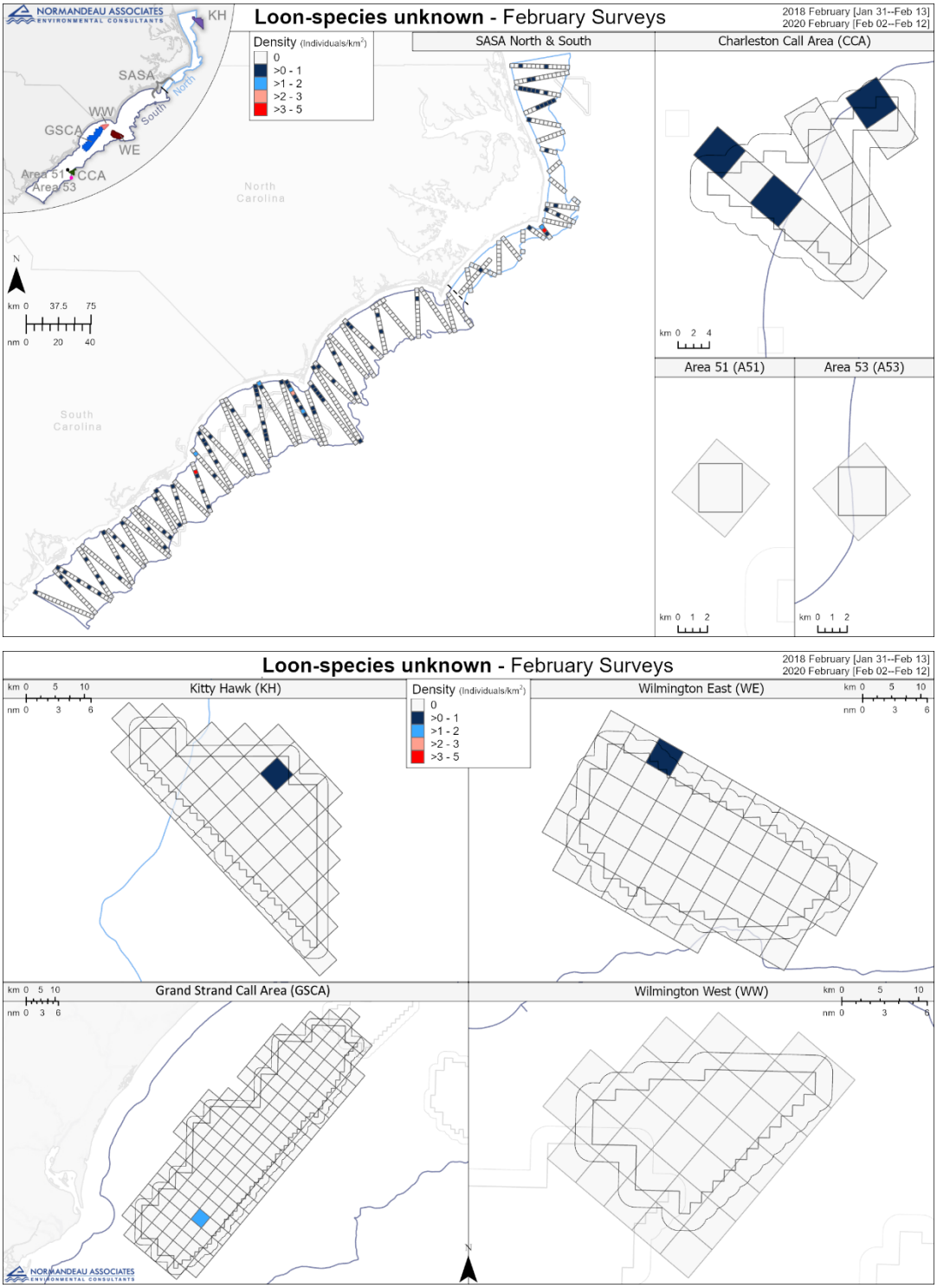


Figure C–57. Spatial distribution of loon-species unknown during the February surveys for all areas

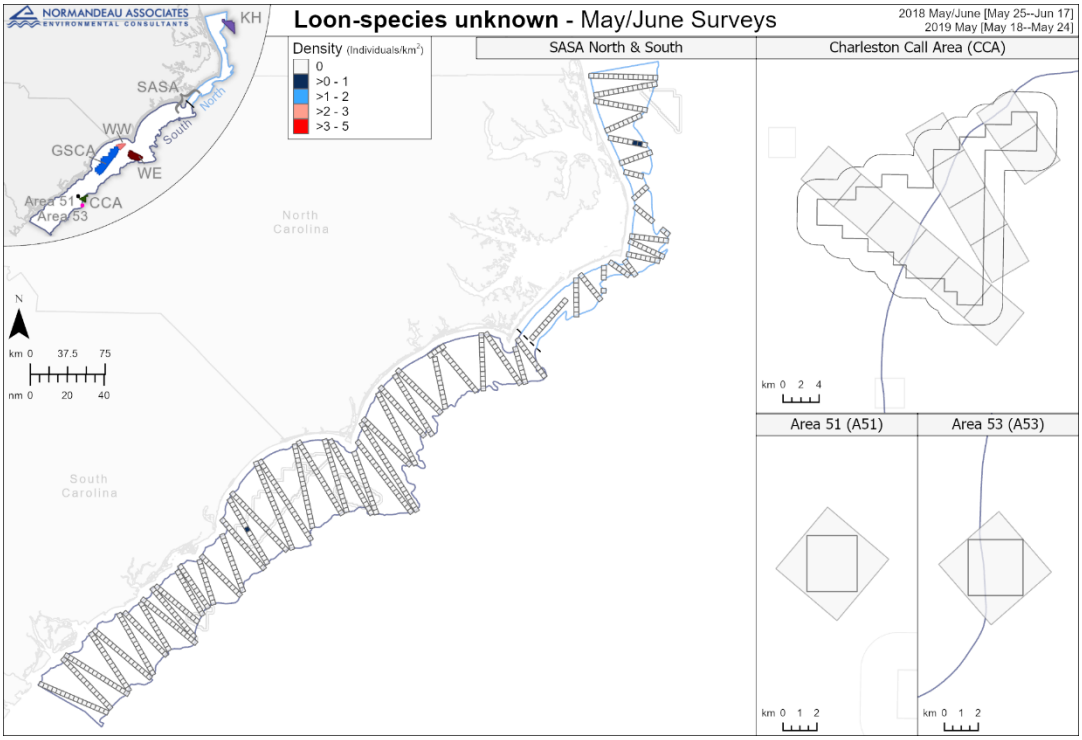


Figure C–58. Spatial distribution of loon-species unknown during the May/June surveys for all areas

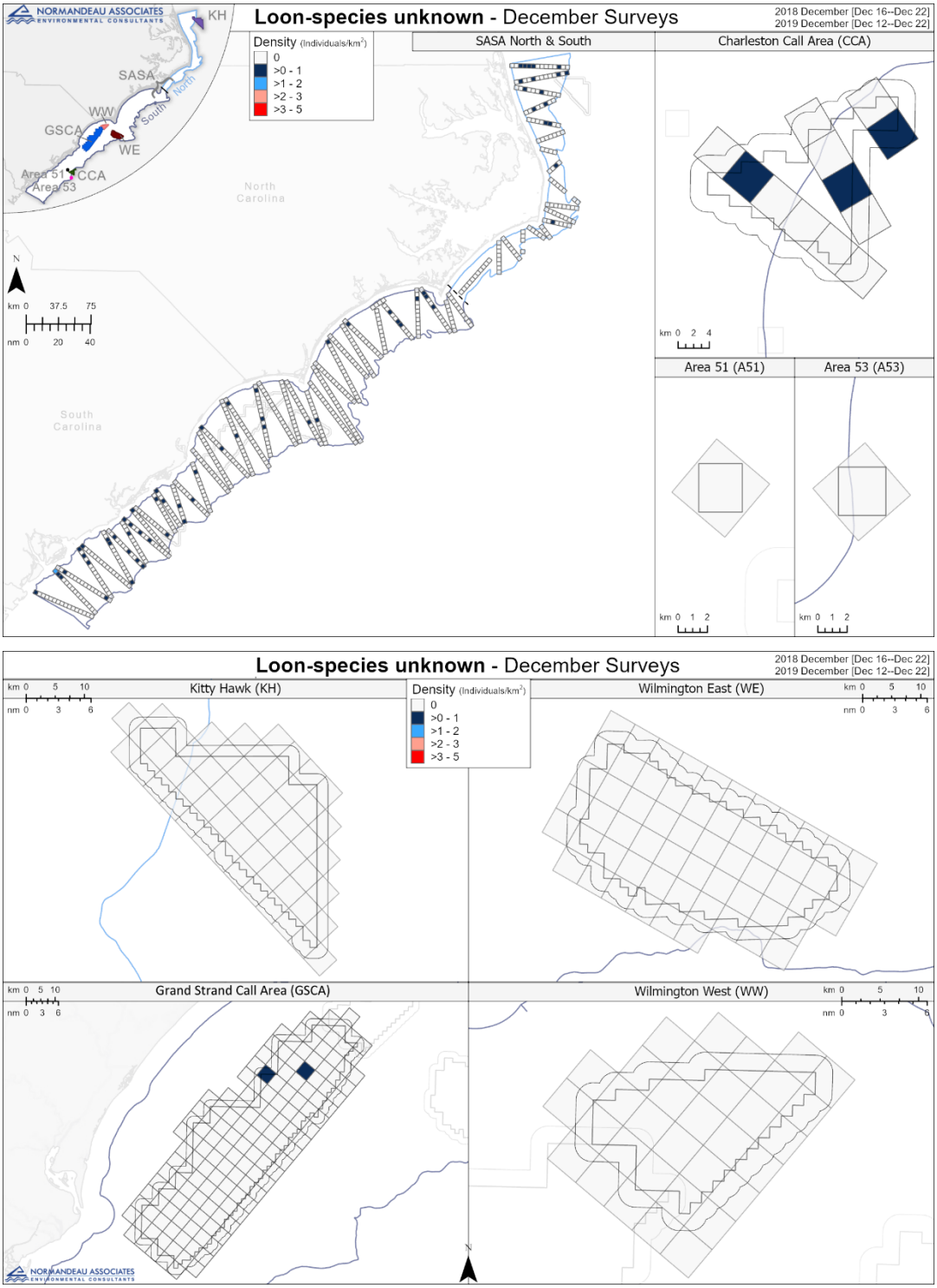


Figure C–59. Spatial distribution of loon-species unknown during the December surveys for all areas

C.4.3 Grebe

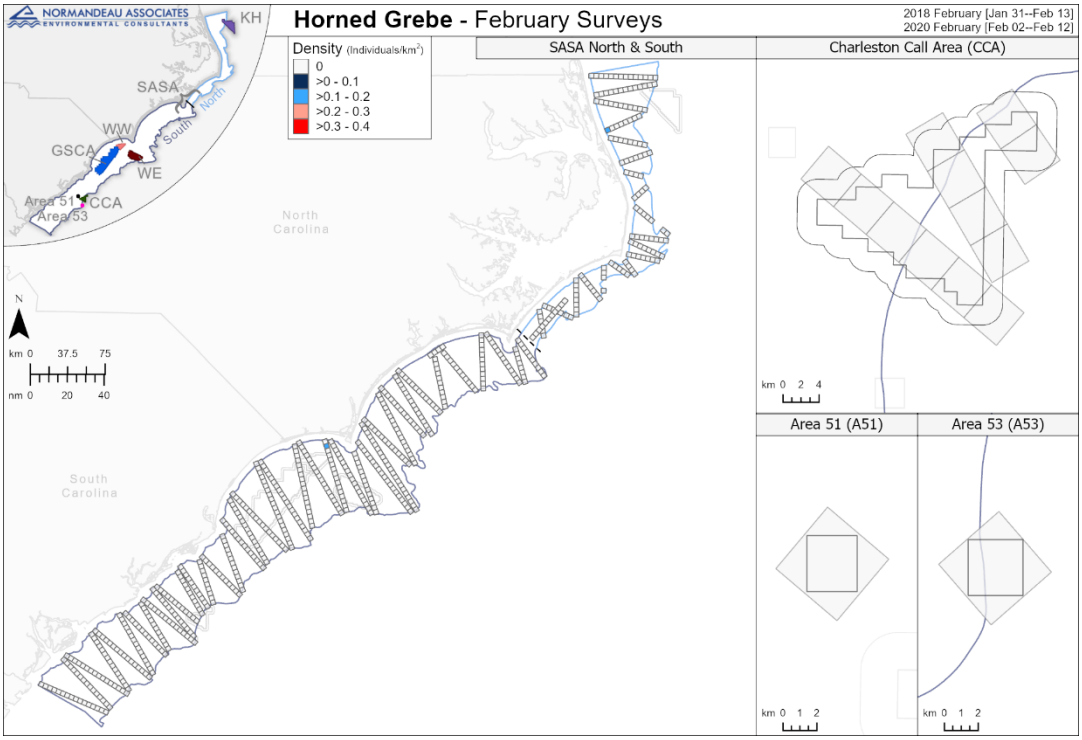


Figure C–60. Spatial distribution of horned grebes during the February surveys for all areas

C.4.4 Fulmar

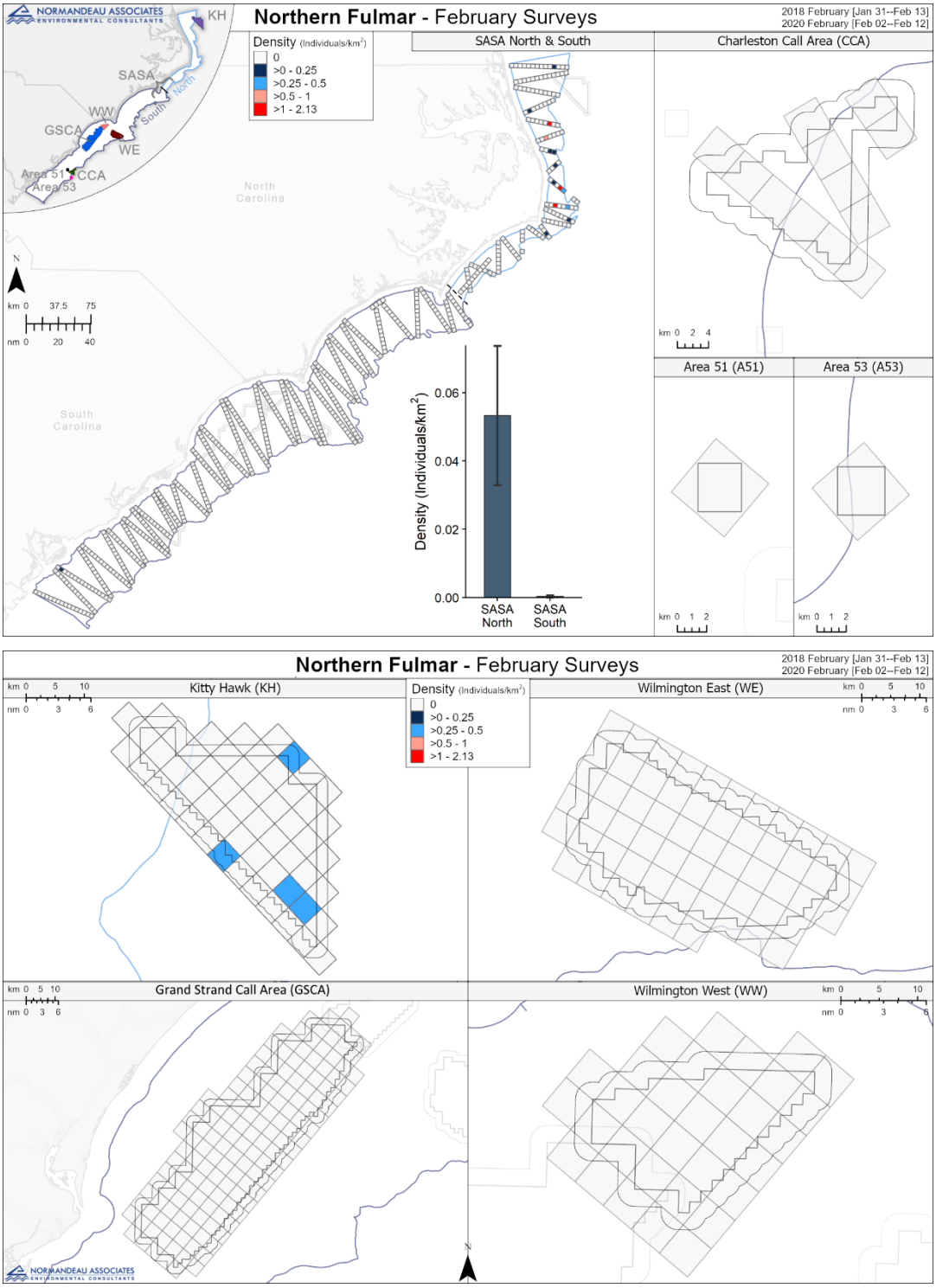


Figure C–61. Spatial distribution of northern fulmars during the February surveys for all areas

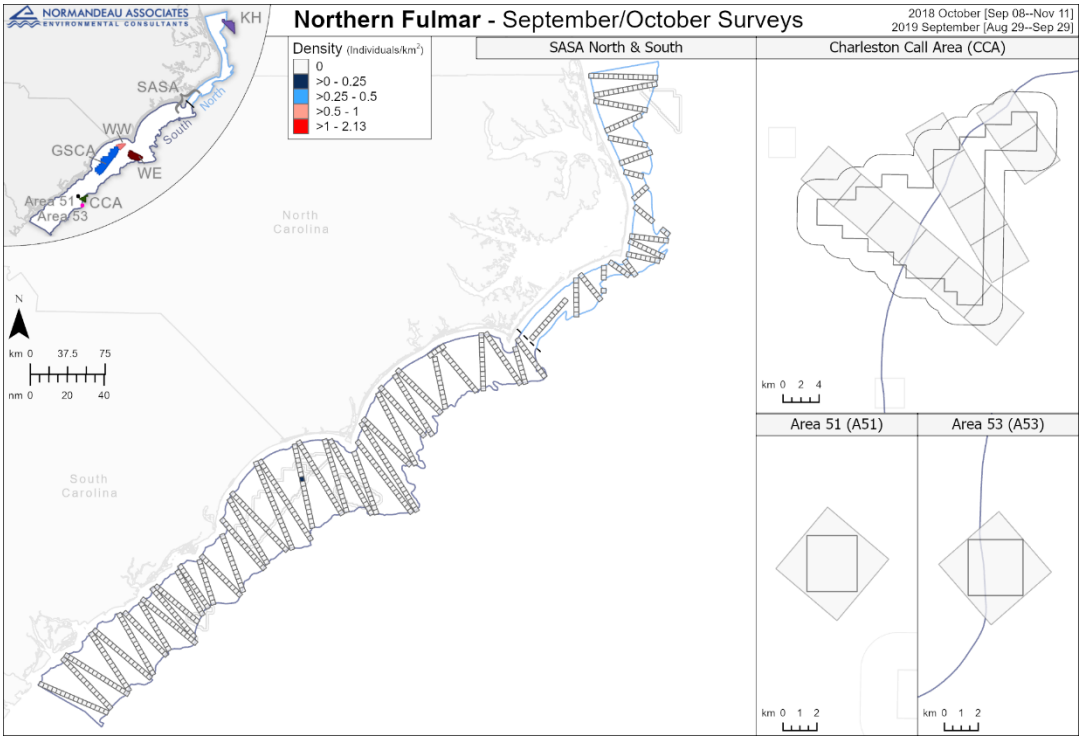


Figure C–62. Spatial distribution of northern fulmars during the September/October surveys for all areas

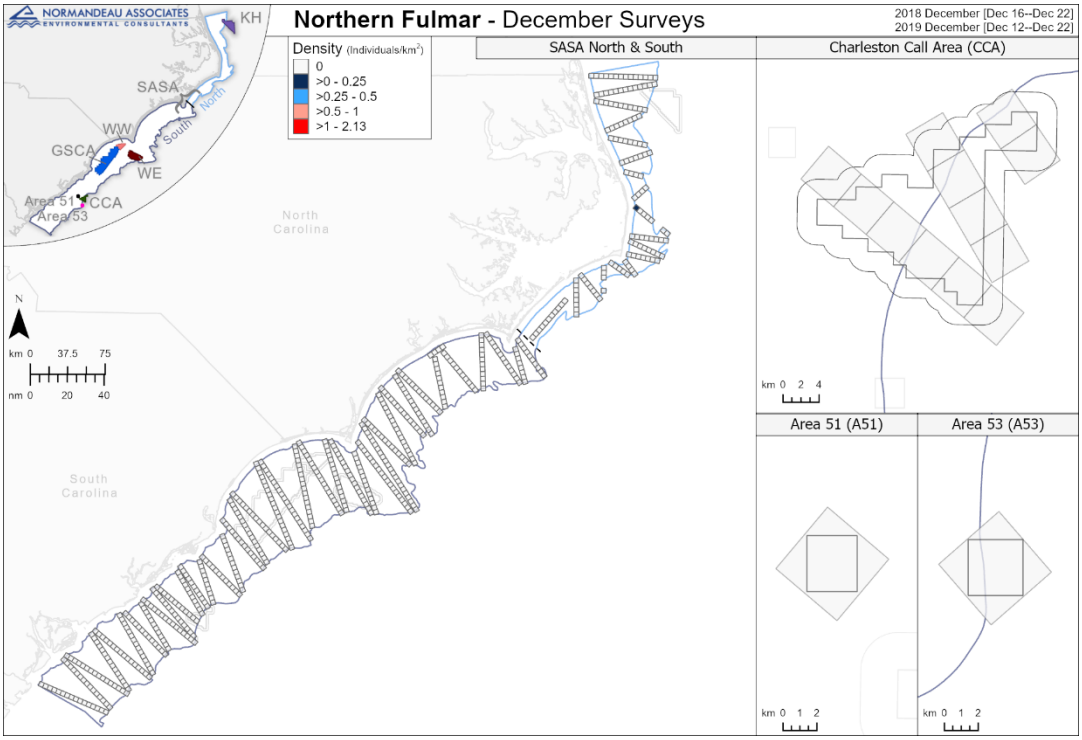


Figure C–63. Spatial distribution of northern fulmars during the December surveys for all areas

C.4.5 Petrel

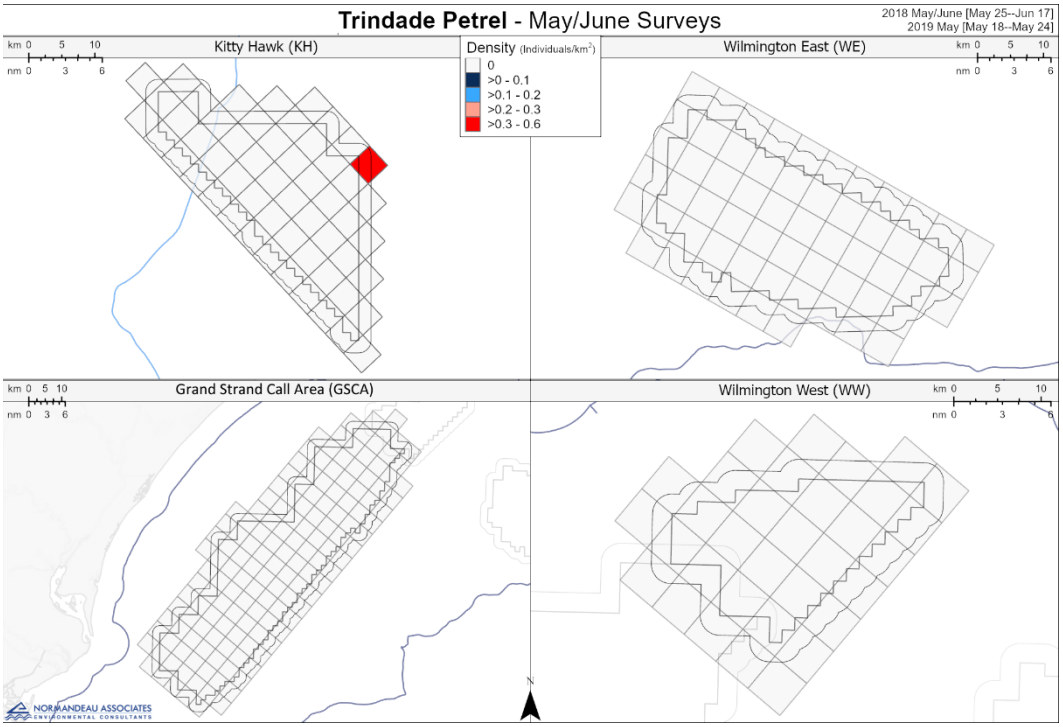


Figure C–64. Spatial distribution of Trindade petrels during the May/June surveys for all areas

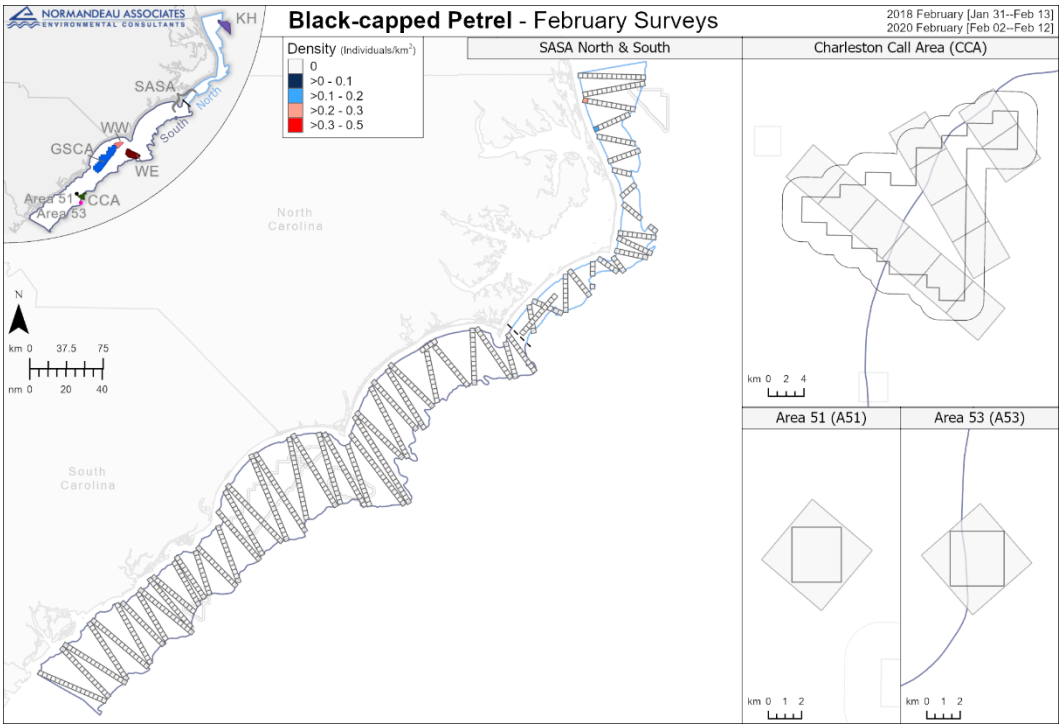


Figure C–65. Spatial distribution of black-capped petrels during the February surveys for all areas

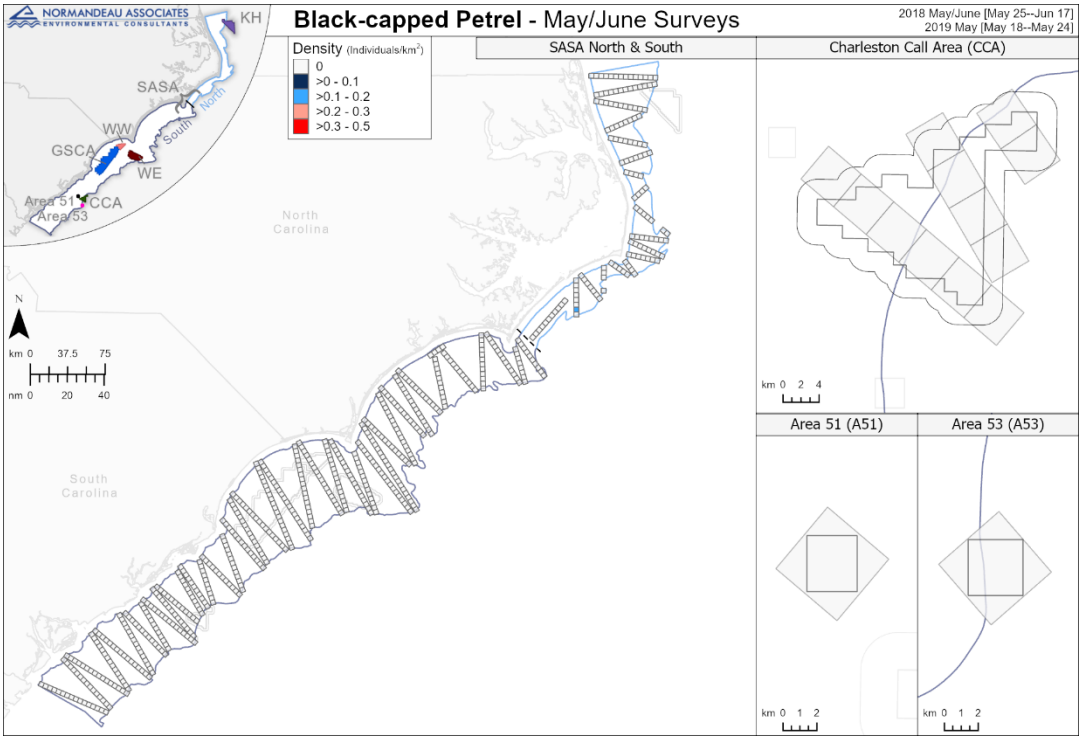


Figure C–66. Spatial distribution of black-capped petrels during the May/June surveys for all areas

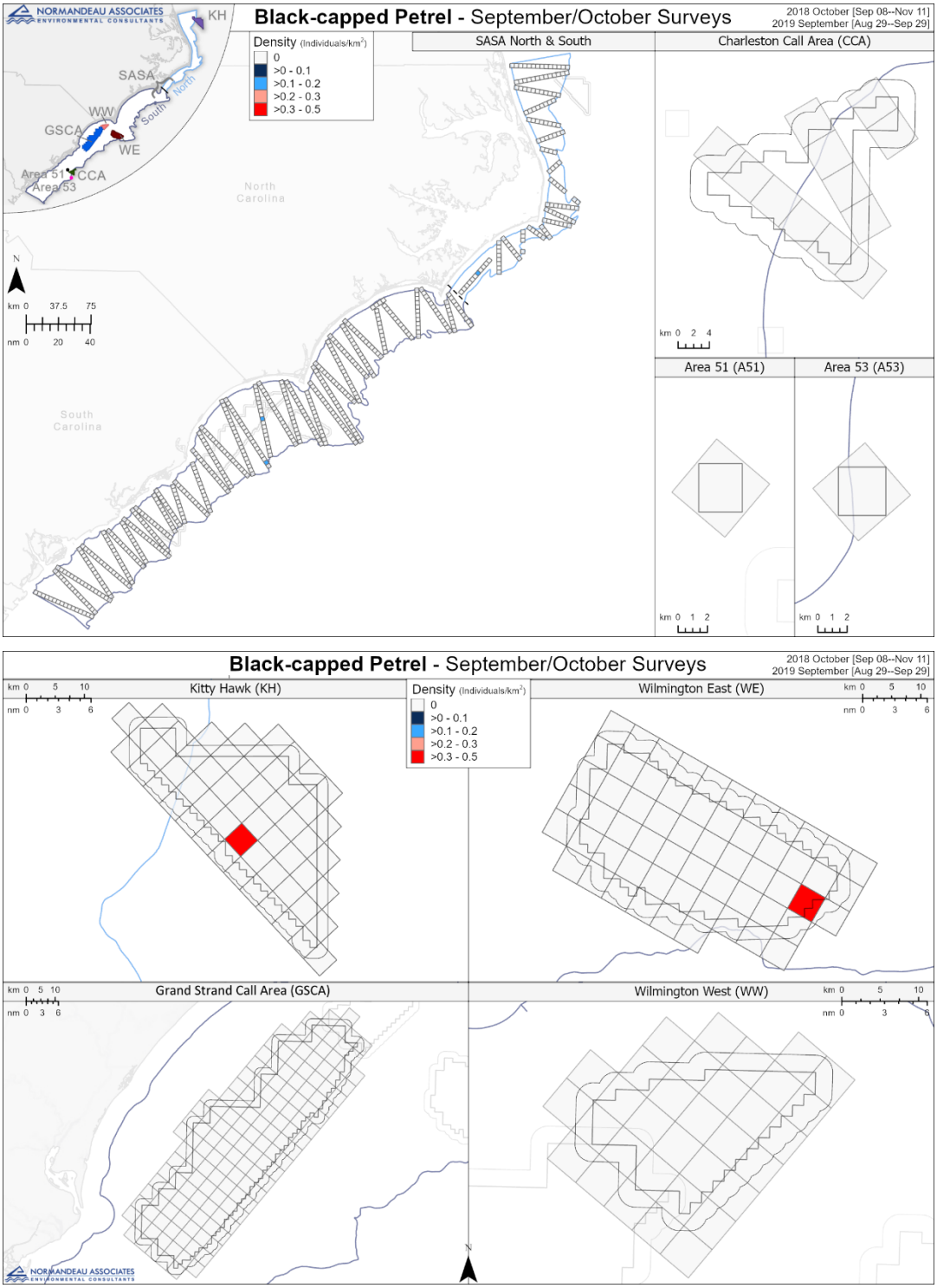


Figure C–67. Spatial distribution of black-capped petrels during the September/ October surveys for all areas

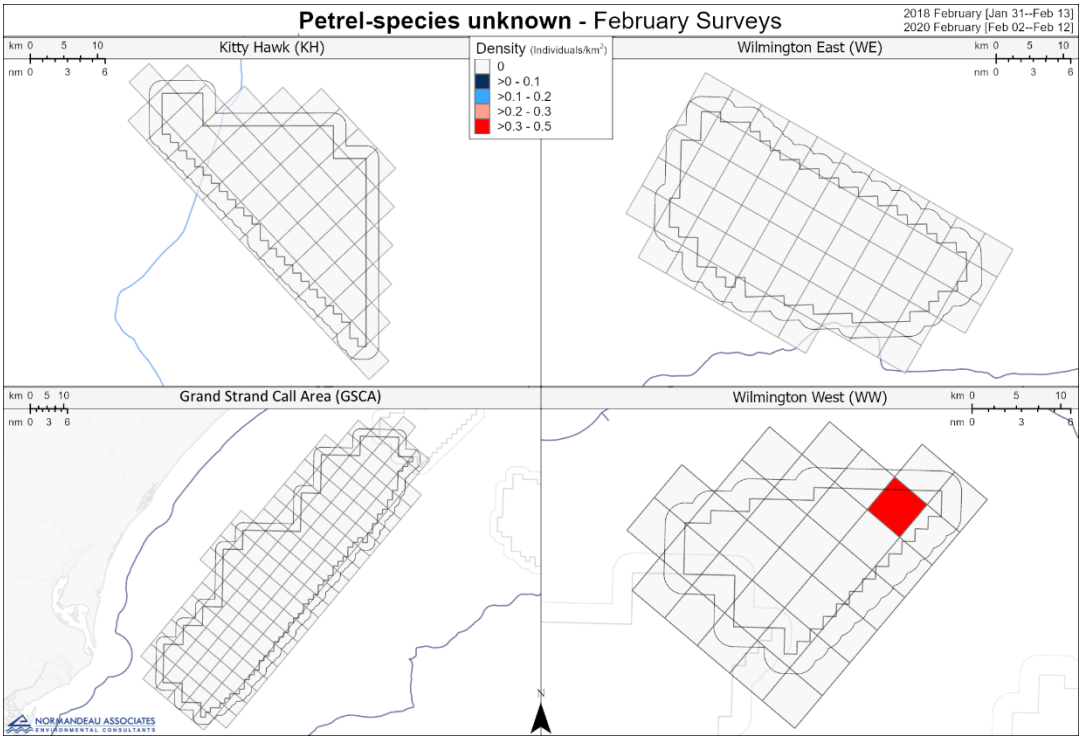


Figure C–68. Spatial distribution of petrel-species unknown during the February surveys for all areas

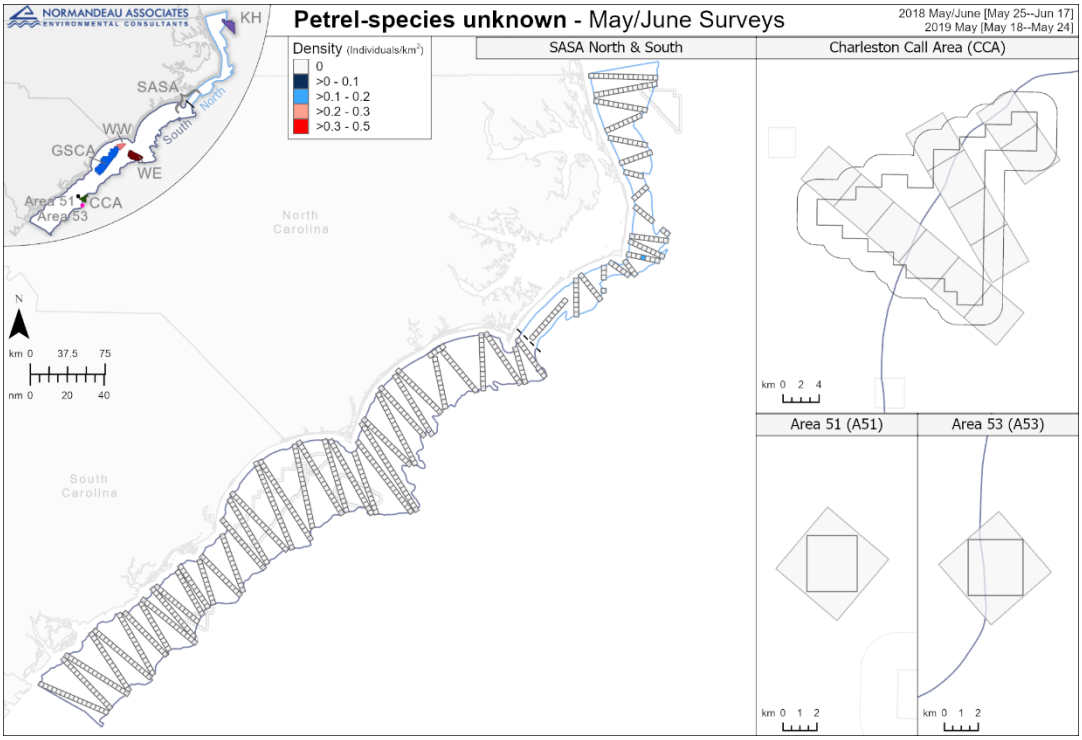


Figure C–69. Spatial distribution of petrel-species unknown during the May/June surveys for all areas

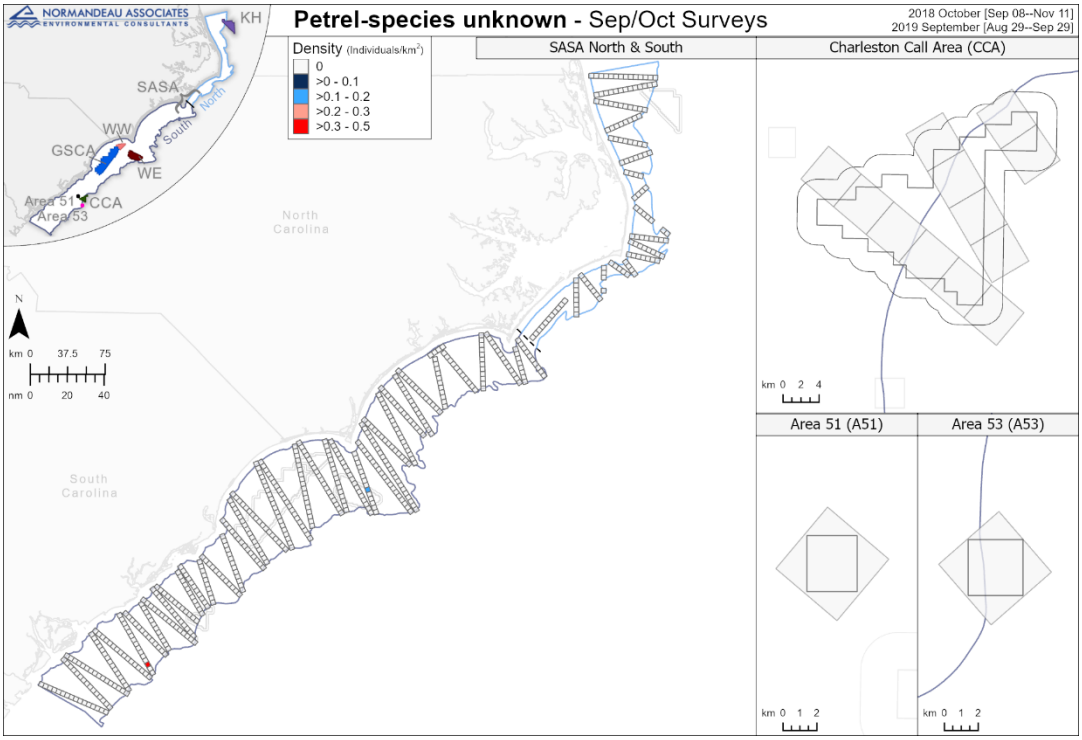


Figure C–70. Spatial distribution of petrel-species unknown during the September/ October surveys for all areas

C.4.6 Shearwater

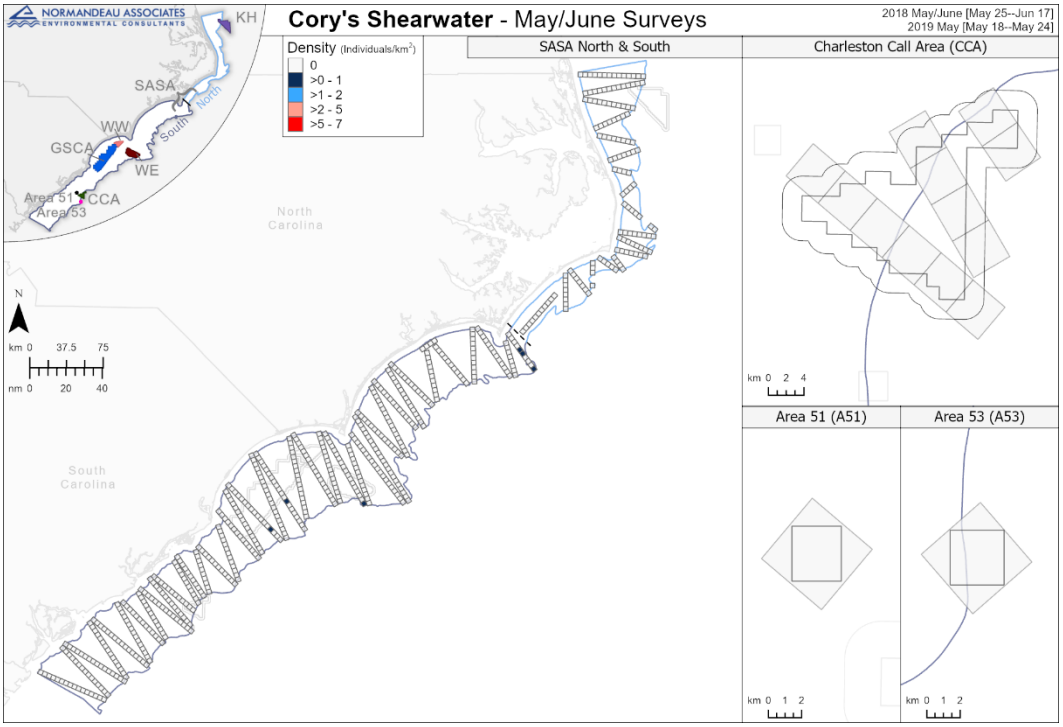


Figure C–71. Spatial distribution of Cory's shearwaters during the May/June surveys for all areas

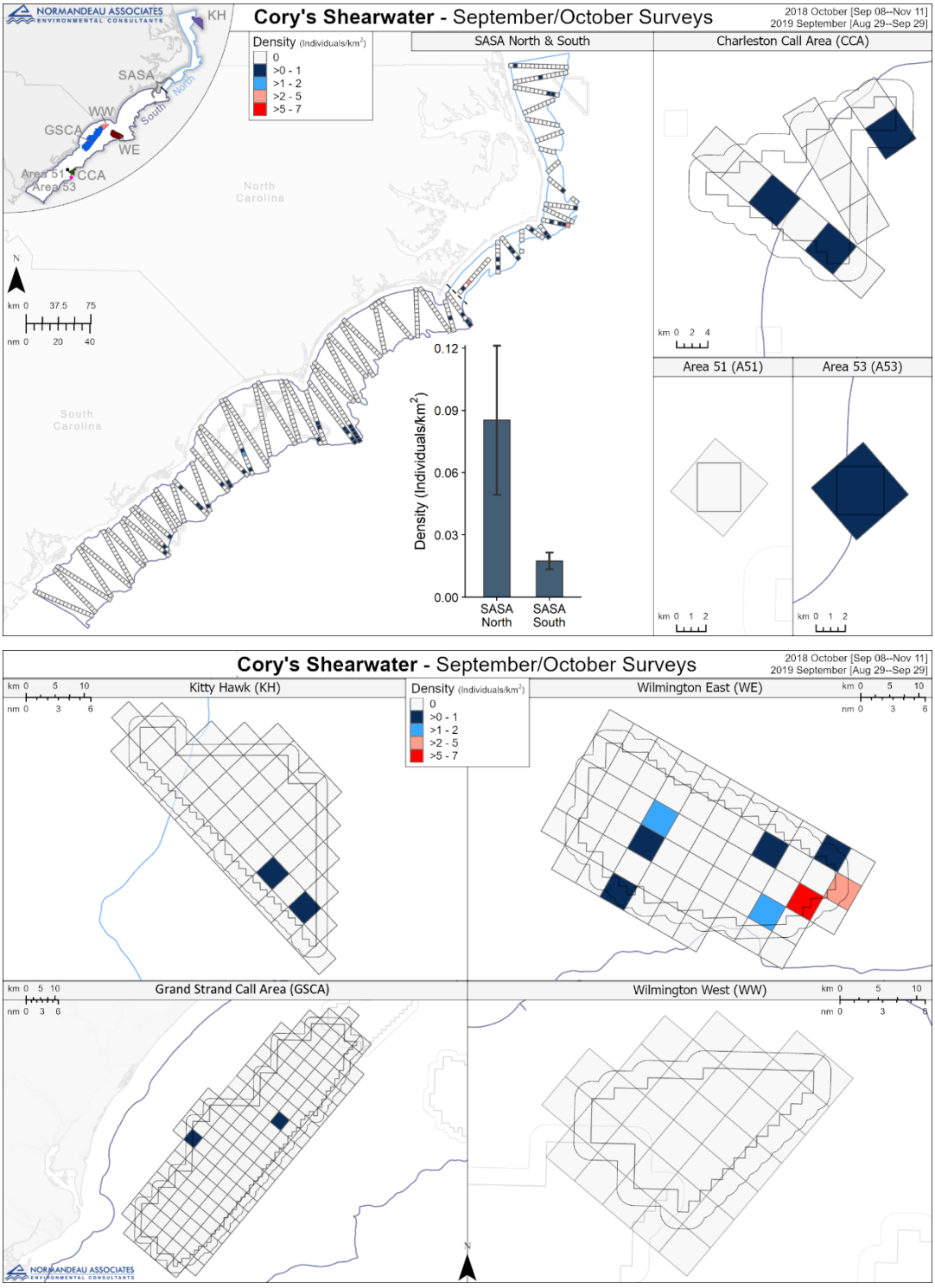


Figure C–72. Spatial distribution of Cory's shearwaters during the September/ October surveys for all areas

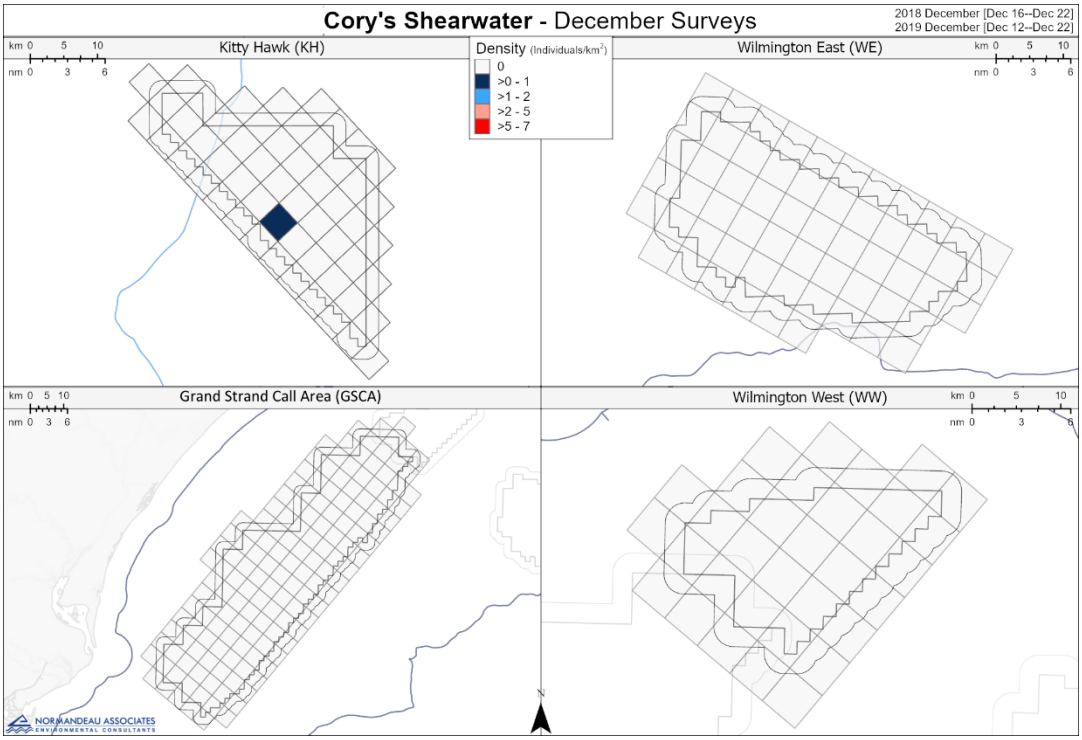


Figure C–73. Spatial distribution of Cory's shearwaters during the December surveys for all areas

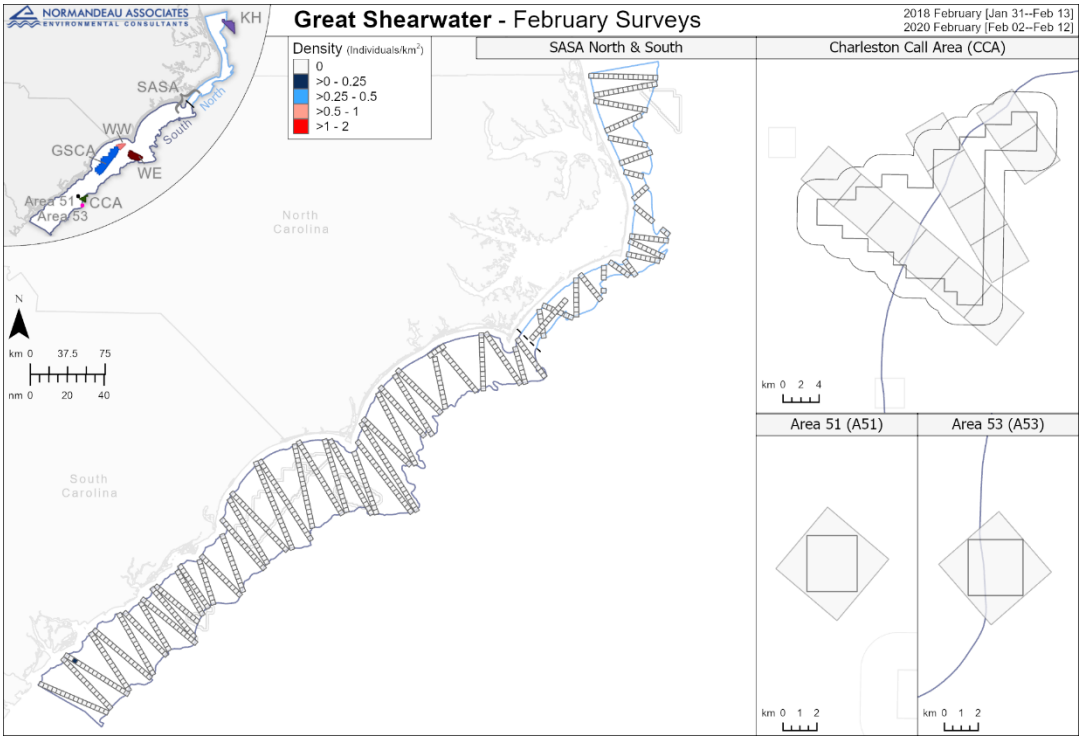


Figure C–74. Spatial distribution of great shearwaters during the February surveys for all areas

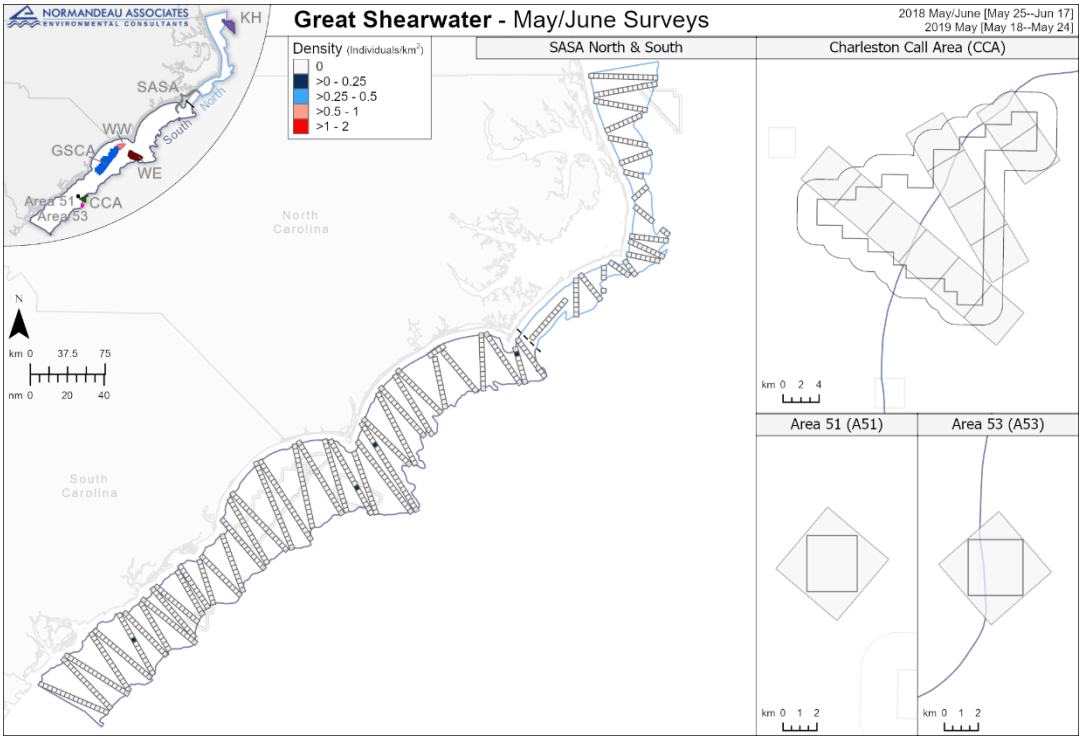


Figure C–75. Spatial distribution of great shearwaters during the May/June surveys for all areas

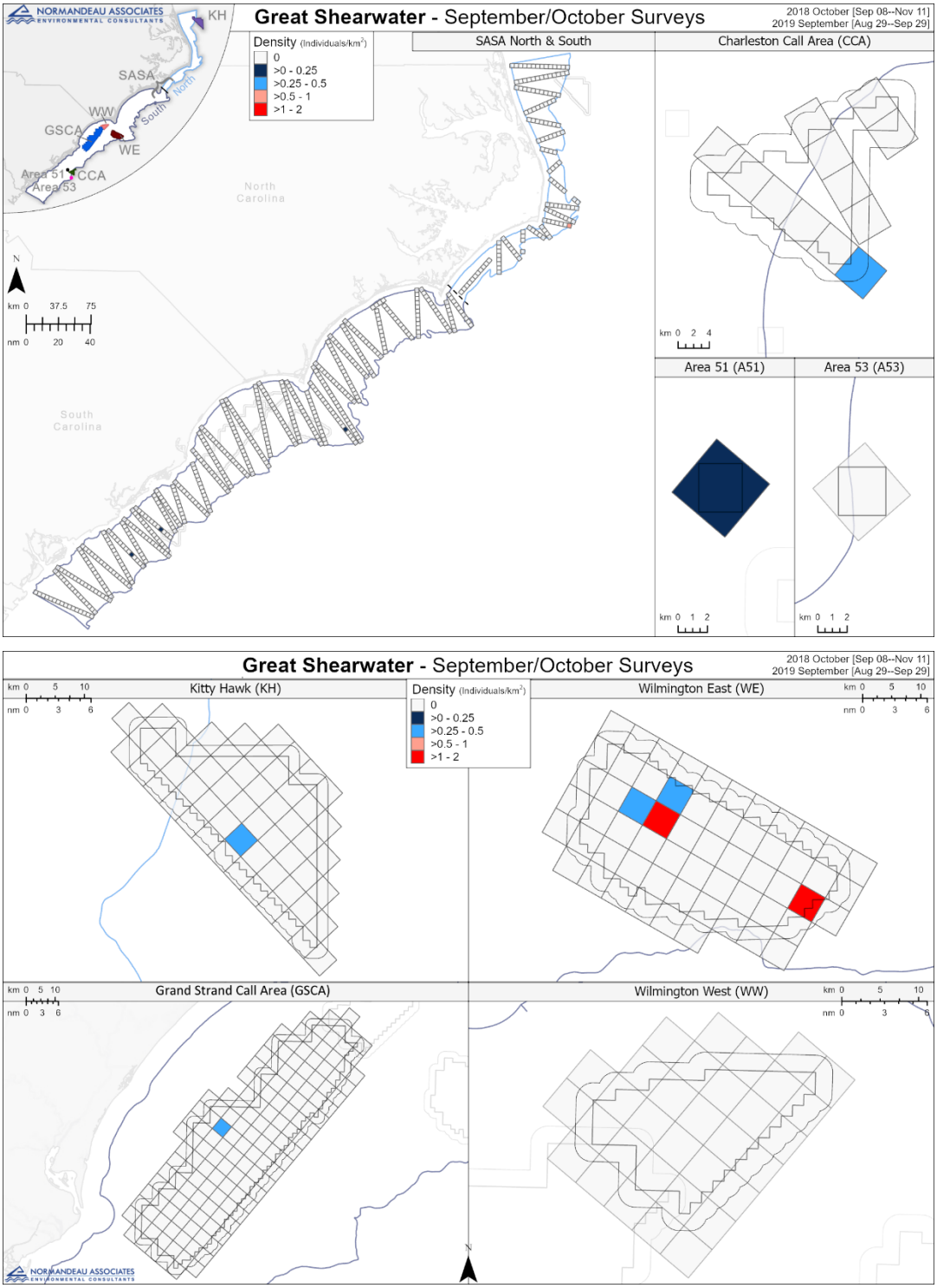


Figure C–76. Spatial distribution of great shearwaters during the September/ October surveys for all areas

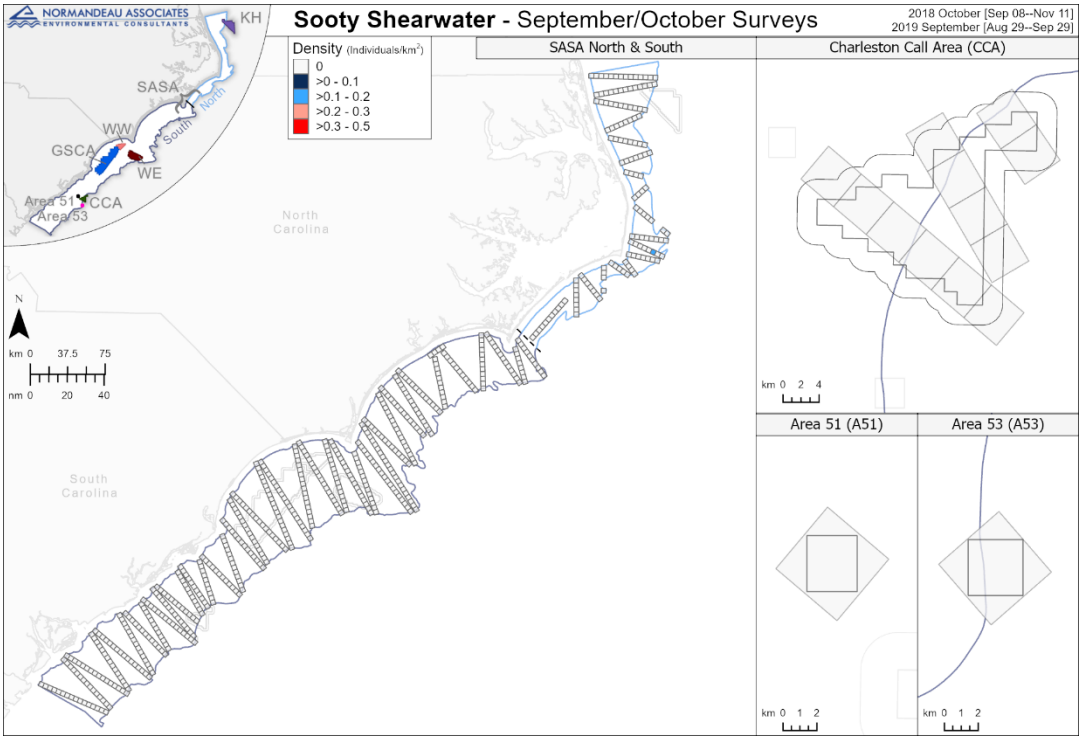


Figure C–77. Spatial distribution of sooty shearwaters during the September/ October surveys for all areas

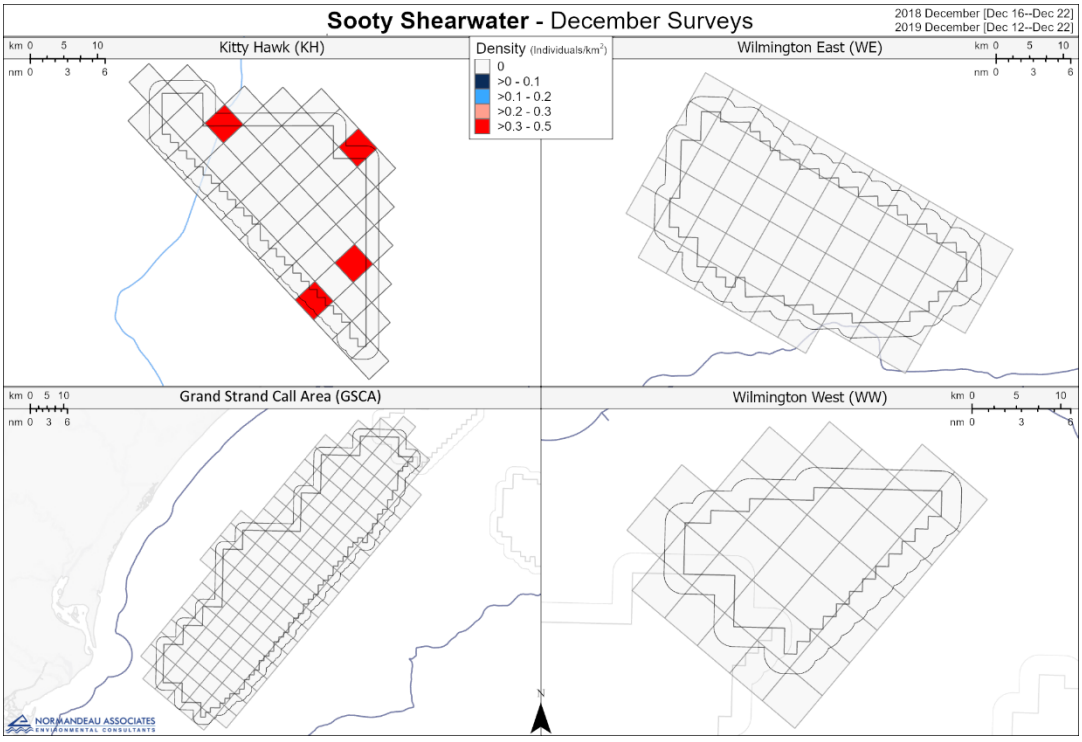


Figure C–78. Spatial distribution of sooty shearwaters during the December surveys for all areas

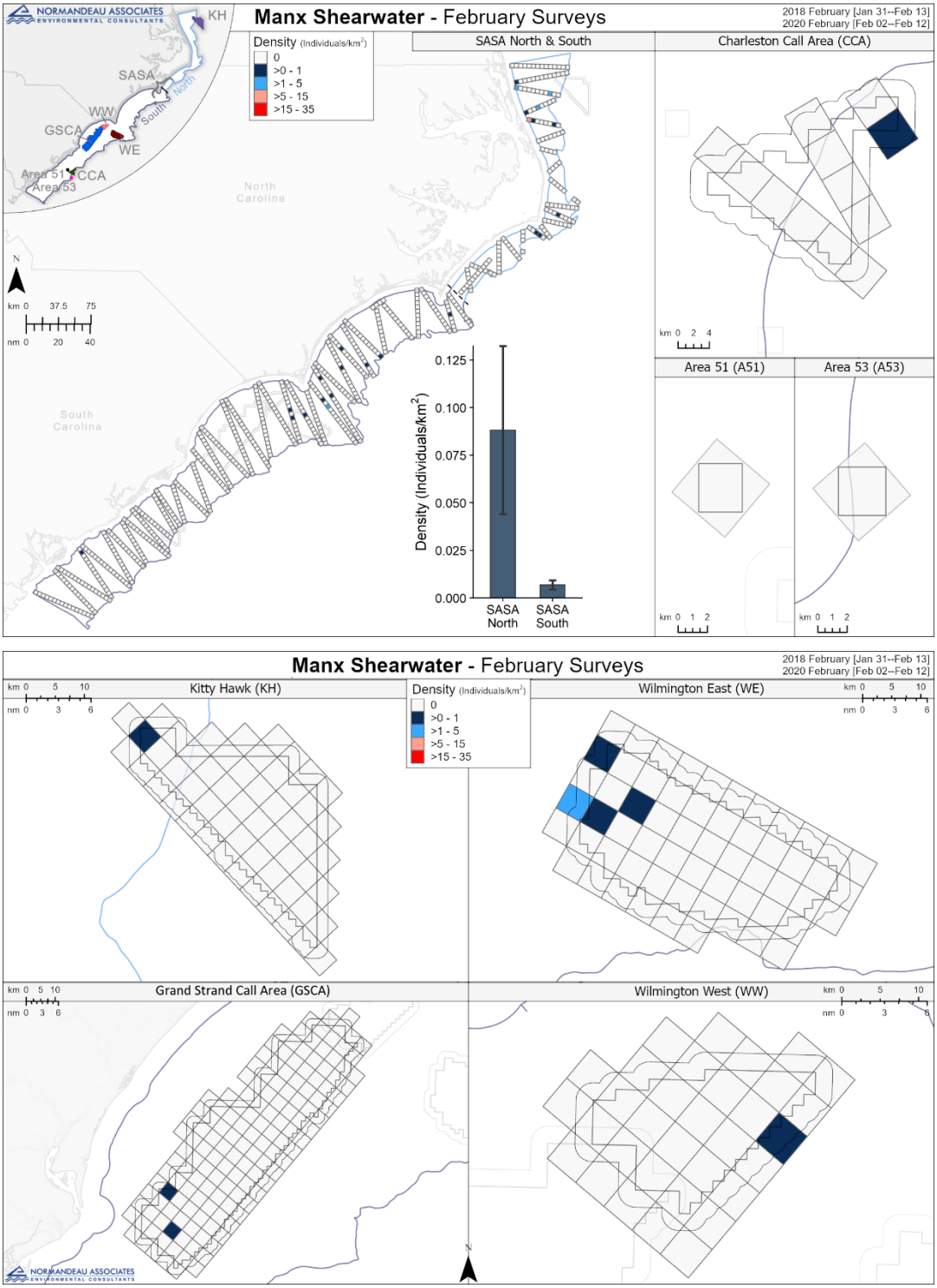


Figure C–79. Spatial distribution of Manx shearwaters during the February surveys for all areas

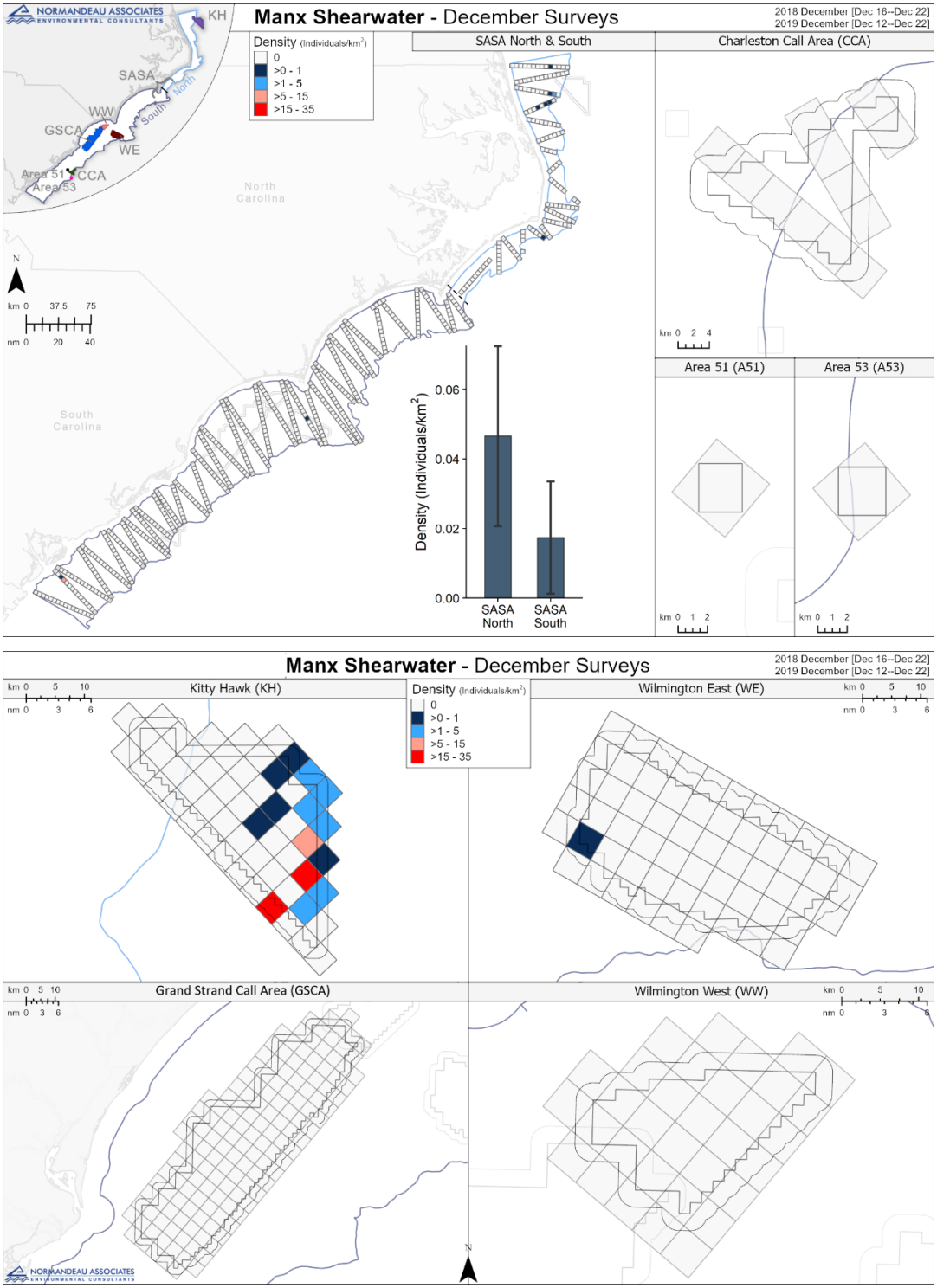


Figure C–80. Spatial distribution of Manx shearwaters during the December surveys for all areas

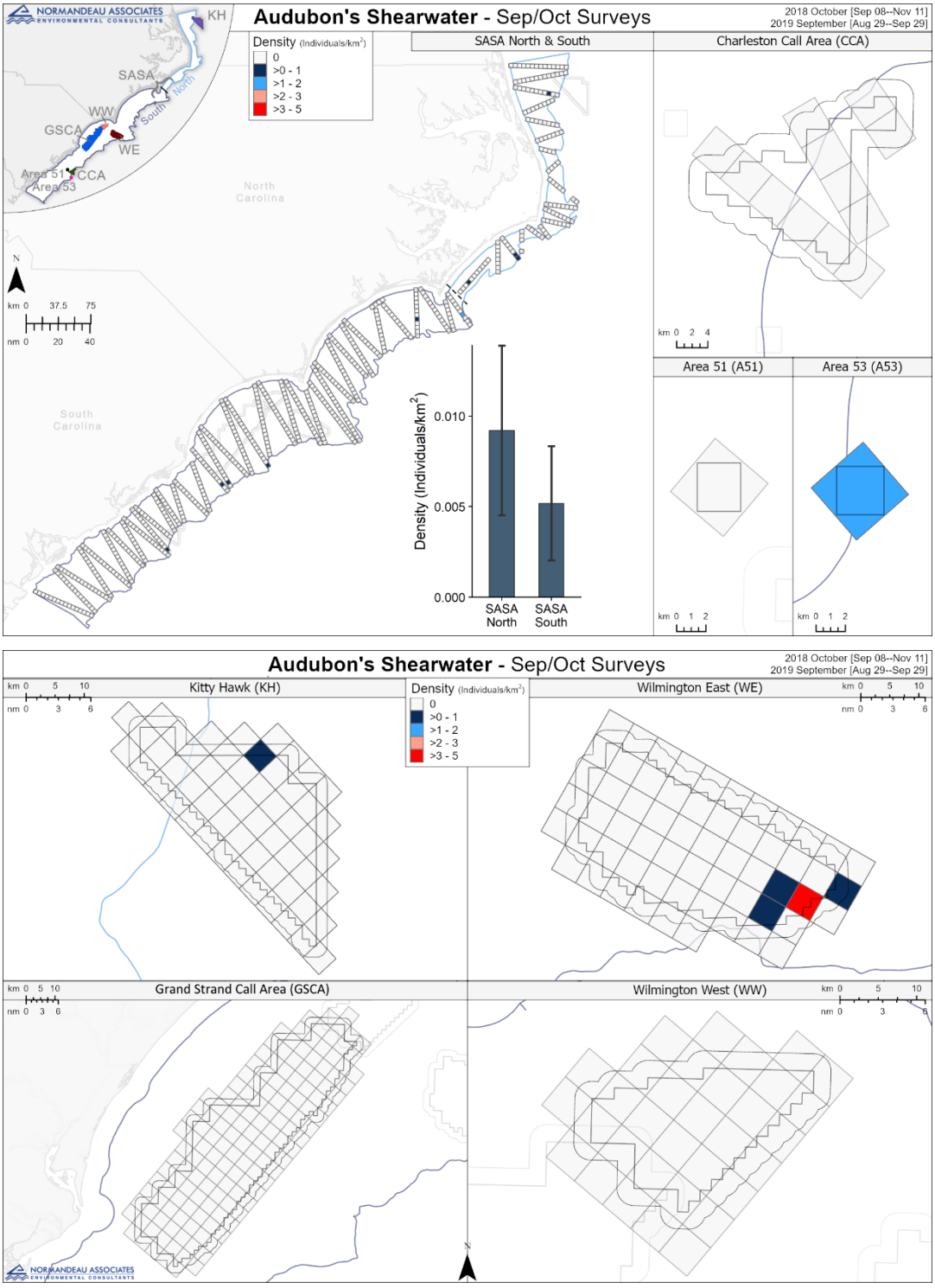


Figure C–81. Spatial distribution of Audubon's shearwaters during the September/ October surveys for all areas

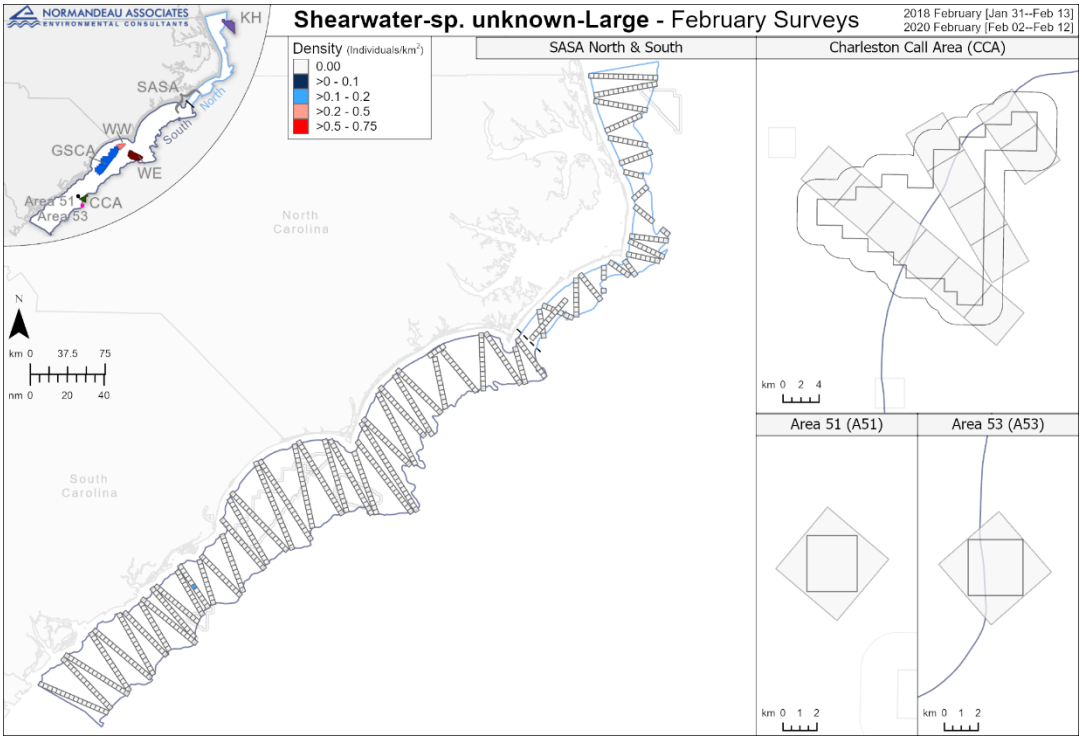


Figure C–82. Spatial distribution of shearwater-species unknown-large during the February surveys for all areas

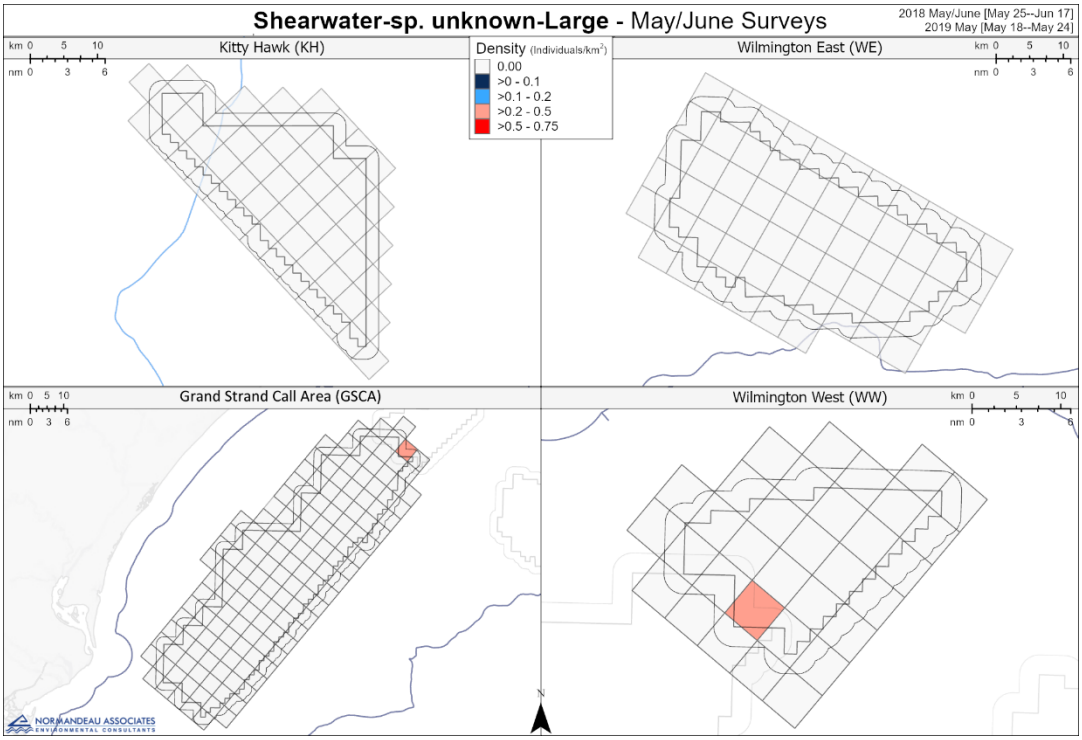


Figure C–83. Spatial distribution of shearwater-species unknown-large during the May/June surveys for all areas

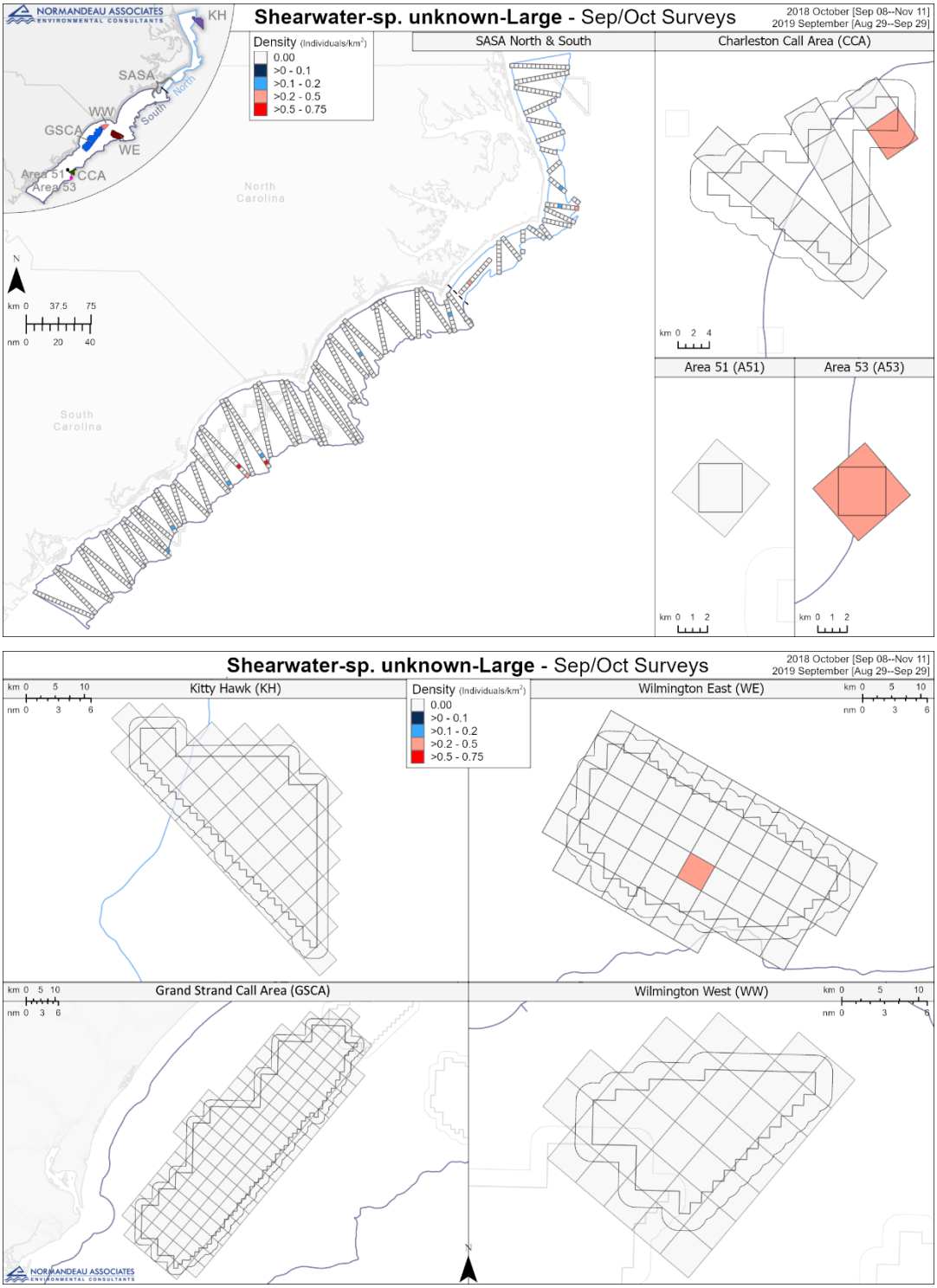


Figure C–84. Spatial distribution of shearwater-species unknown-large during the September/October surveys for all areas

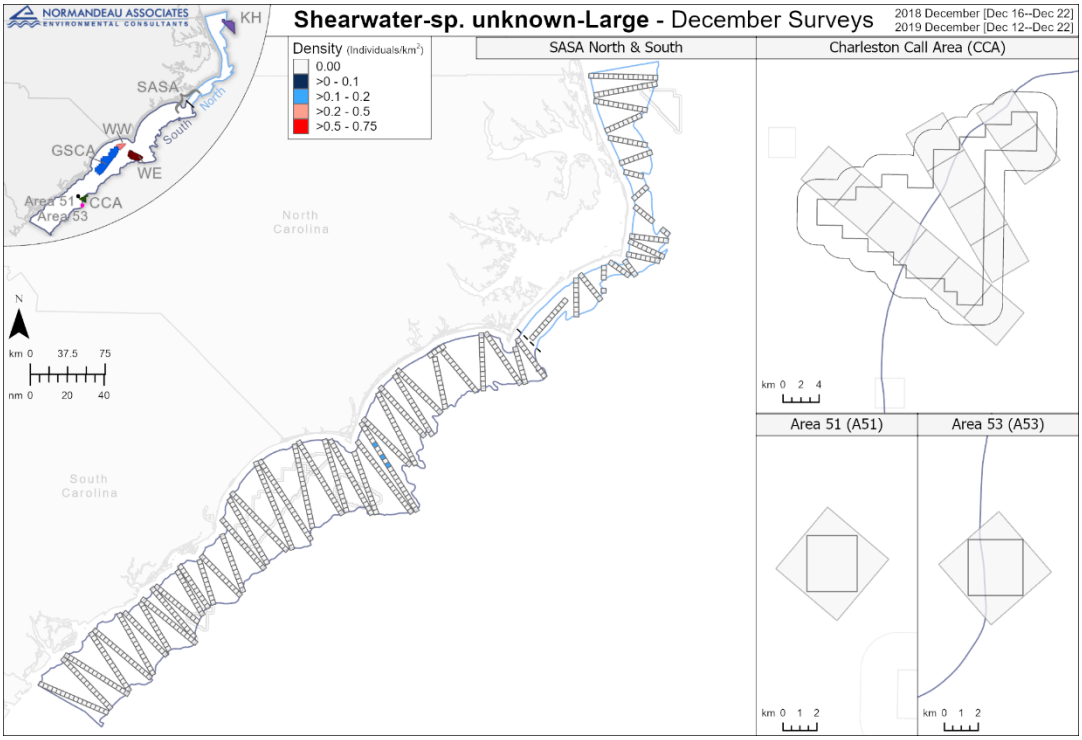


Figure C–85. Spatial distribution of shearwater-species unknown-large during the December surveys for all areas

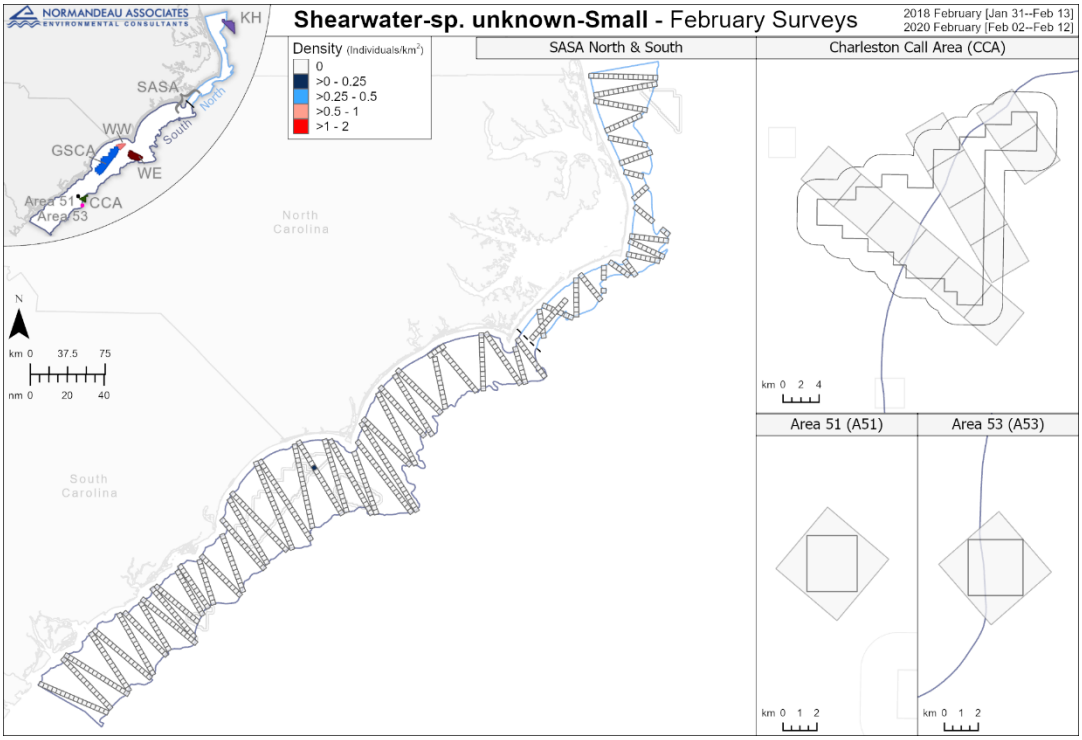


Figure C–86. Spatial distribution of shearwater-species unknown-small during the February surveys for all areas

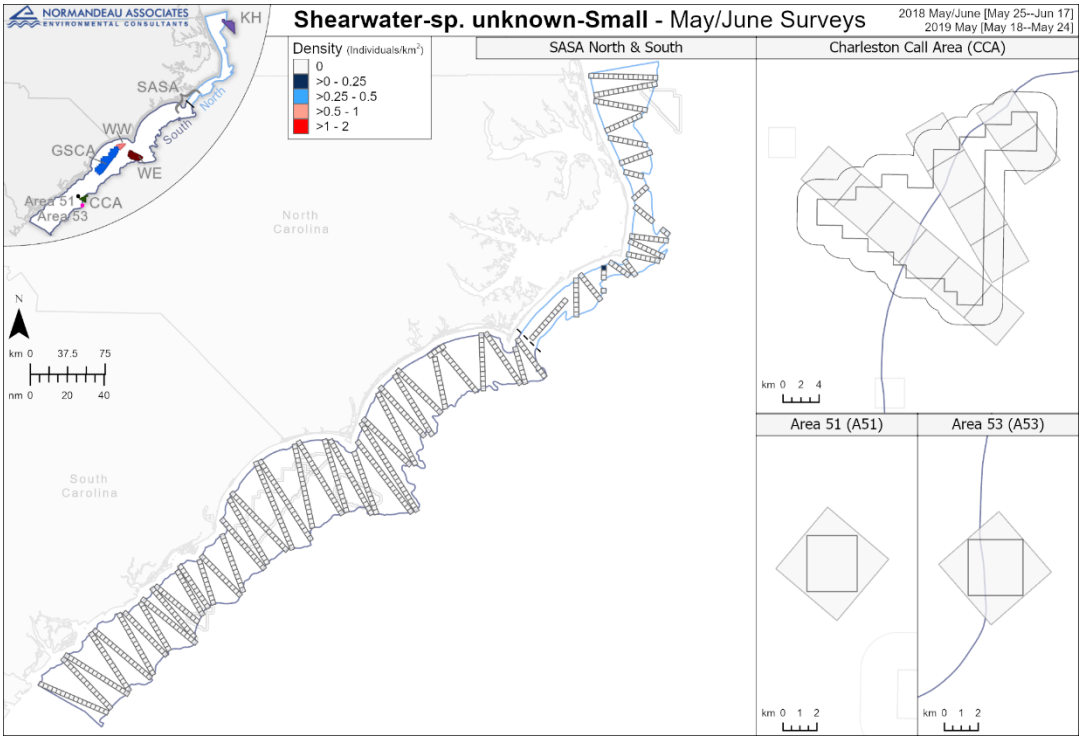


Figure C–87. Spatial distribution of shearwater-species unknown-small during the May/June surveys for all areas

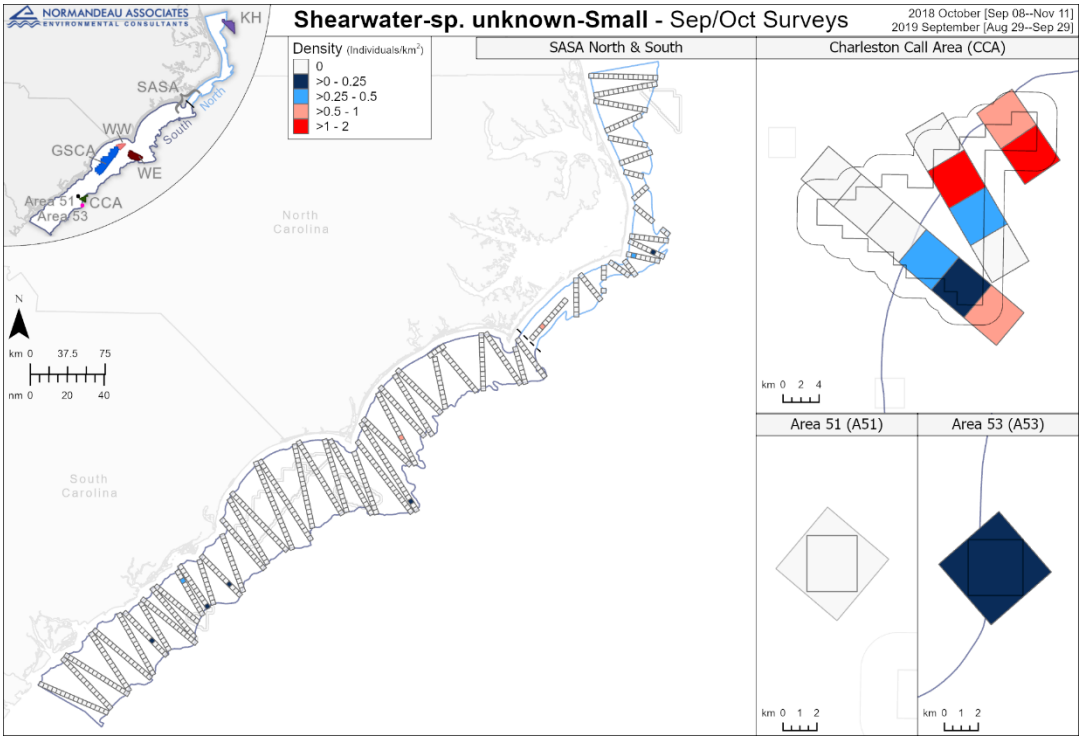


Figure C–88. Spatial distribution of shearwater-species unknown-small during the September/October surveys for all areas

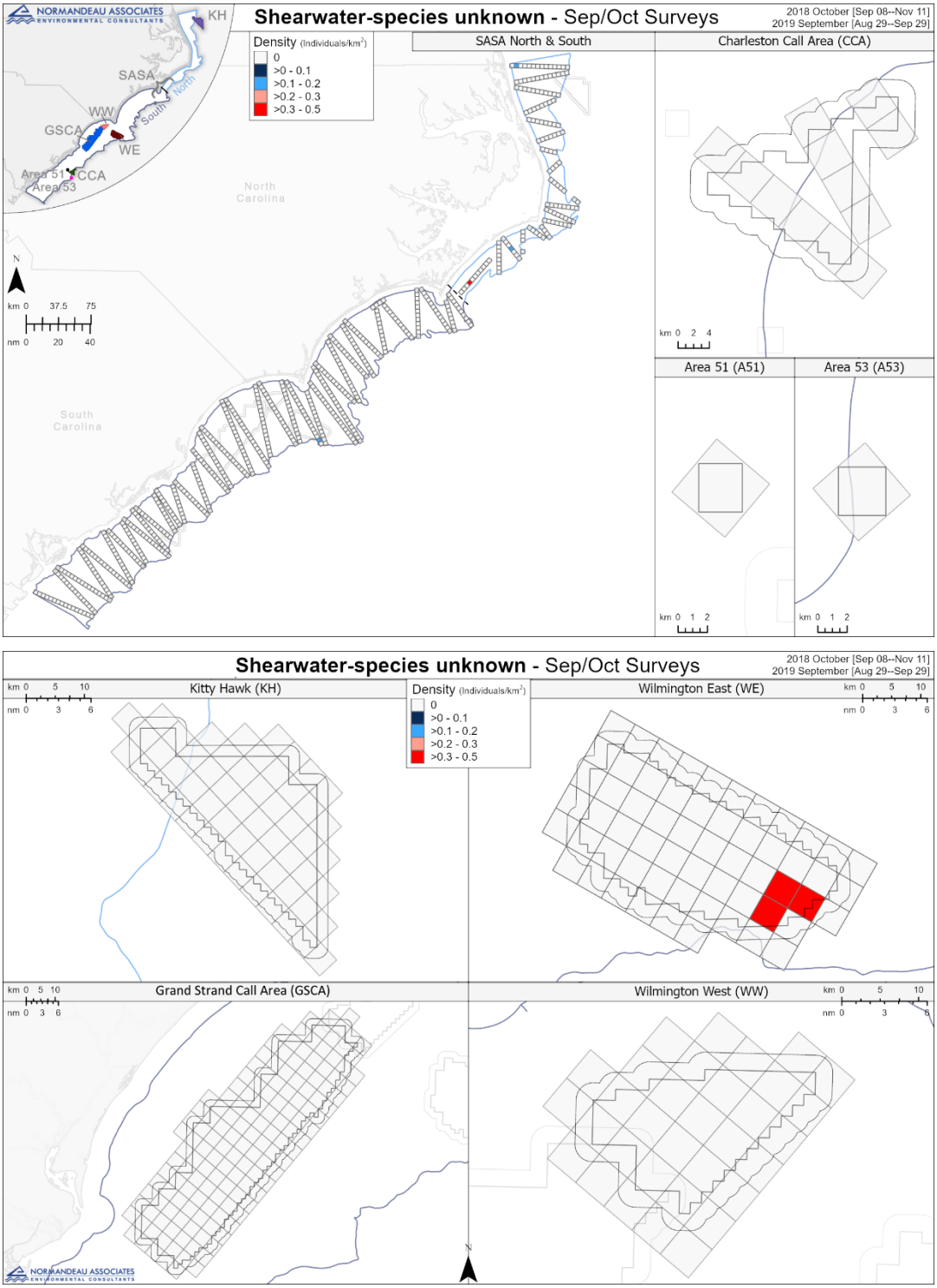


Figure C–89. Spatial distribution of shearwater-species unknown during the September/October surveys for all areas

C.4.7 Storm-Petrel

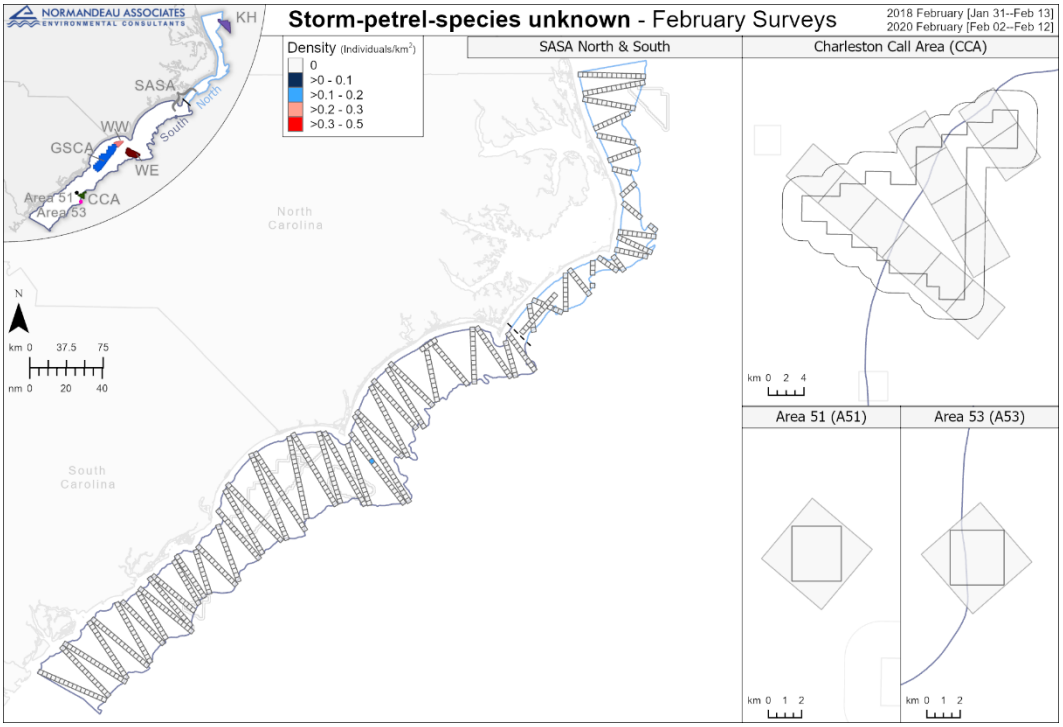


Figure C–90. Spatial distribution of storm-petrel-species unknown during the February surveys for all areas

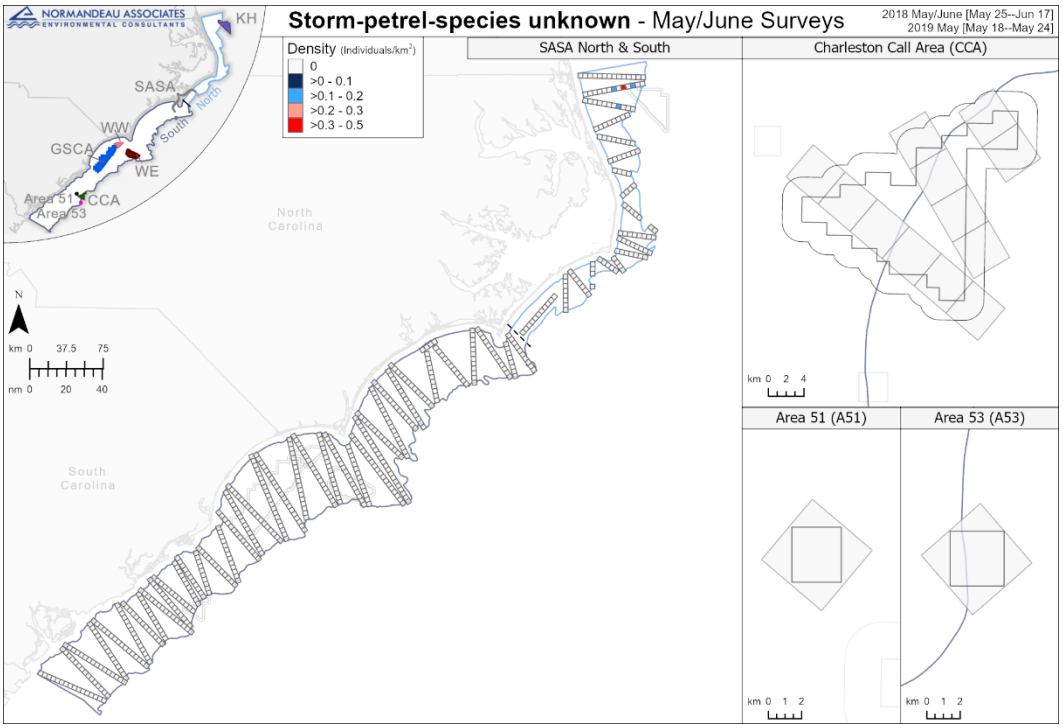


Figure C–91. Spatial distribution of storm-petrel-species unknown during the May/June surveys for all areas

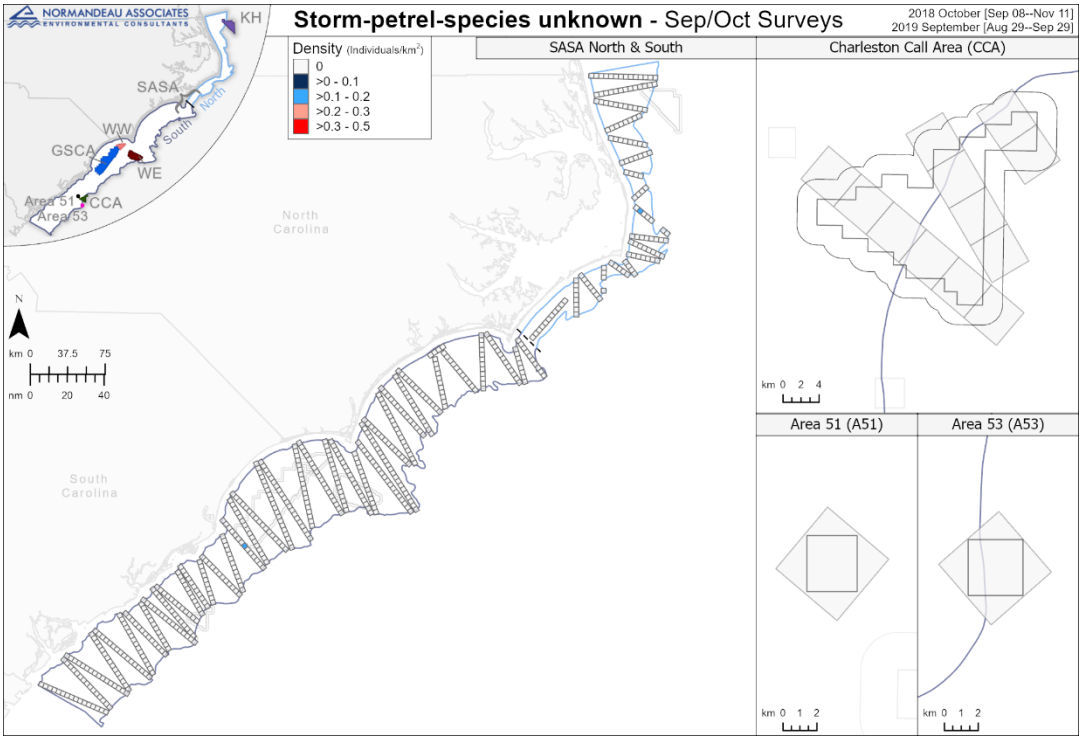


Figure C–92. Spatial distribution of storm-petrel-species unknown during the September/October surveys for all areas

C.4.8 Gannet

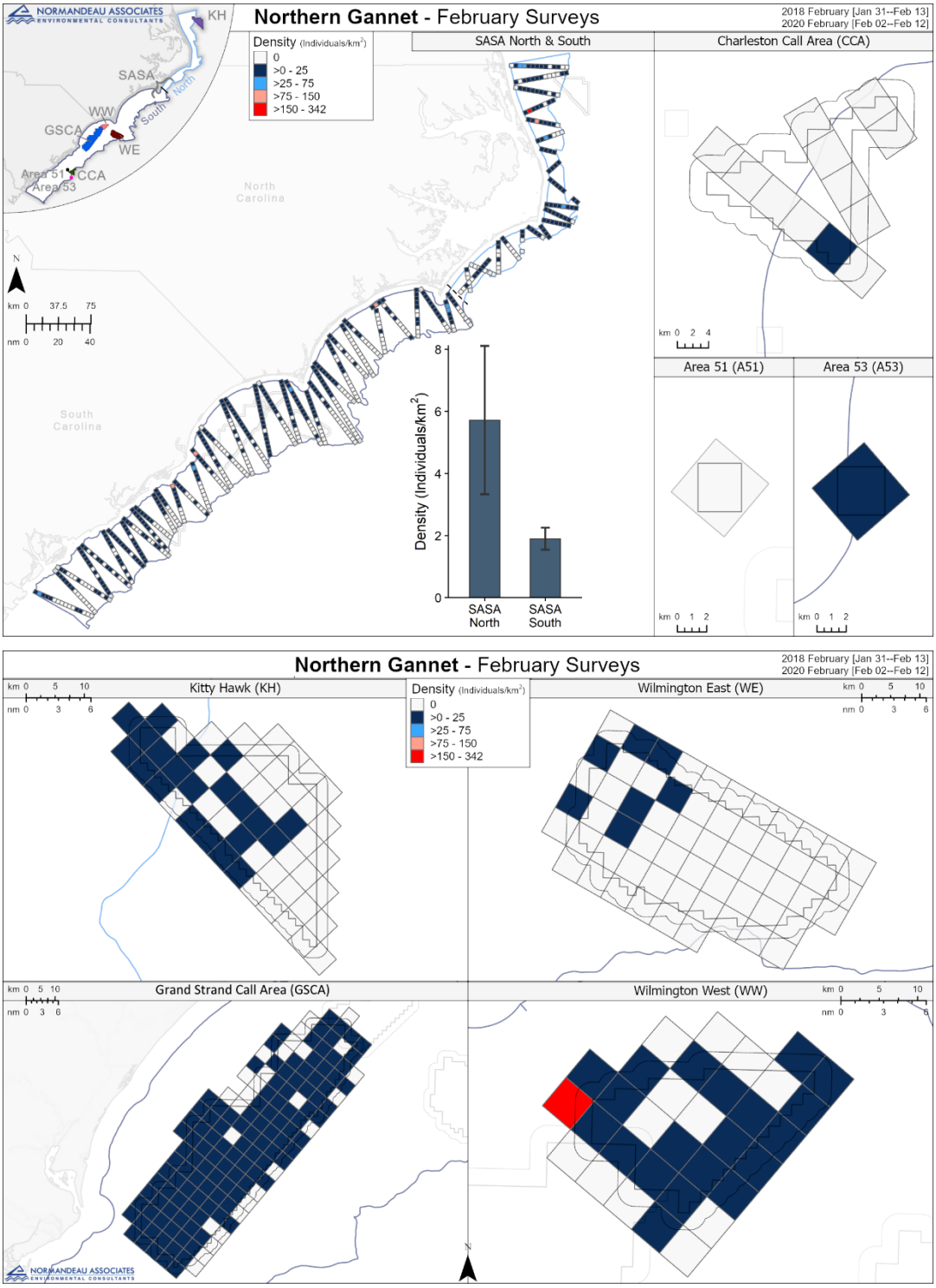


Figure C–93. Spatial distribution of northern gannets during the February surveys for all areas

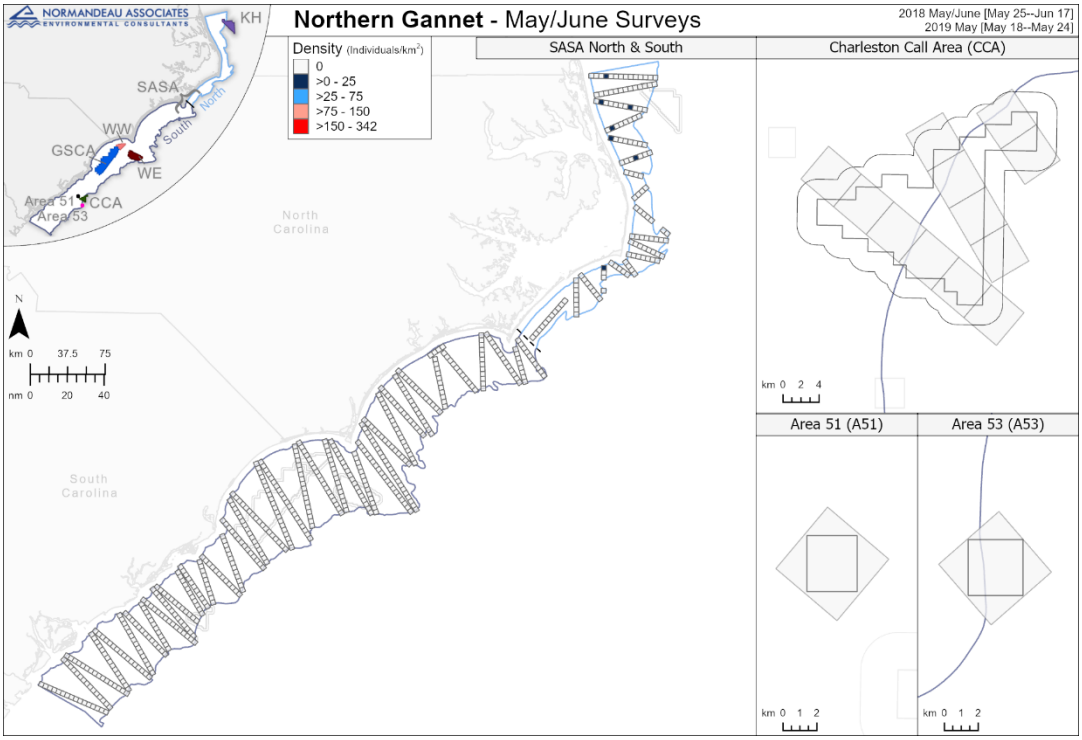


Figure C–94. Spatial distribution of northern gannets during the May/June surveys for all areas

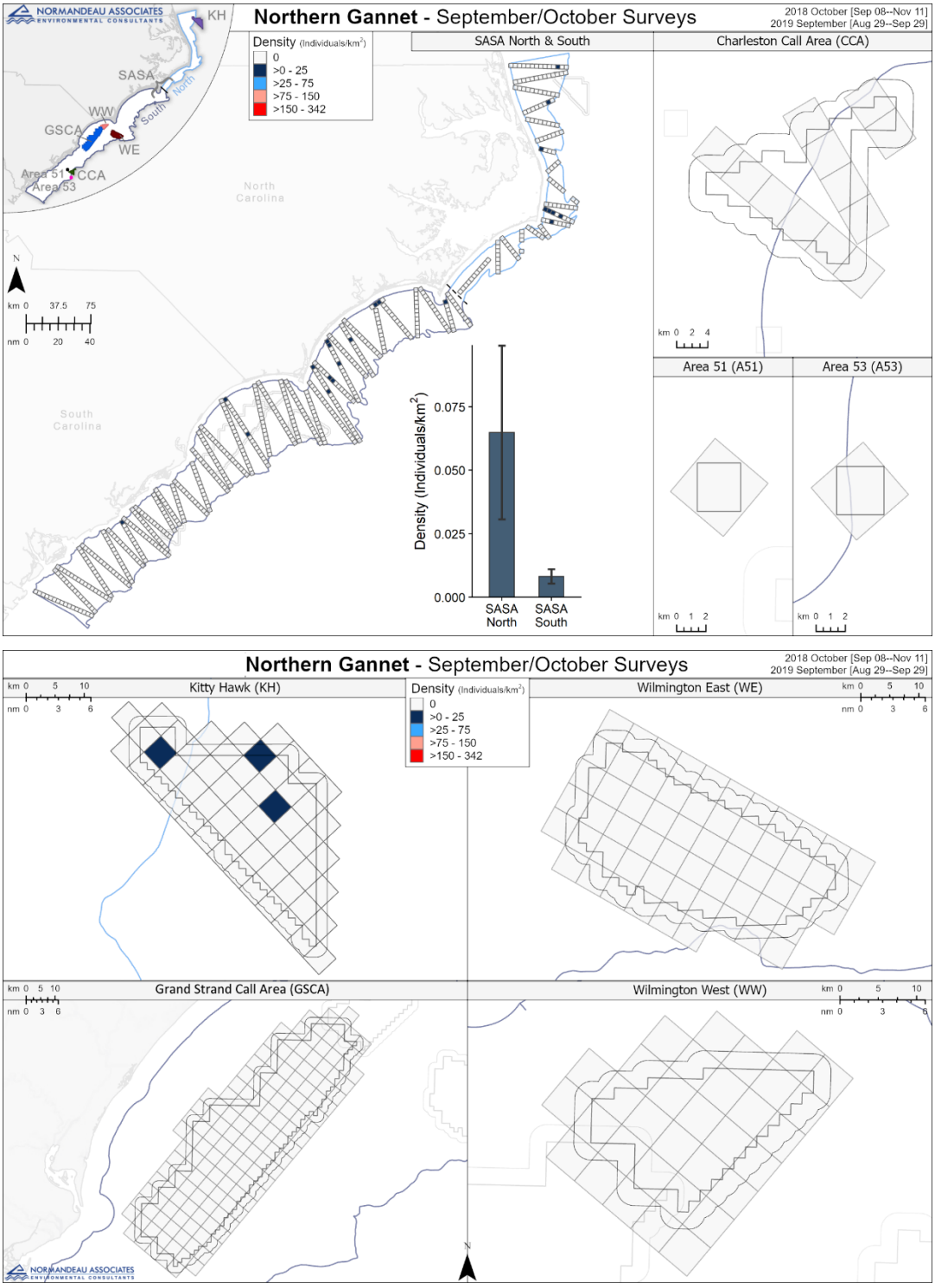


Figure C–95. Spatial distribution of northern gannets during the September/ October surveys for all areas

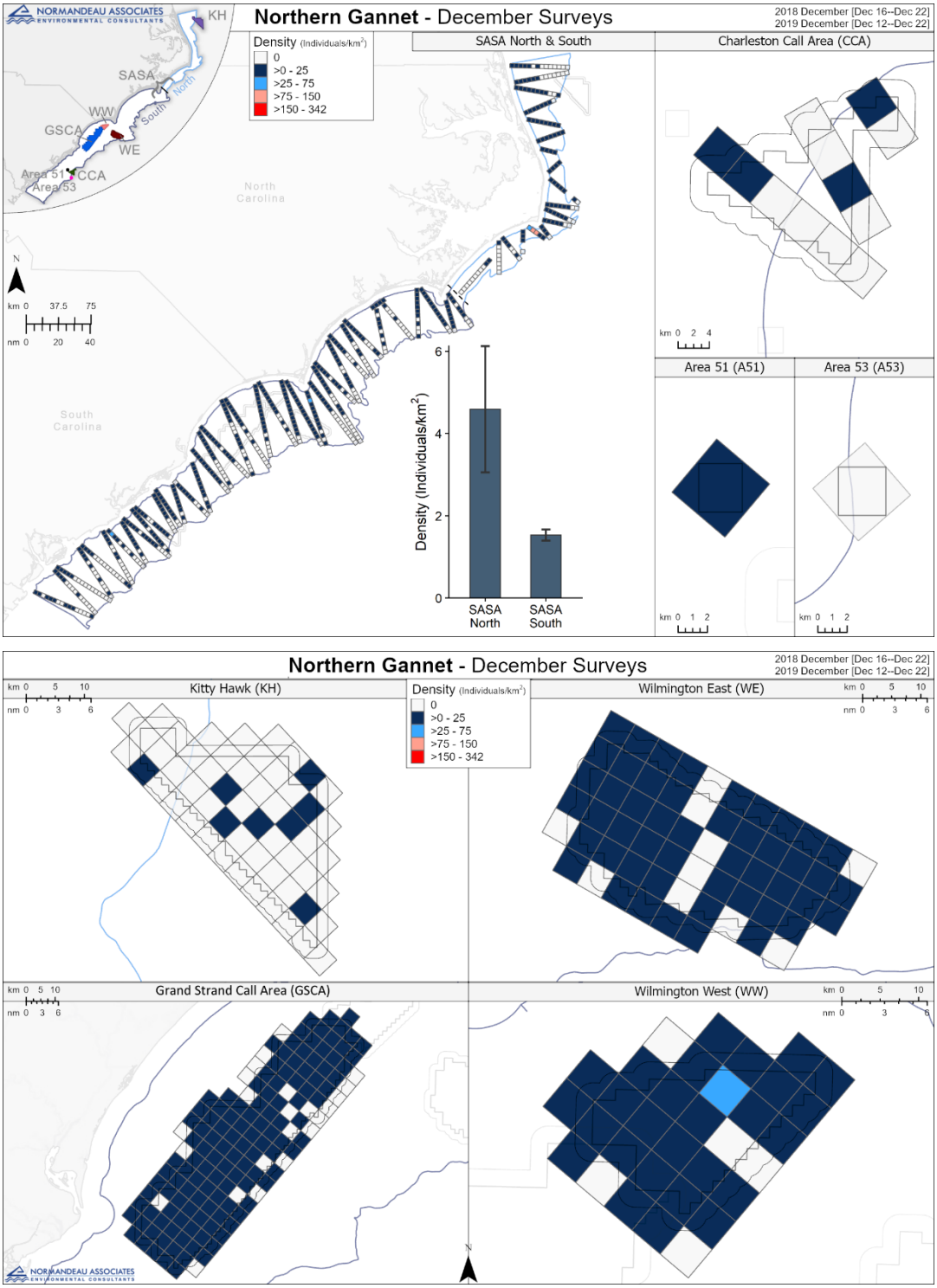


Figure C–96. Spatial distribution of northern gannets during the December surveys for all areas

C.4.9 Cormorant

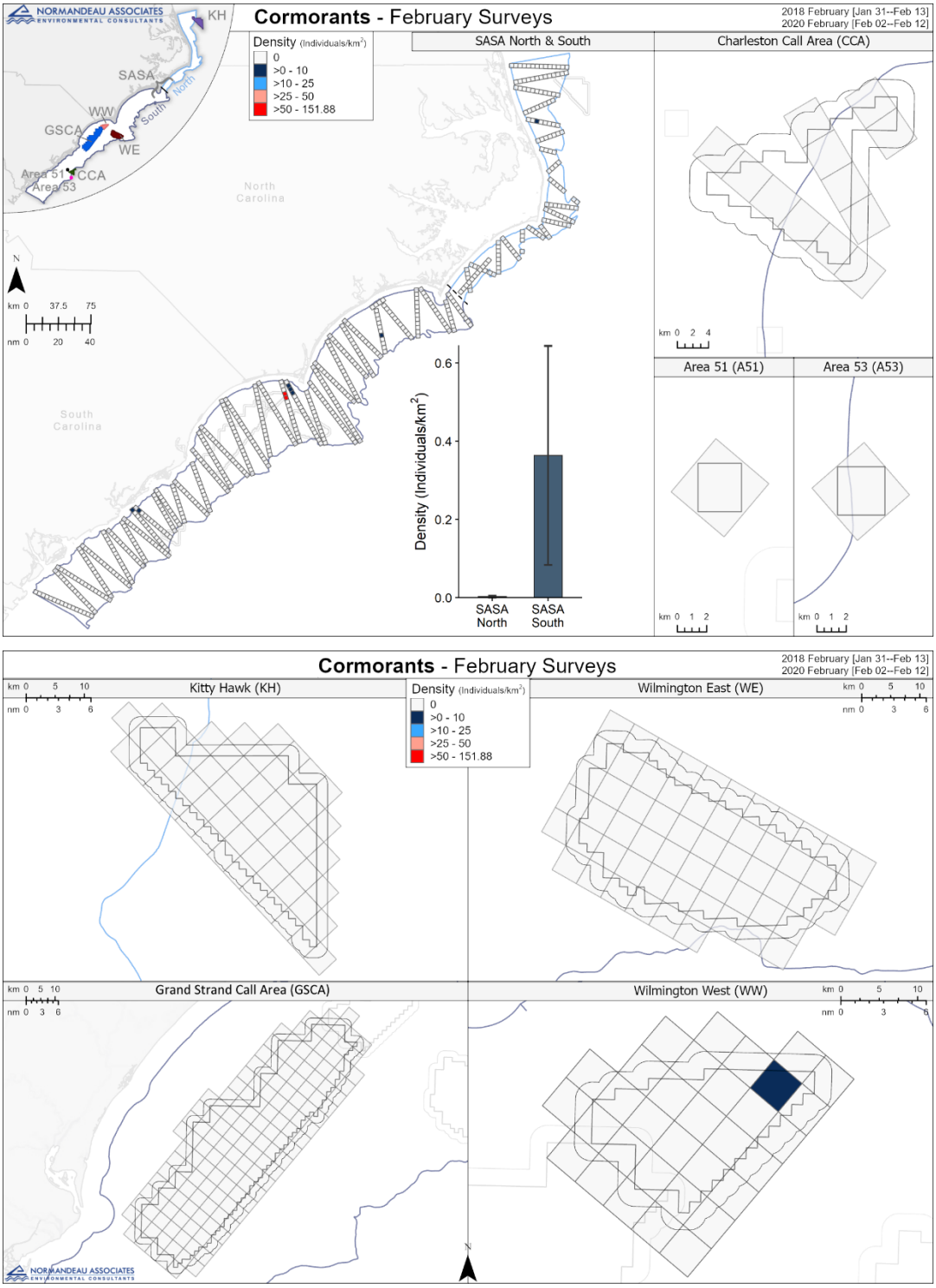


Figure C–97. Spatial distribution of all cormorant species during the February surveys for all areas

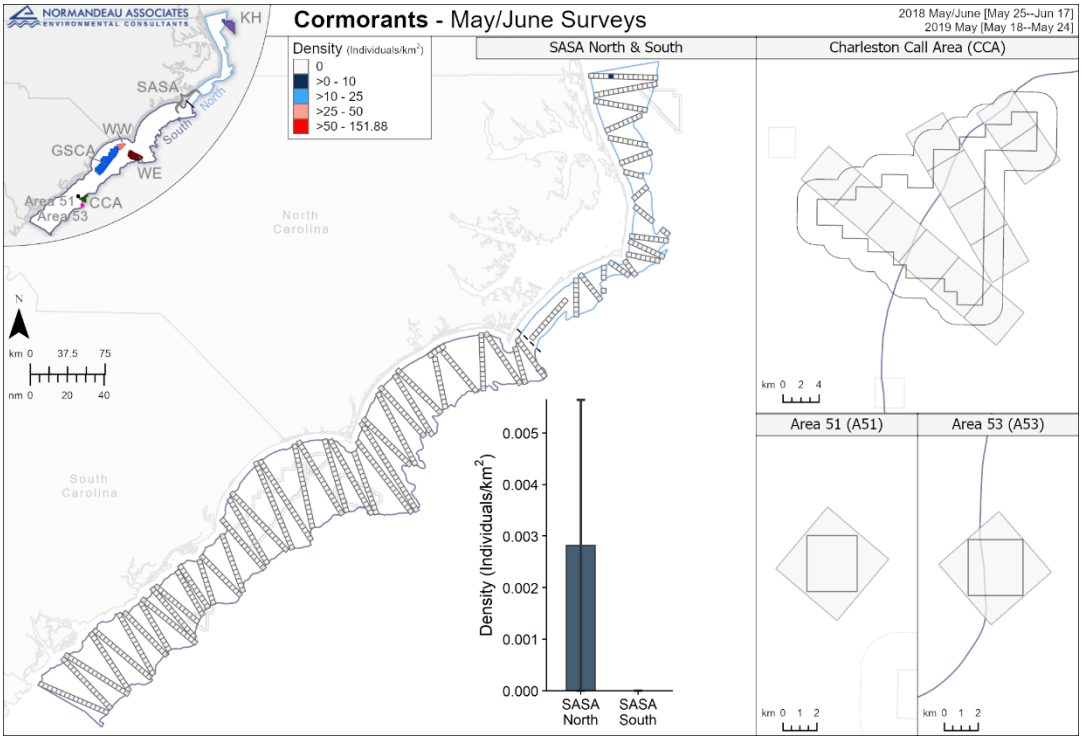


Figure C–98. Spatial distribution of all cormorant species during the May/June surveys for all areas

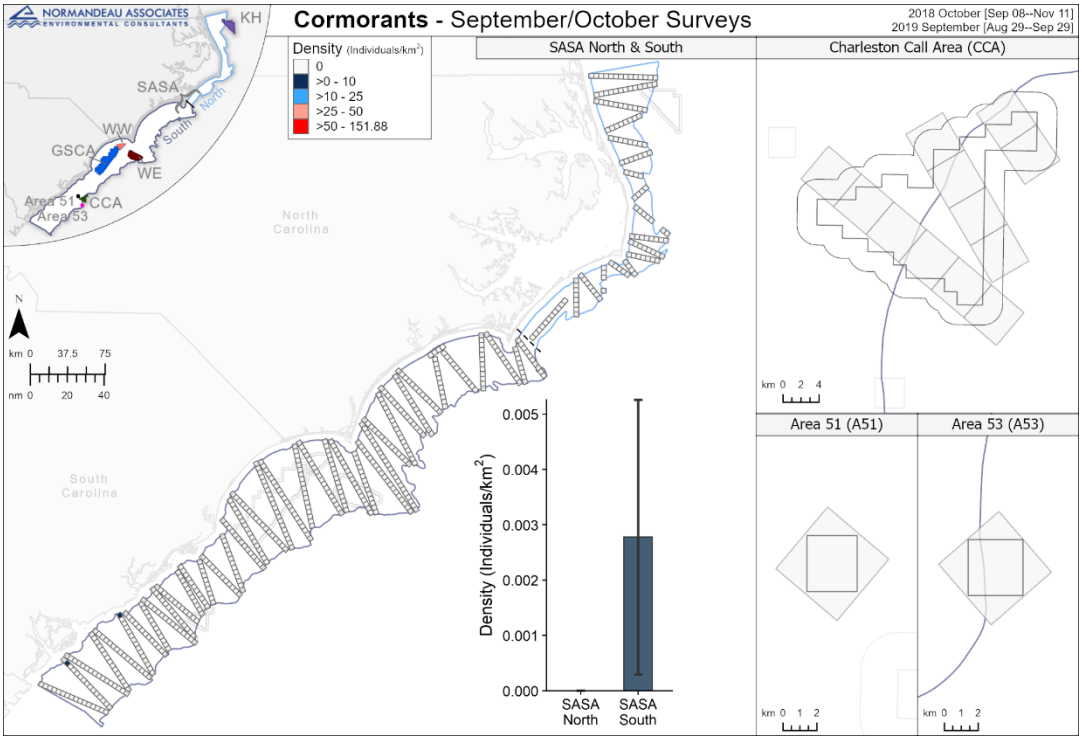


Figure C–99. Spatial distribution of all cormorant species during the September/October surveys for all areas

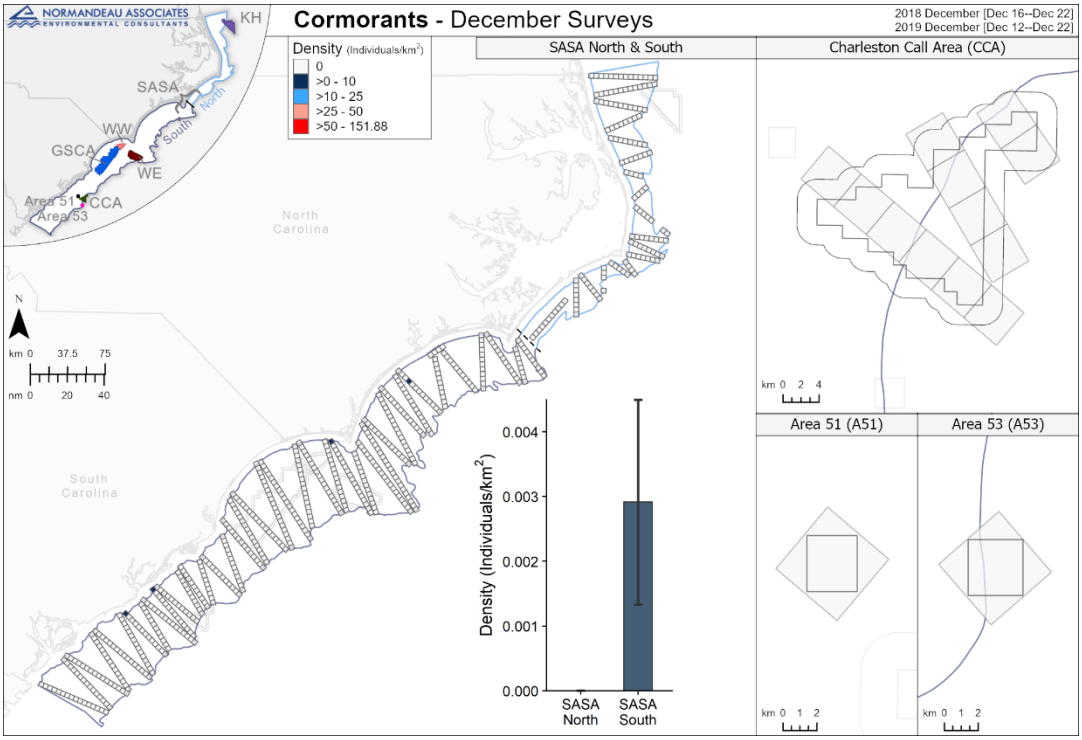


Figure C–100. Spatial distribution of all cormorant species during the December surveys for all areas

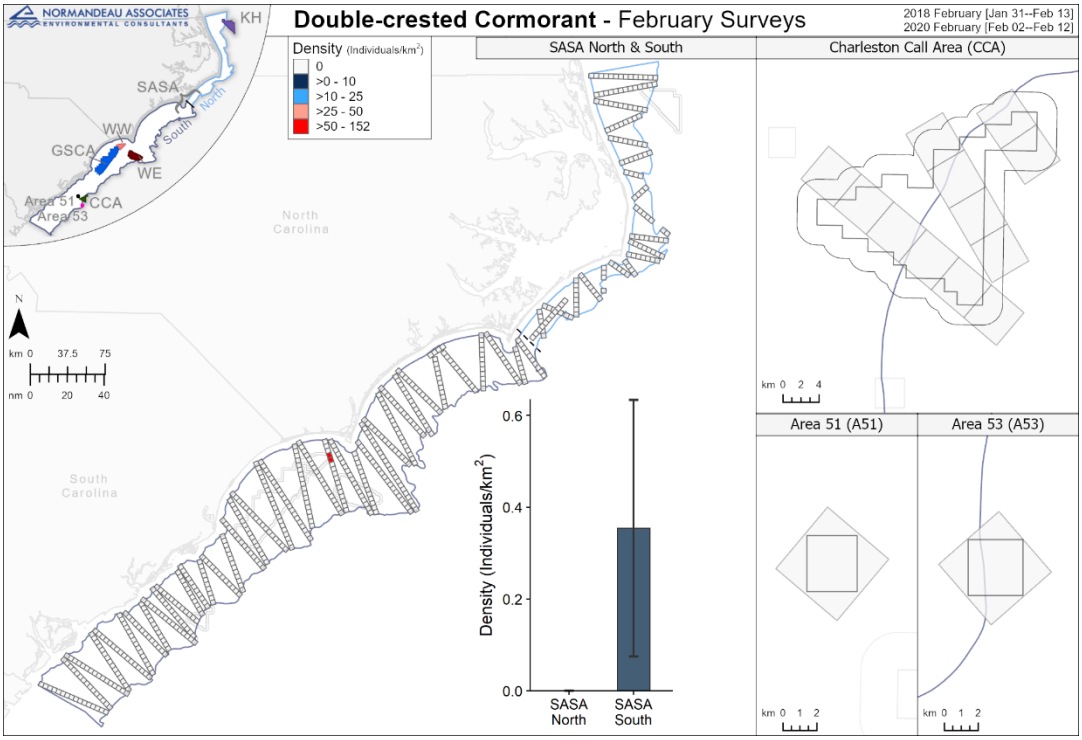


Figure C–101. Spatial distribution of double-crested cormorants during the February surveys for all areas

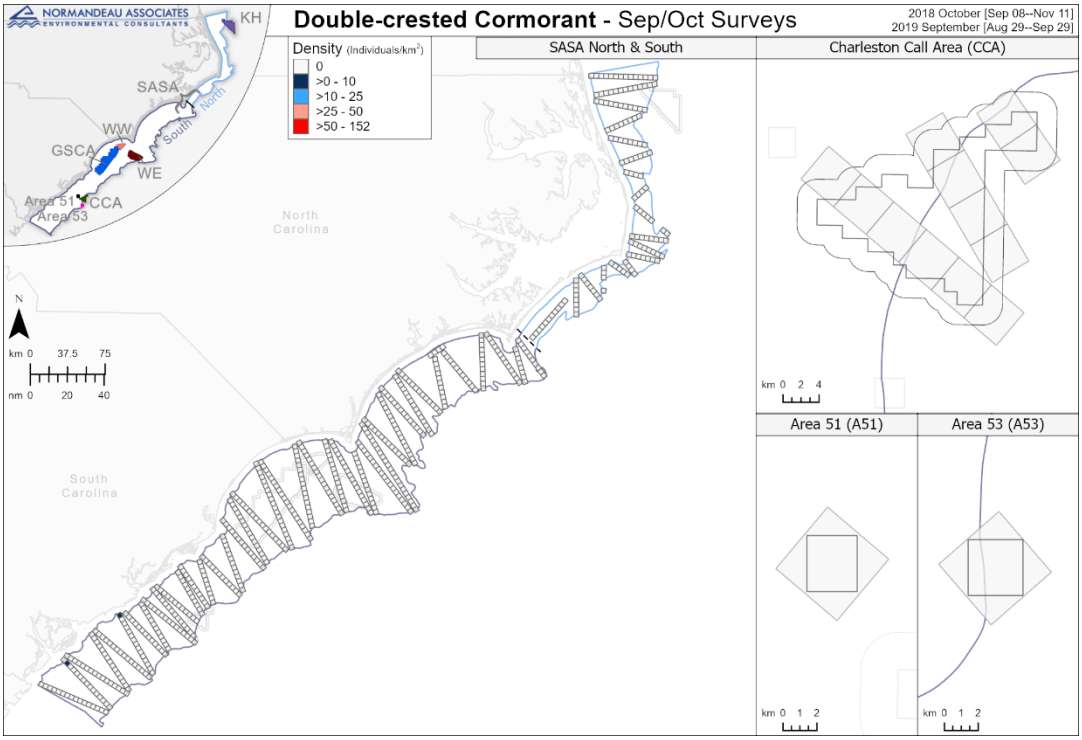


Figure C–102. Spatial distribution of double-crested cormorants during the September/October surveys for all areas

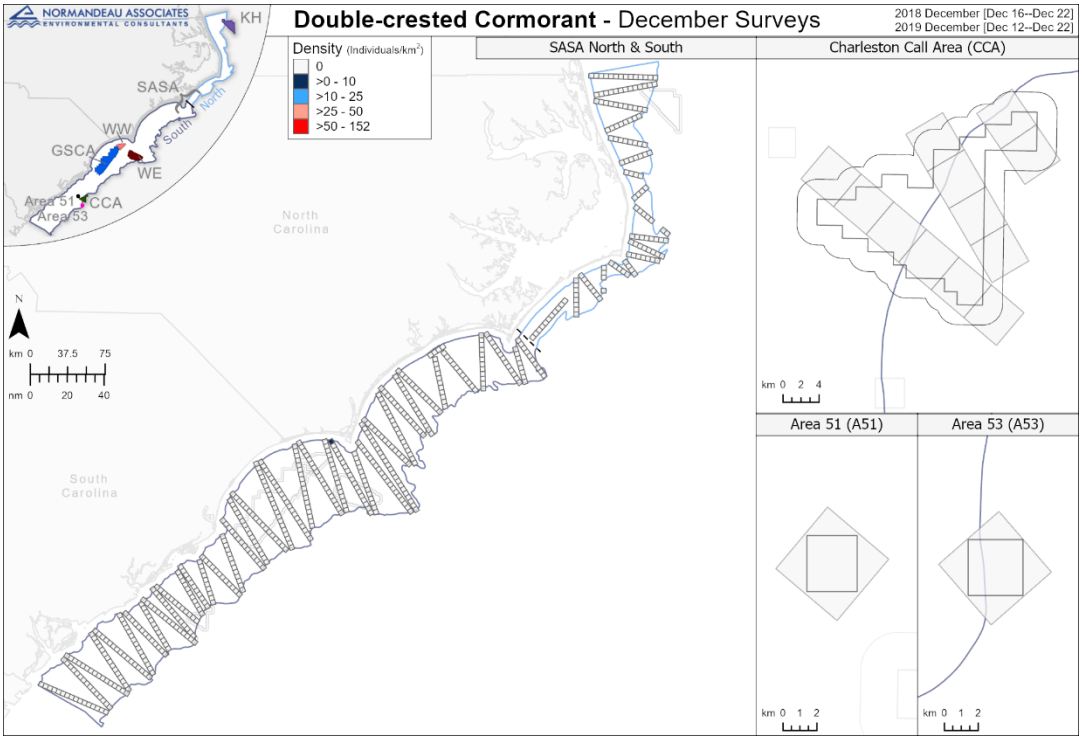


Figure C–103. Spatial distribution of double-crested cormorants during the December surveys for all areas

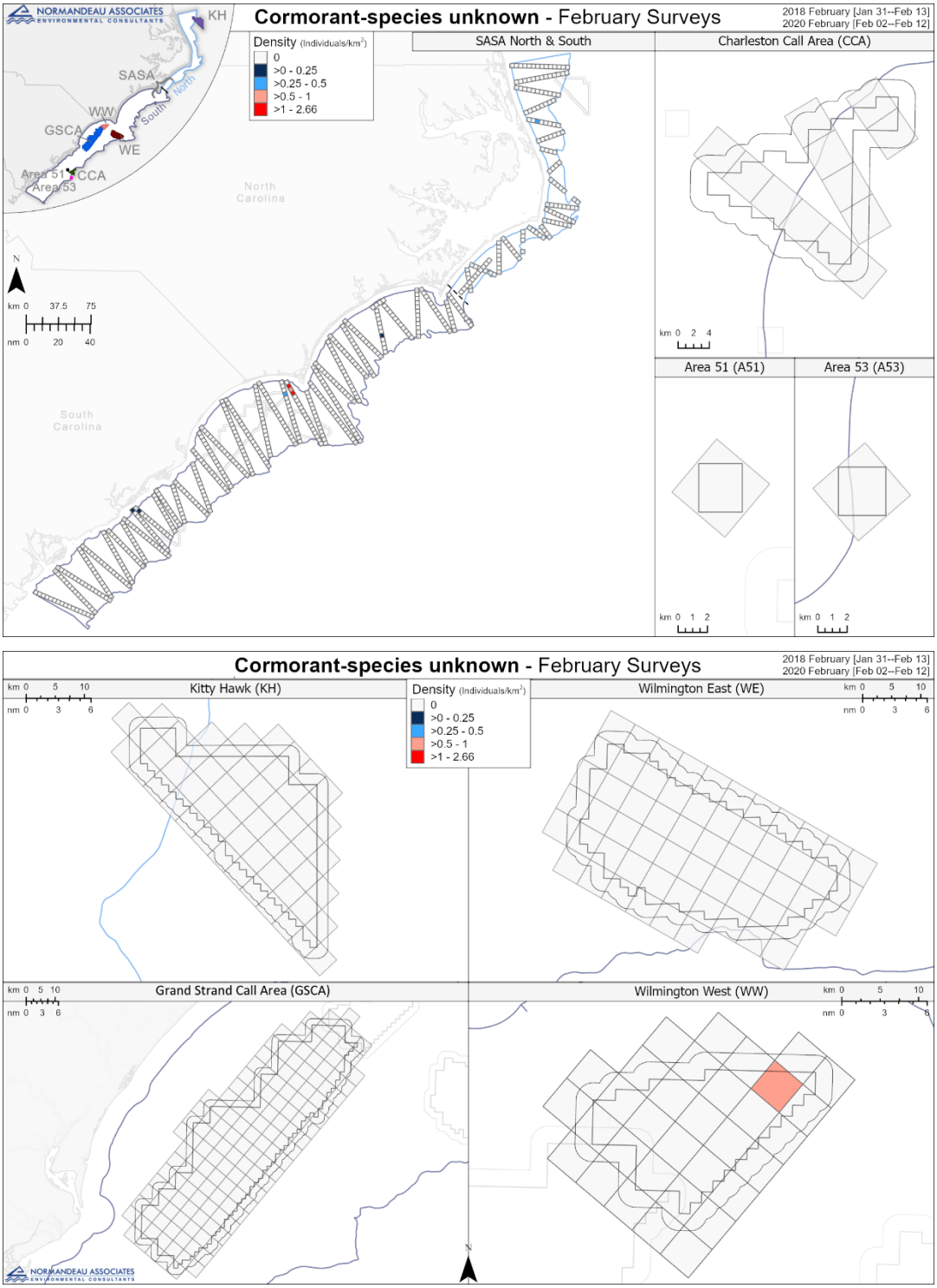


Figure C–104. Spatial distribution of cormorant-species unknown during the February surveys for all areas

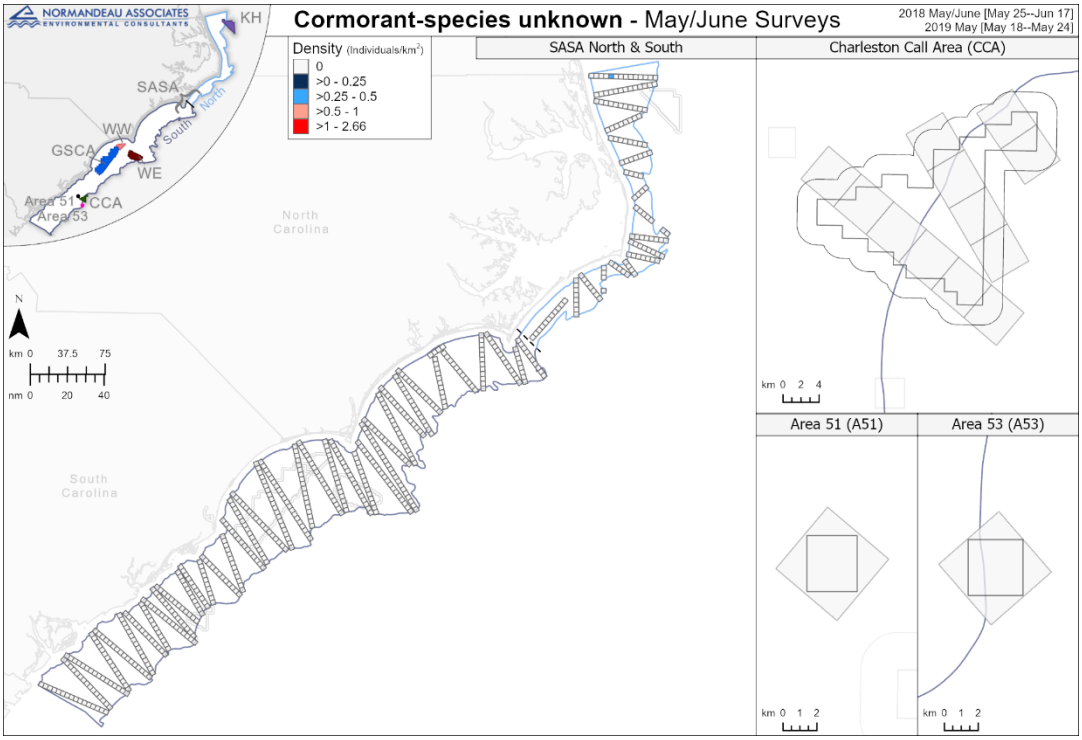


Figure C–105. Spatial distribution of cormorant-species unknown during the May/June surveys for all areas

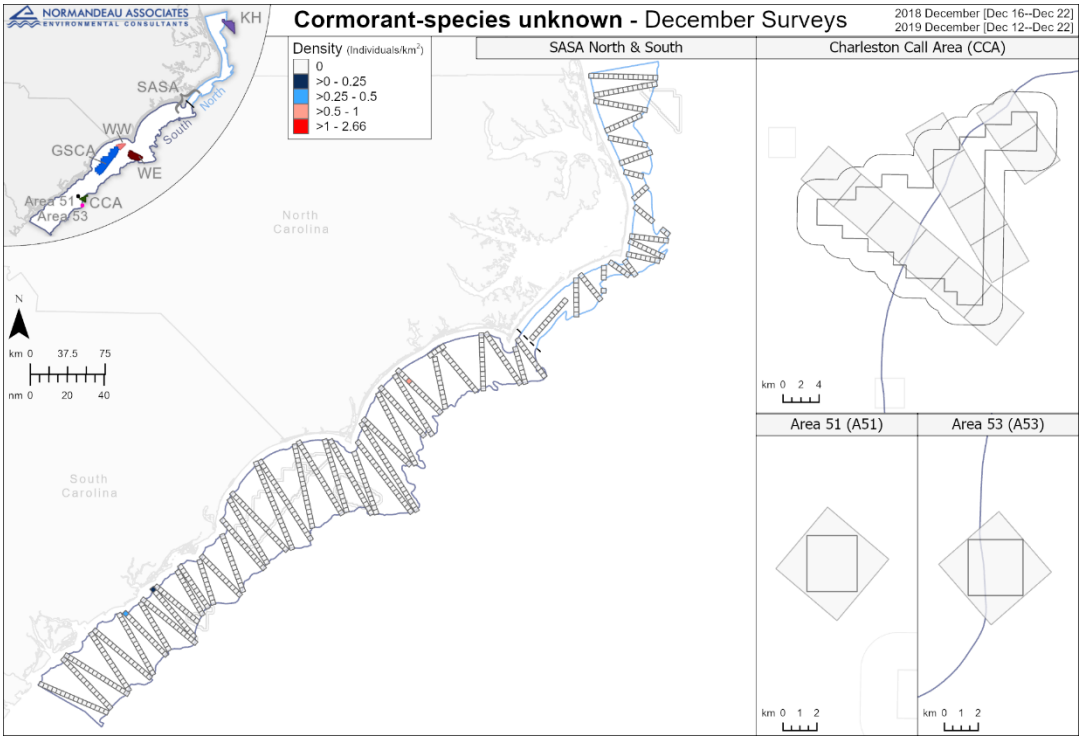


Figure C–106. Spatial distribution of cormorant-species unknown during the December surveys for all areas

C.4.10 Pelican

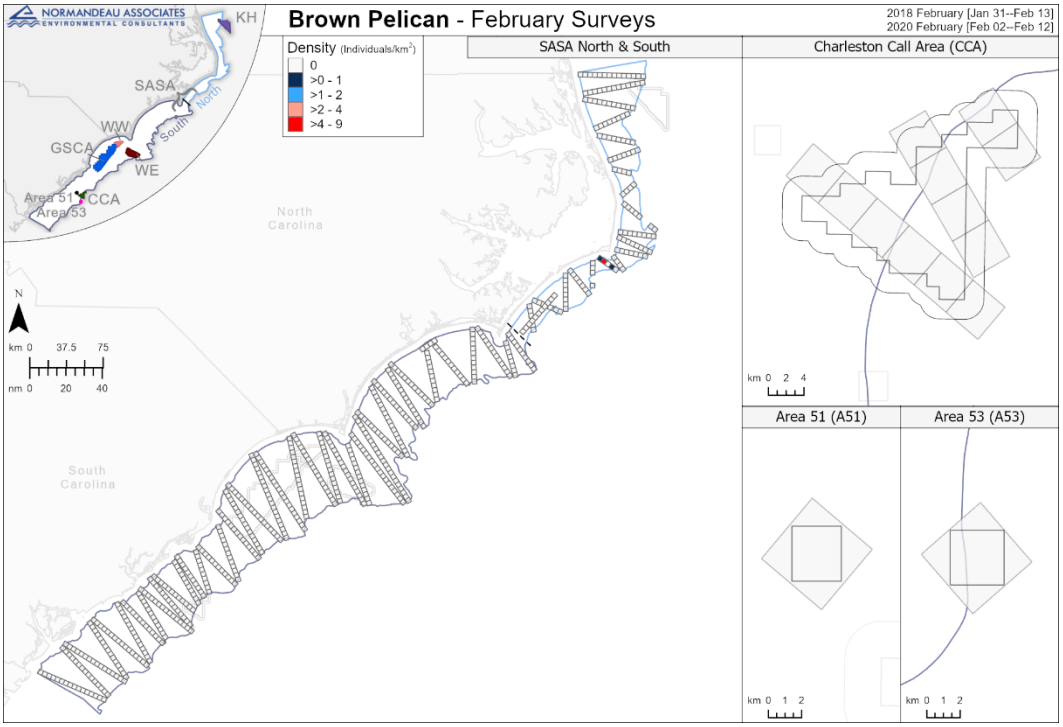


Figure C–107. Spatial distribution of brown pelicans during the February surveys for all areas

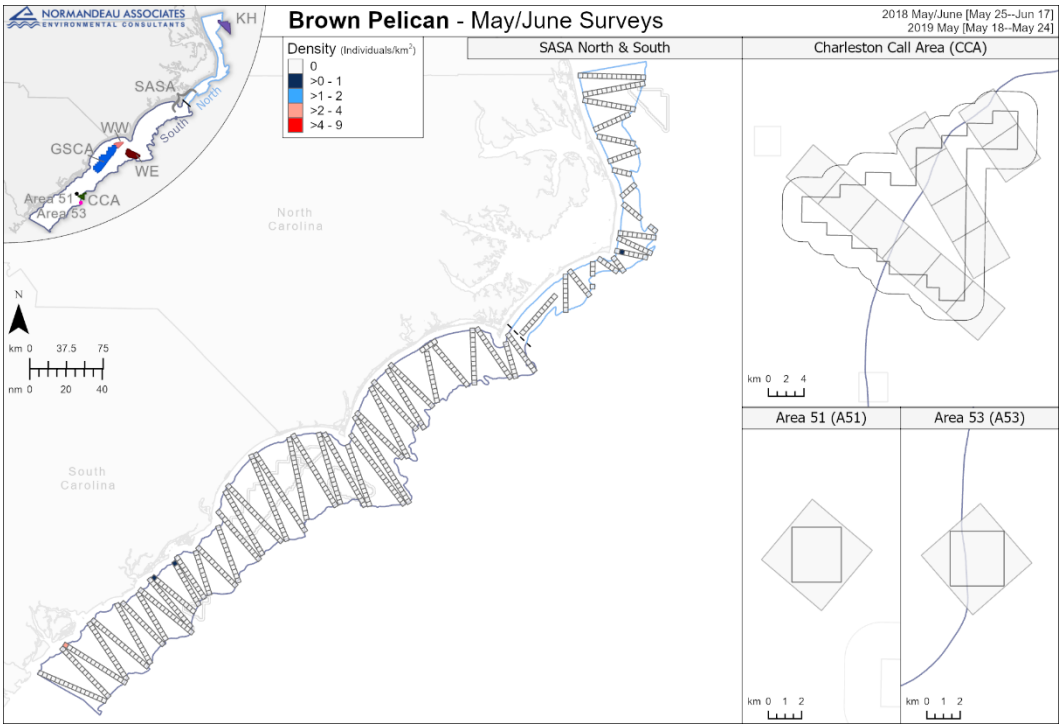


Figure C–108. Spatial distribution of brown pelicans during the May/June surveys for all areas

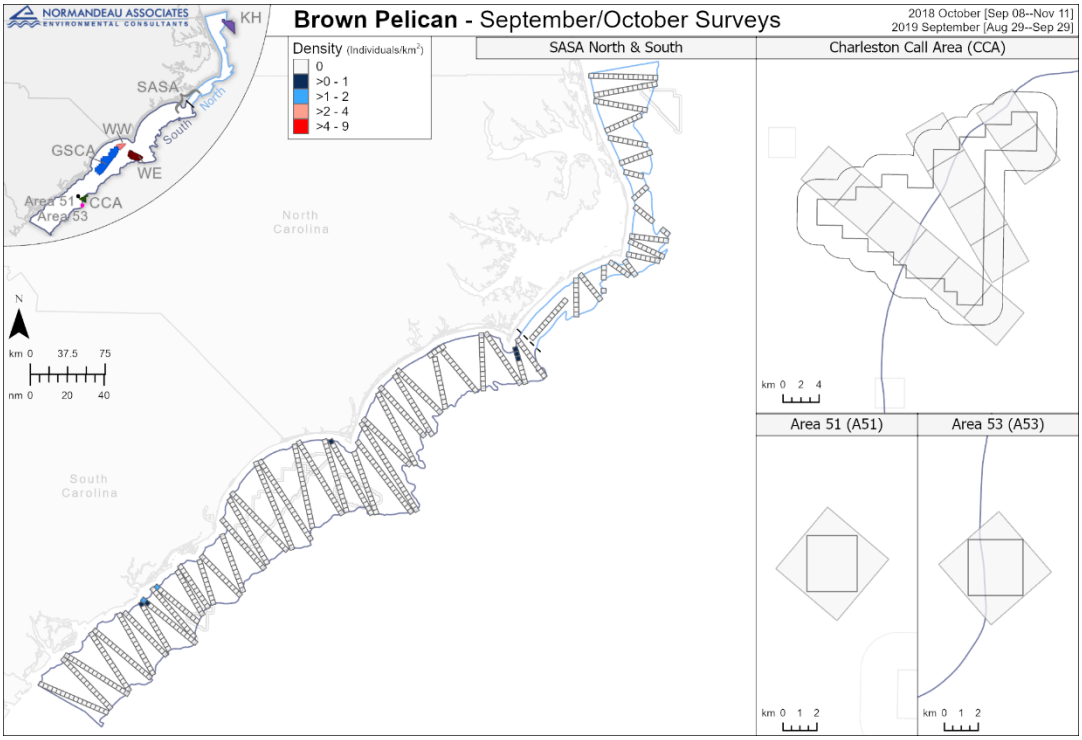


Figure C–109. Spatial distribution of brown pelicans during the September/October surveys for all areas

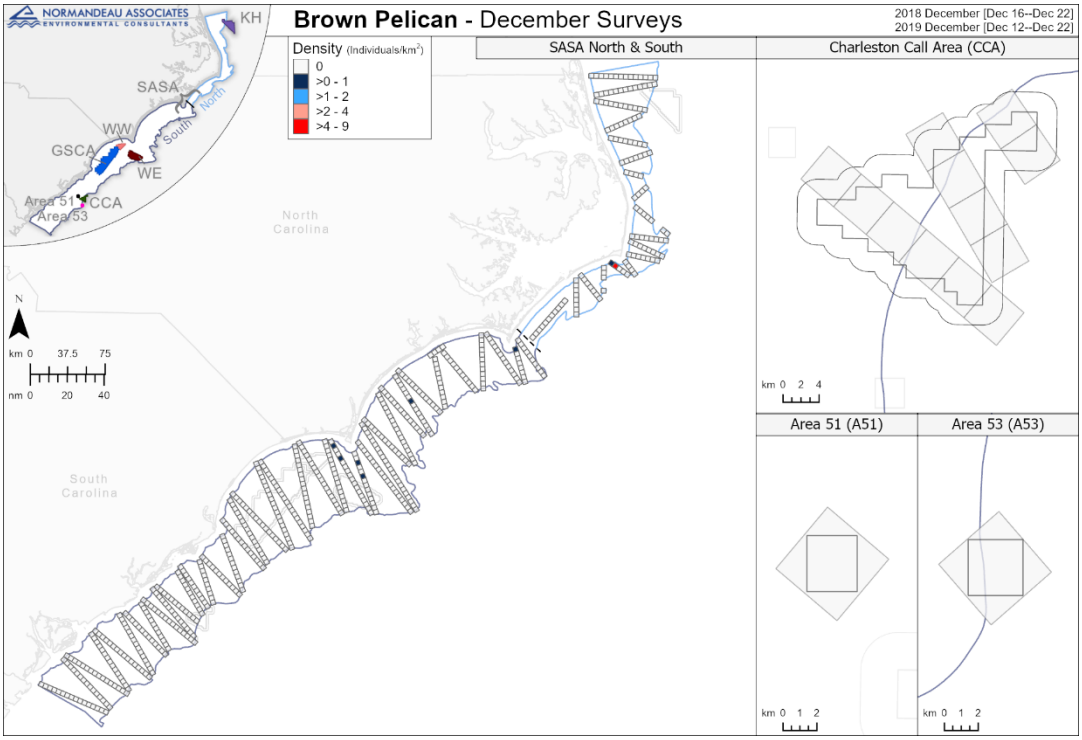


Figure C–110. Spatial distribution of brown pelicans during the December surveys for all areas

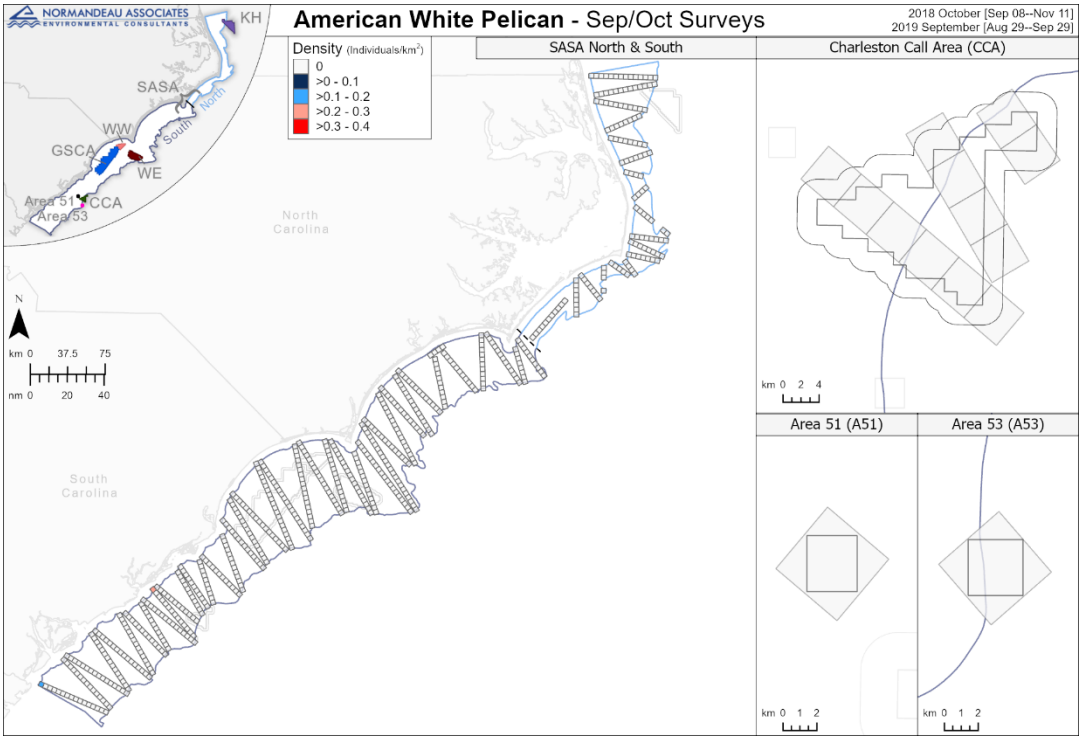


Figure C–111. Spatial distribution of American white pelicans during the September/October surveys for all areas

C.4.11 Ardeidae

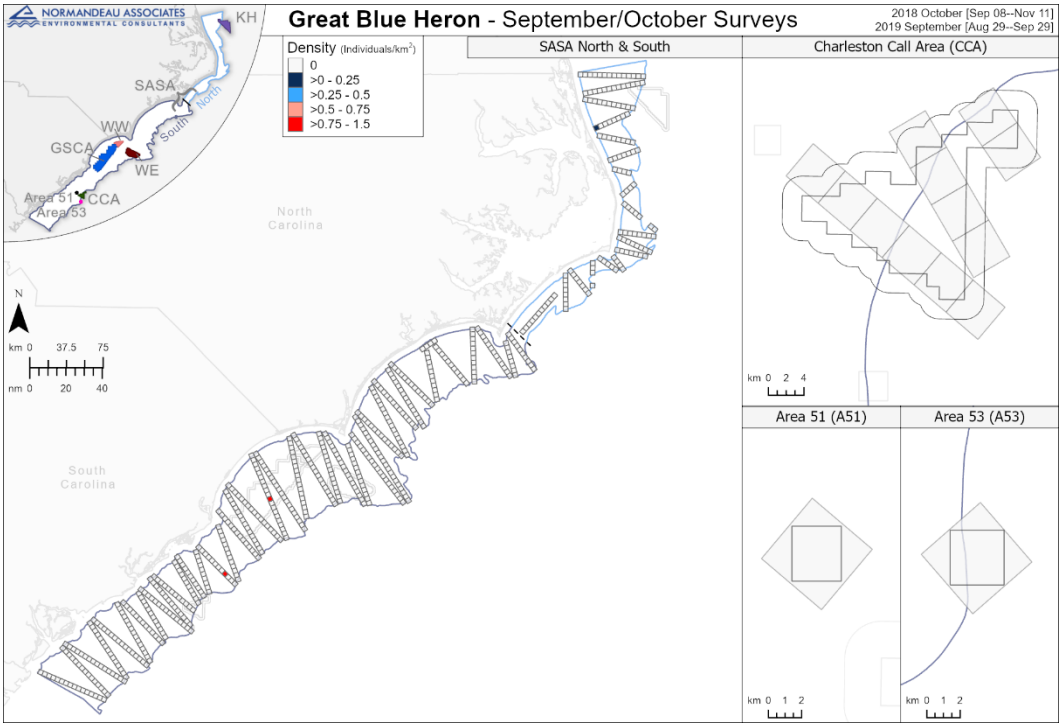


Figure C–112. Spatial distribution of great blue herons during the September/ October surveys for all areas

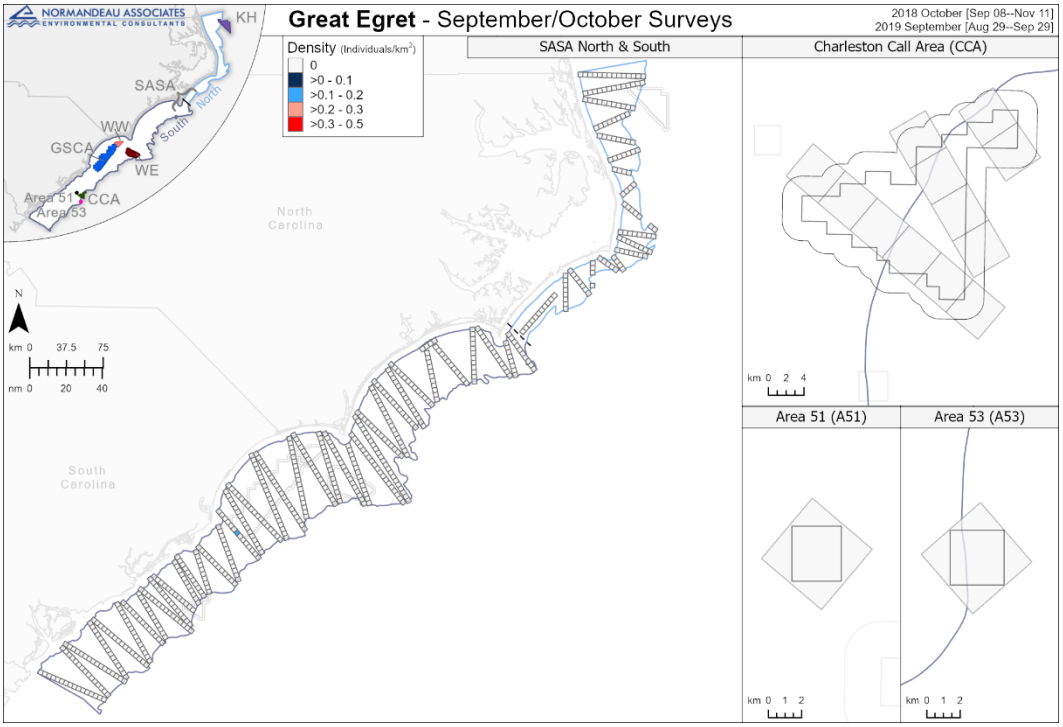


Figure C–113. Spatial distribution of great egrets during the September/October surveys for all areas

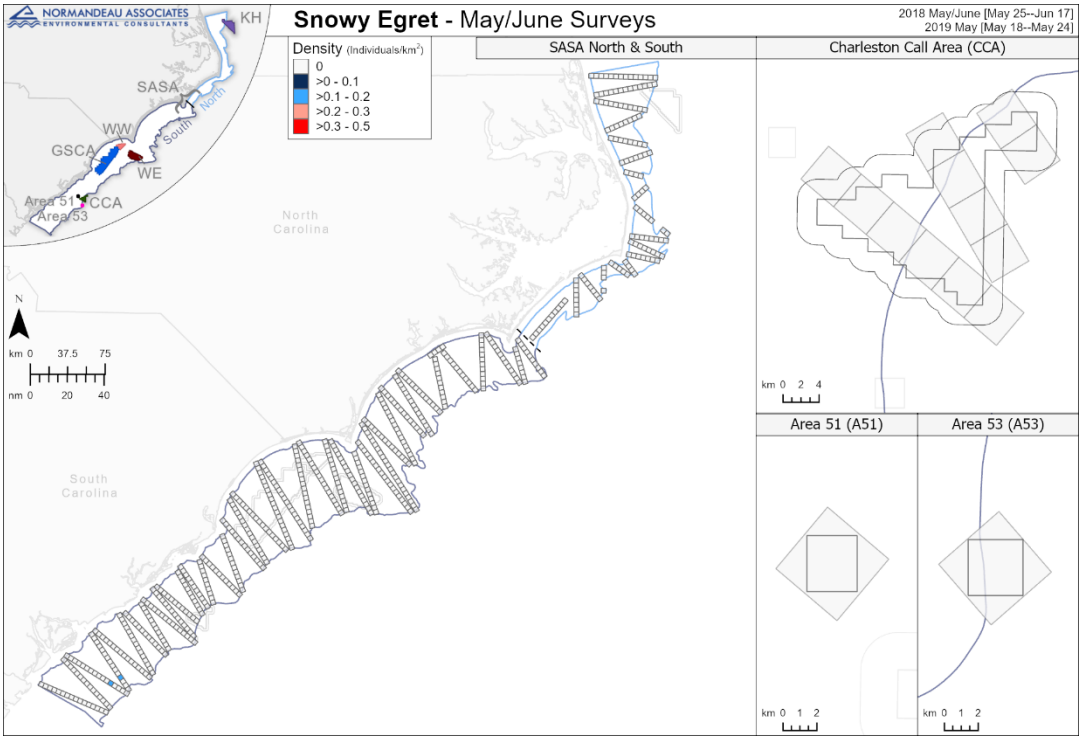


Figure C–114. Spatial distribution of snowy egrets during the May/June surveys for all areas

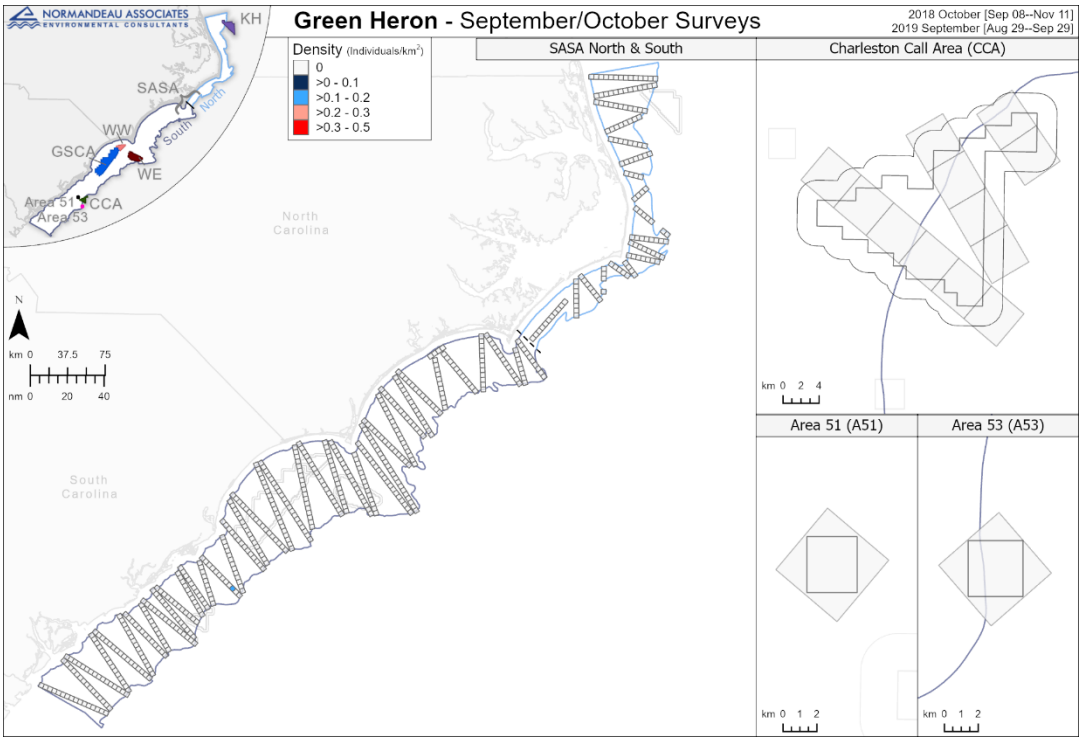


Figure C–115. Spatial distribution of green herons during the September/October surveys for all areas

C.4.12 Raptor

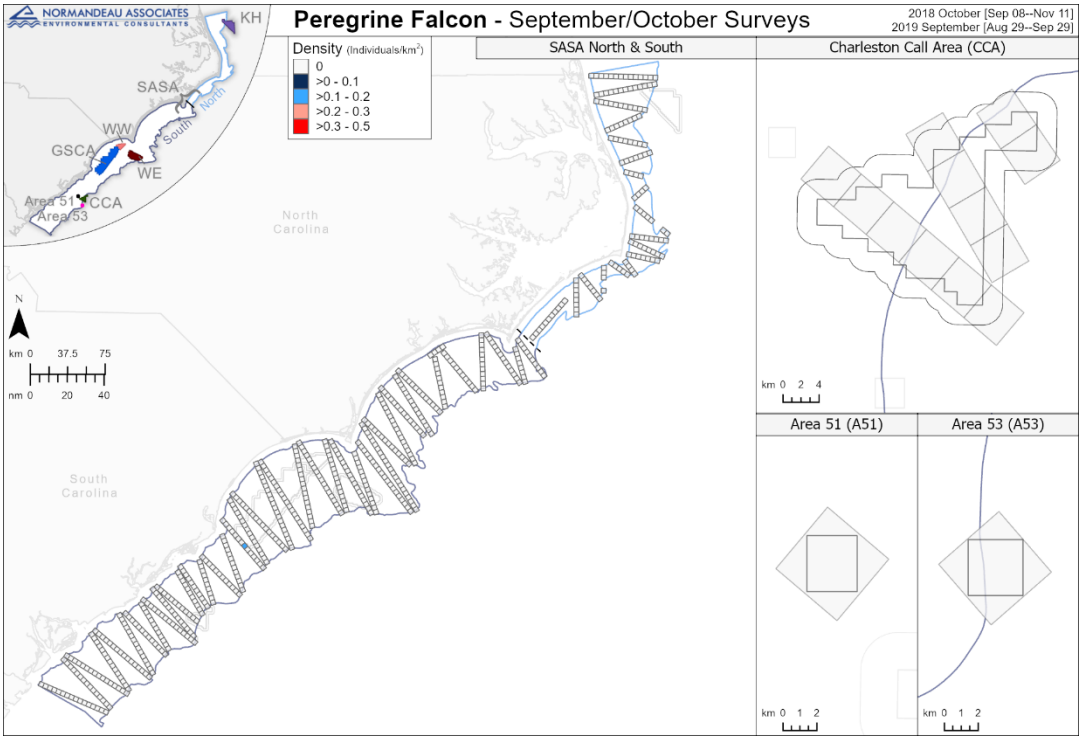
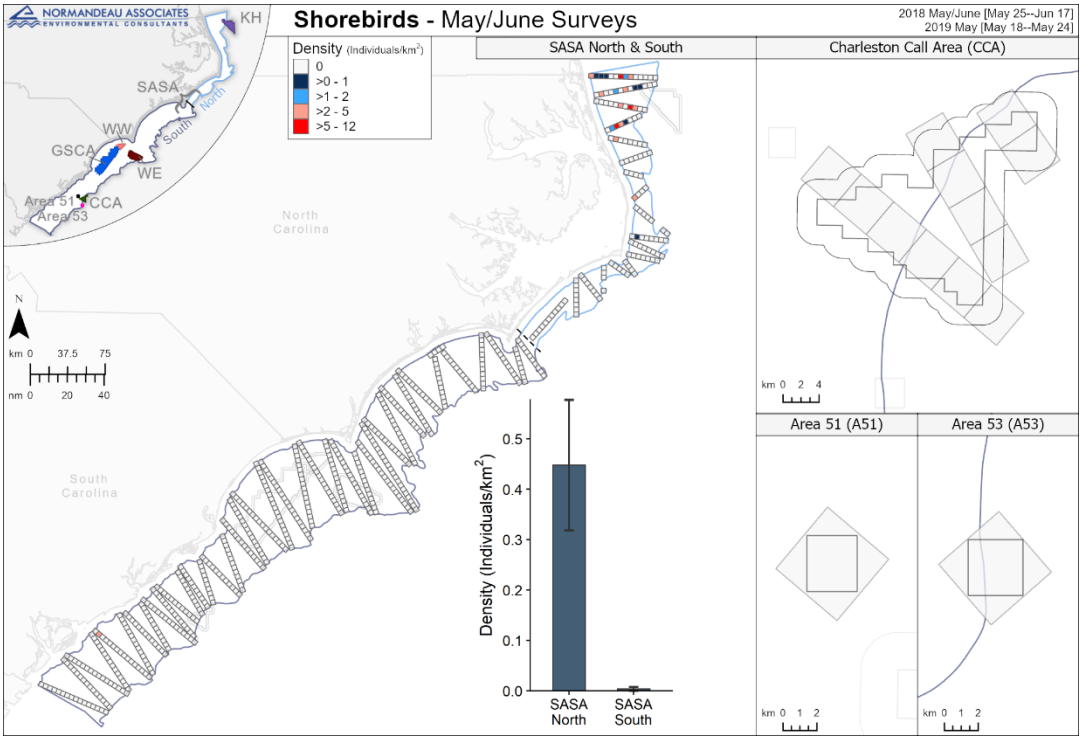


Figure C–116. Spatial distribution of peregrine falcons during the September/ October surveys for all areas

C.4.13 Shorebird



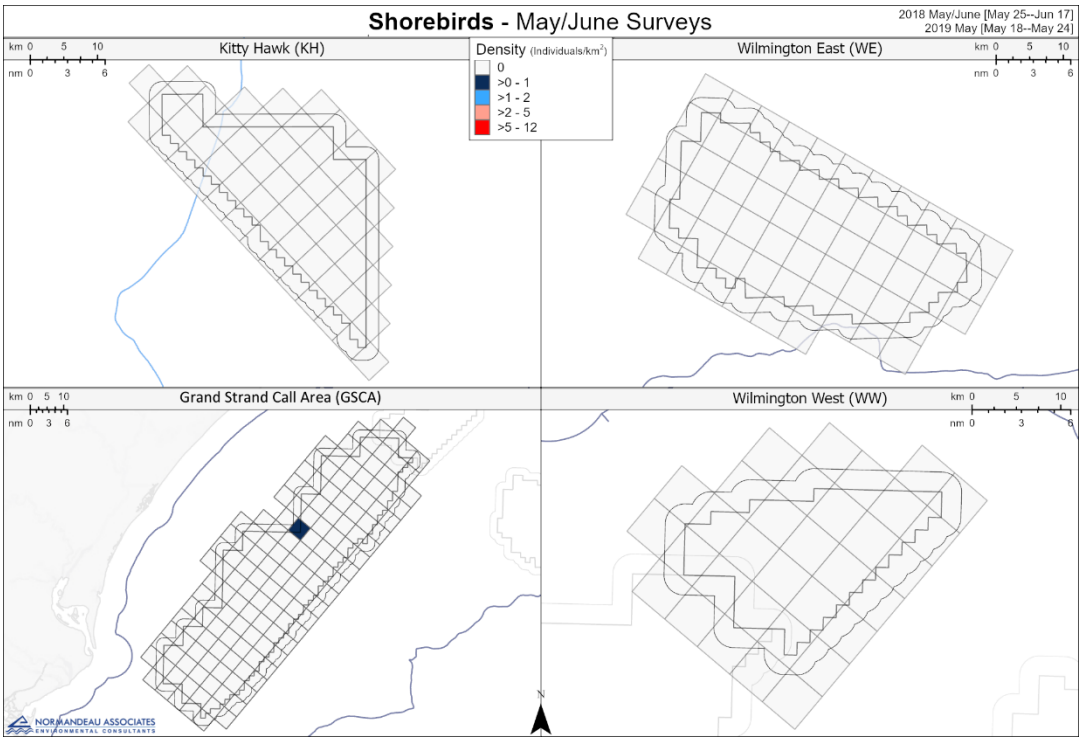


Figure C–117. Spatial distribution of all shorebird species during the May/June surveys for all areas

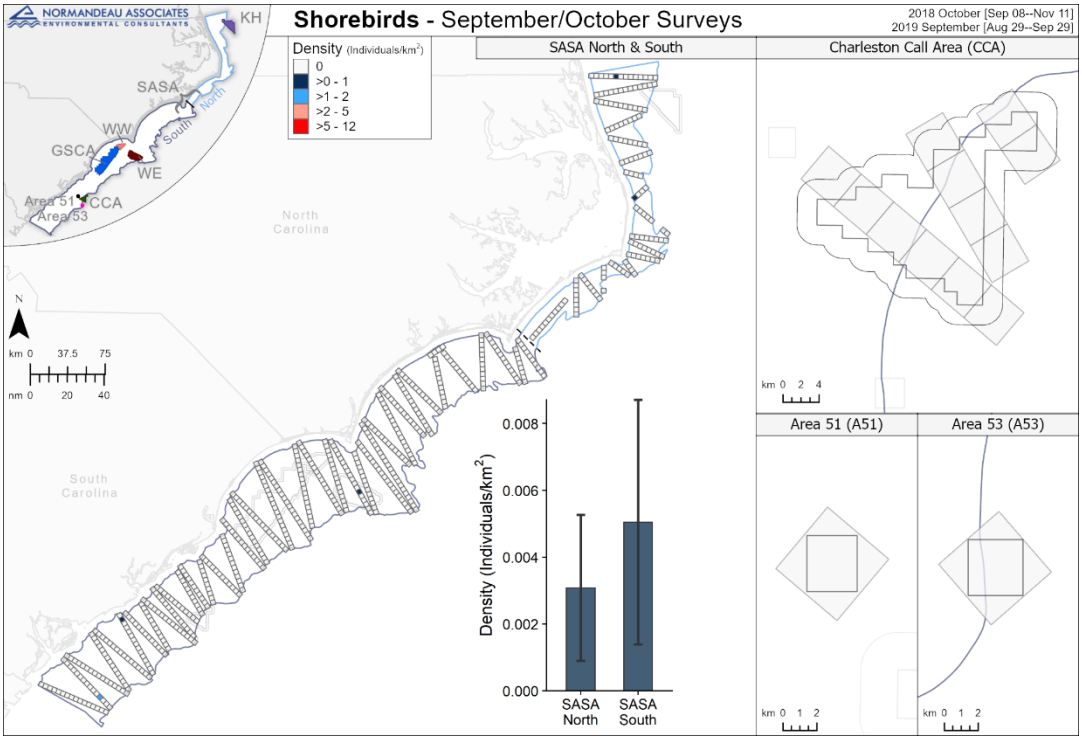


Figure C–118. Spatial distribution of all shorebird species during the September/ October surveys for all areas

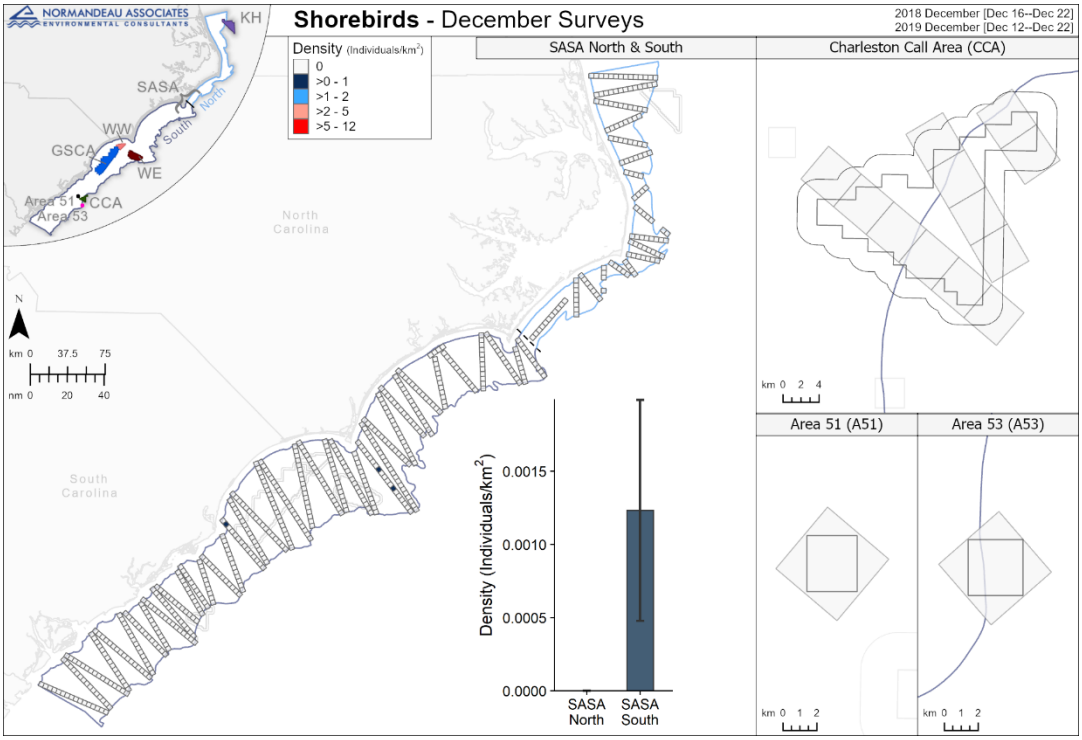


Figure C–119. Spatial distribution of all shorebird species during the December surveys for all areas

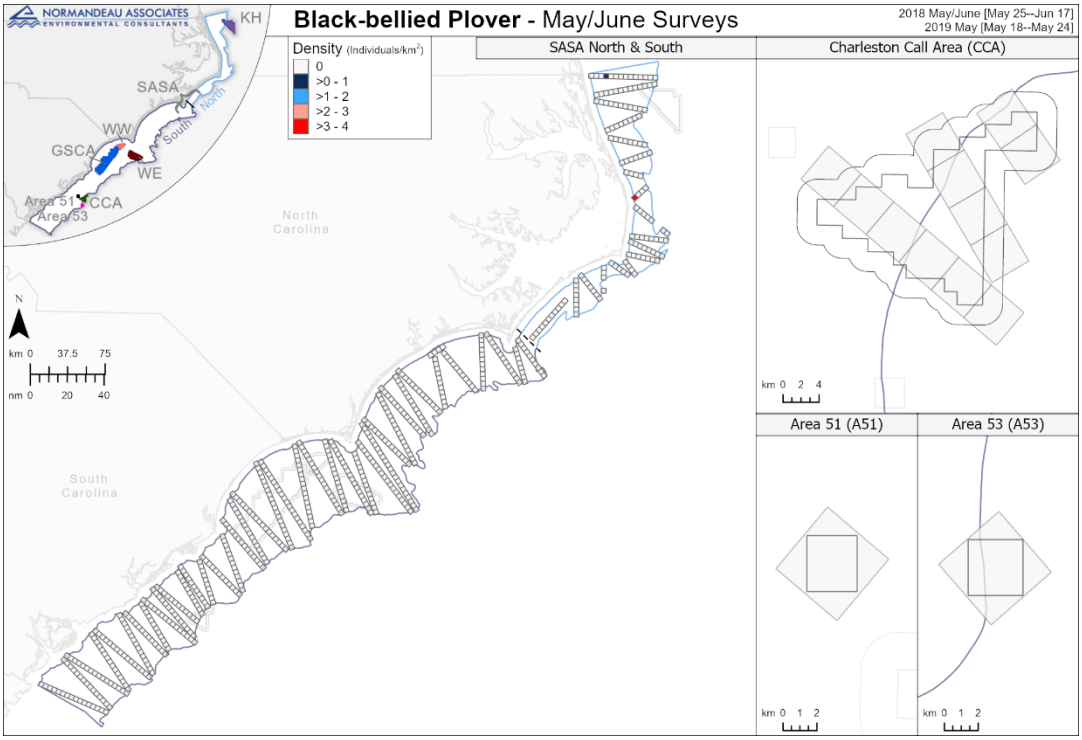


Figure C–120. Spatial distribution of black-bellied plovers during the May/June surveys for all areas

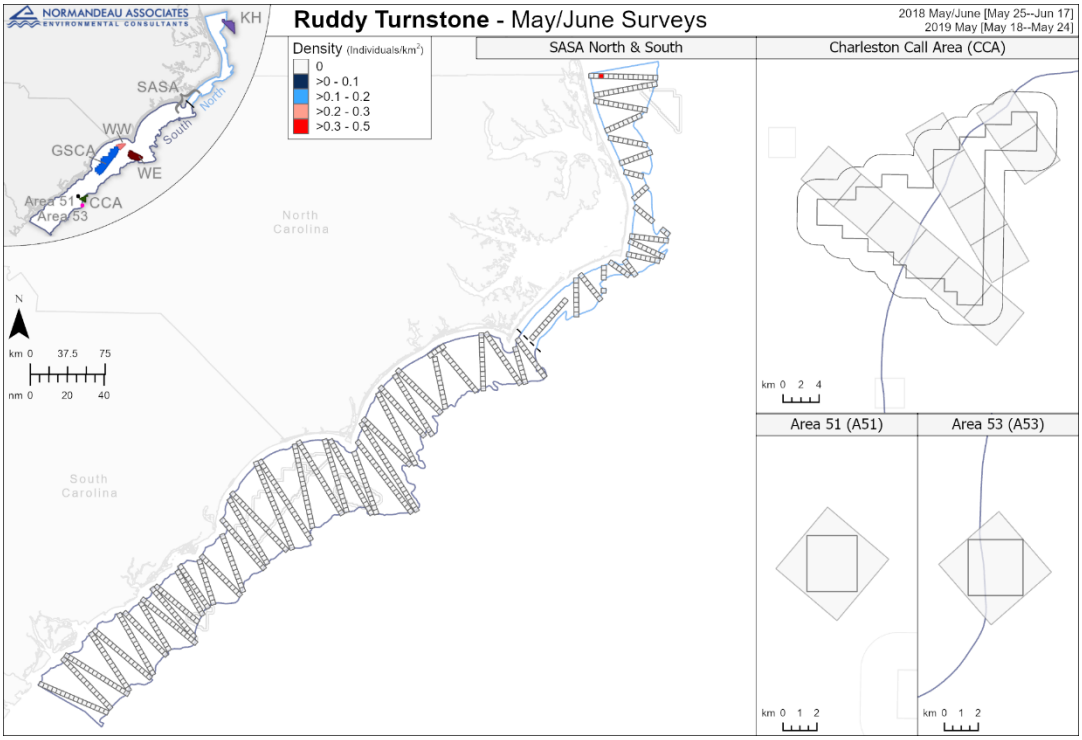


Figure C–121. Spatial distribution of ruddy turnstones during the May/June surveys for all areas

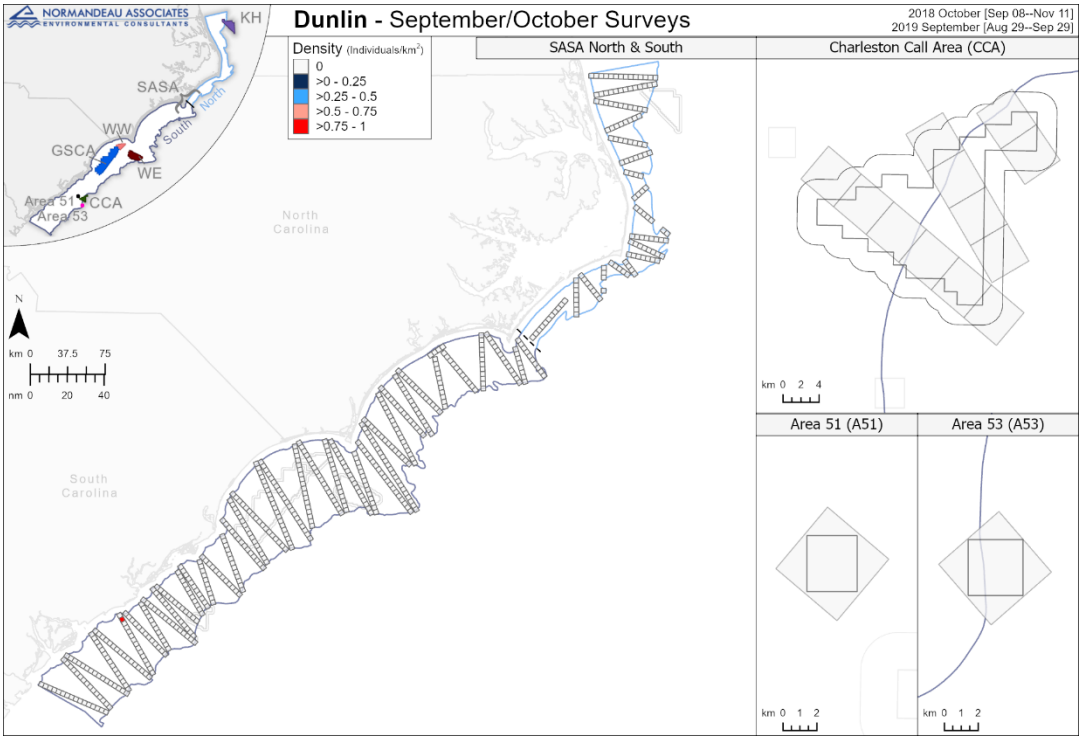


Figure C–122. Spatial distribution of dunlins during the September/October surveys for all areas

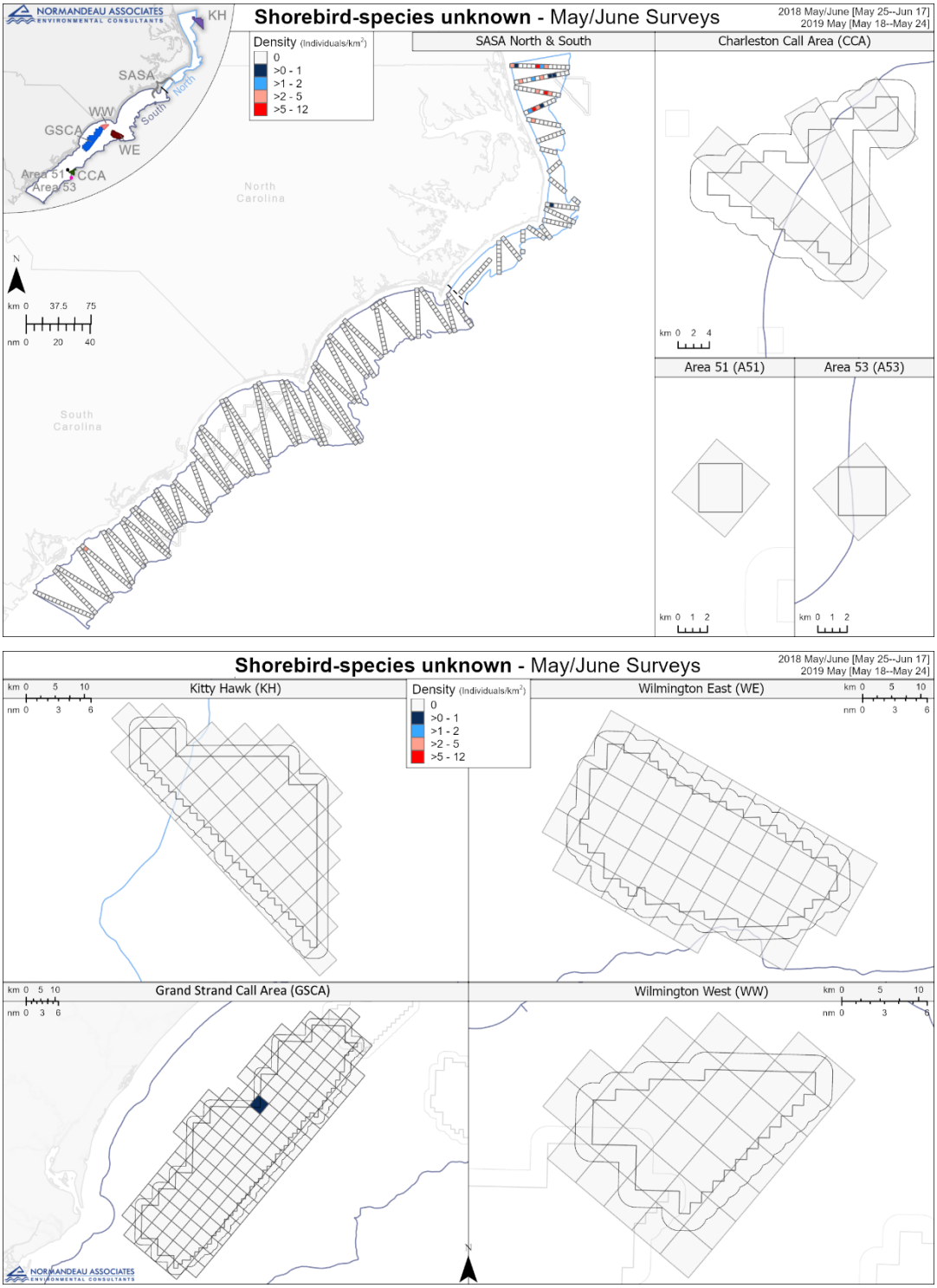


Figure C–123. Spatial distribution of shorebird-species unknown during the May/June surveys for all areas

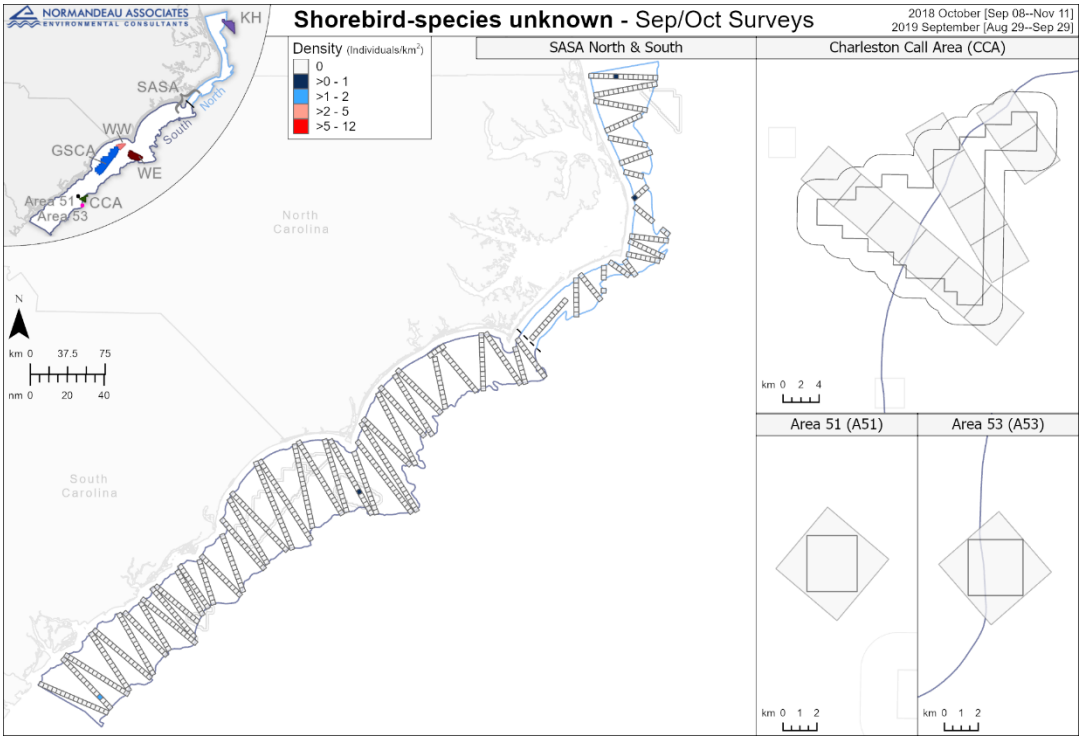


Figure C–124. Spatial distribution of shorebird-species unknown during the September/October surveys for all areas

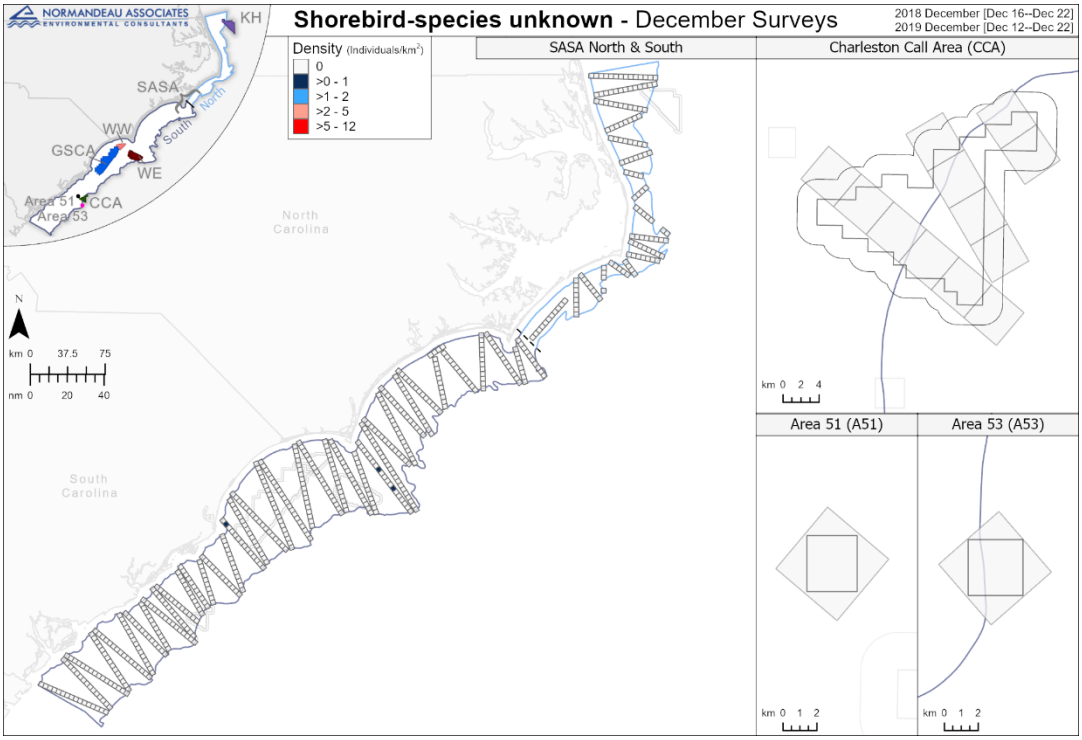


Figure C–125. Spatial distribution of shorebird-species unknown during the December surveys for all areas

C.4.14 Phalarope

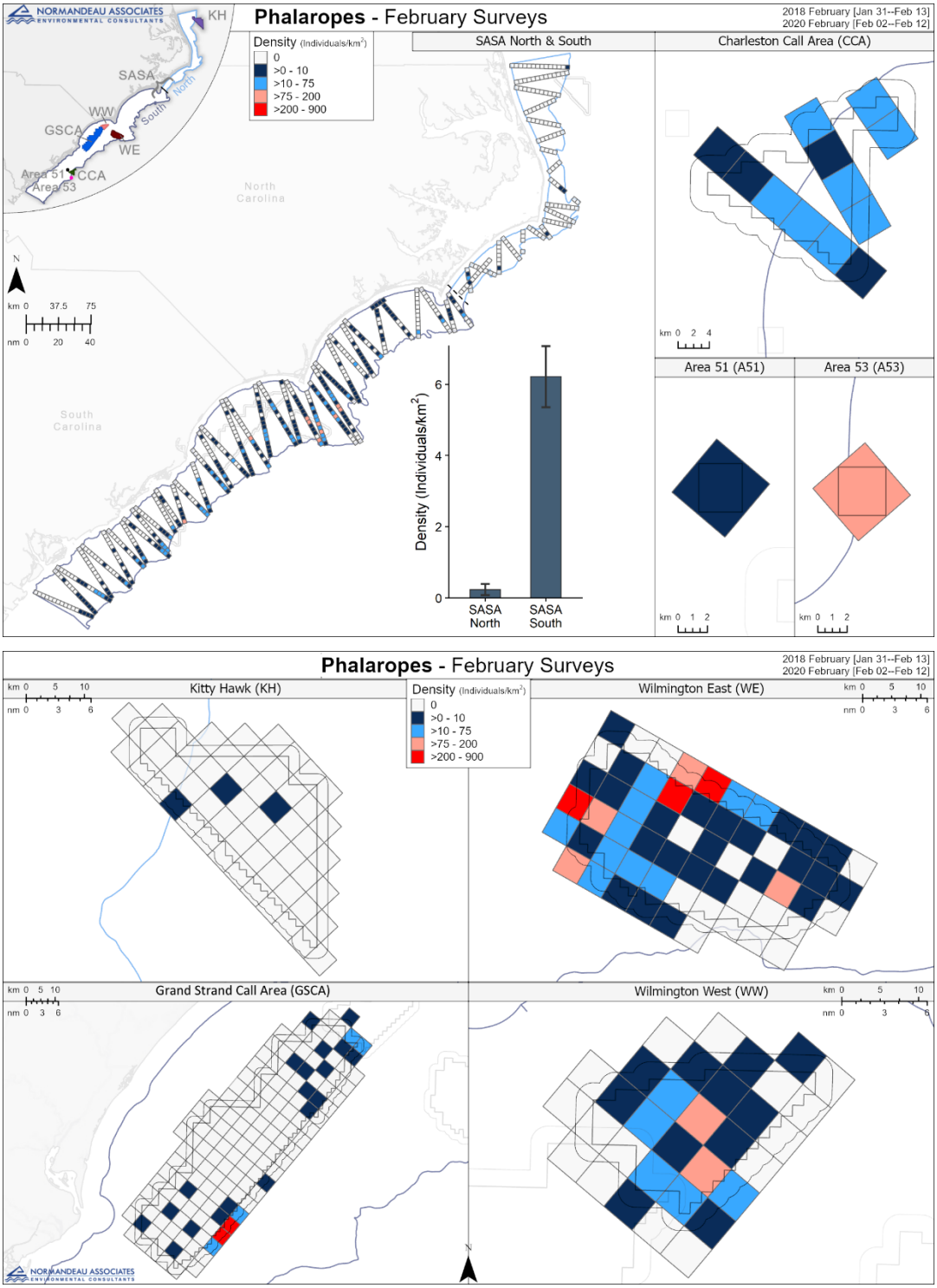


Figure C–126. Spatial distribution of all phalarope species during the February surveys for all areas

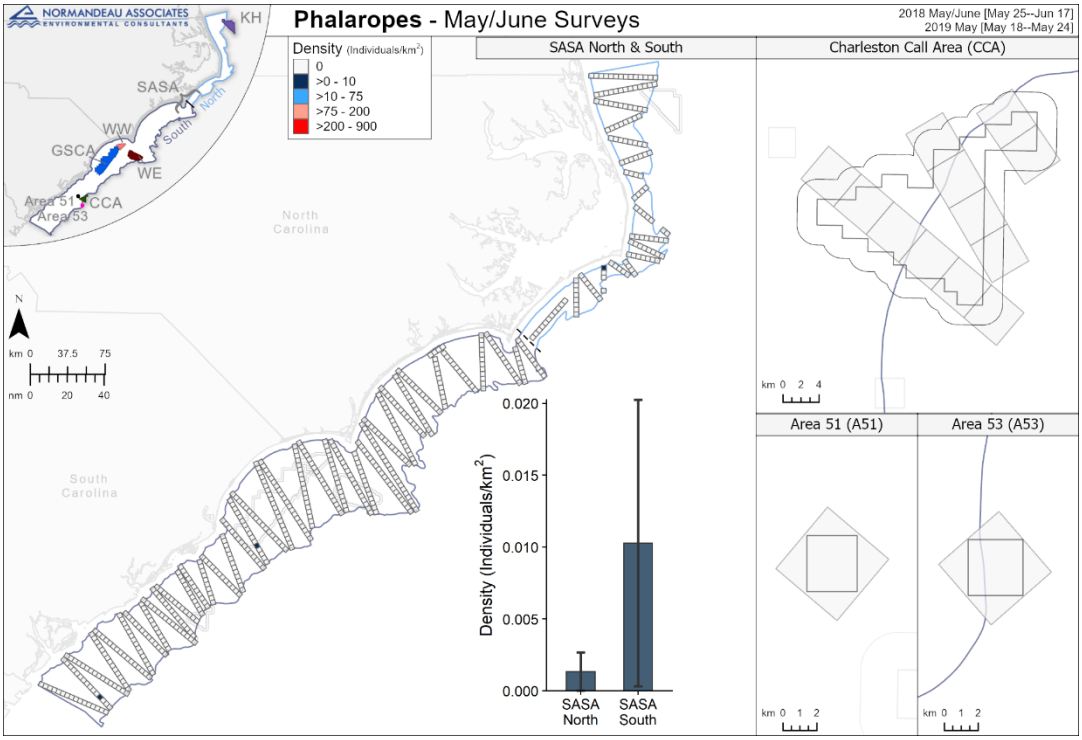


Figure C–127. Spatial distribution of all phalarope species during the May/June surveys for all areas

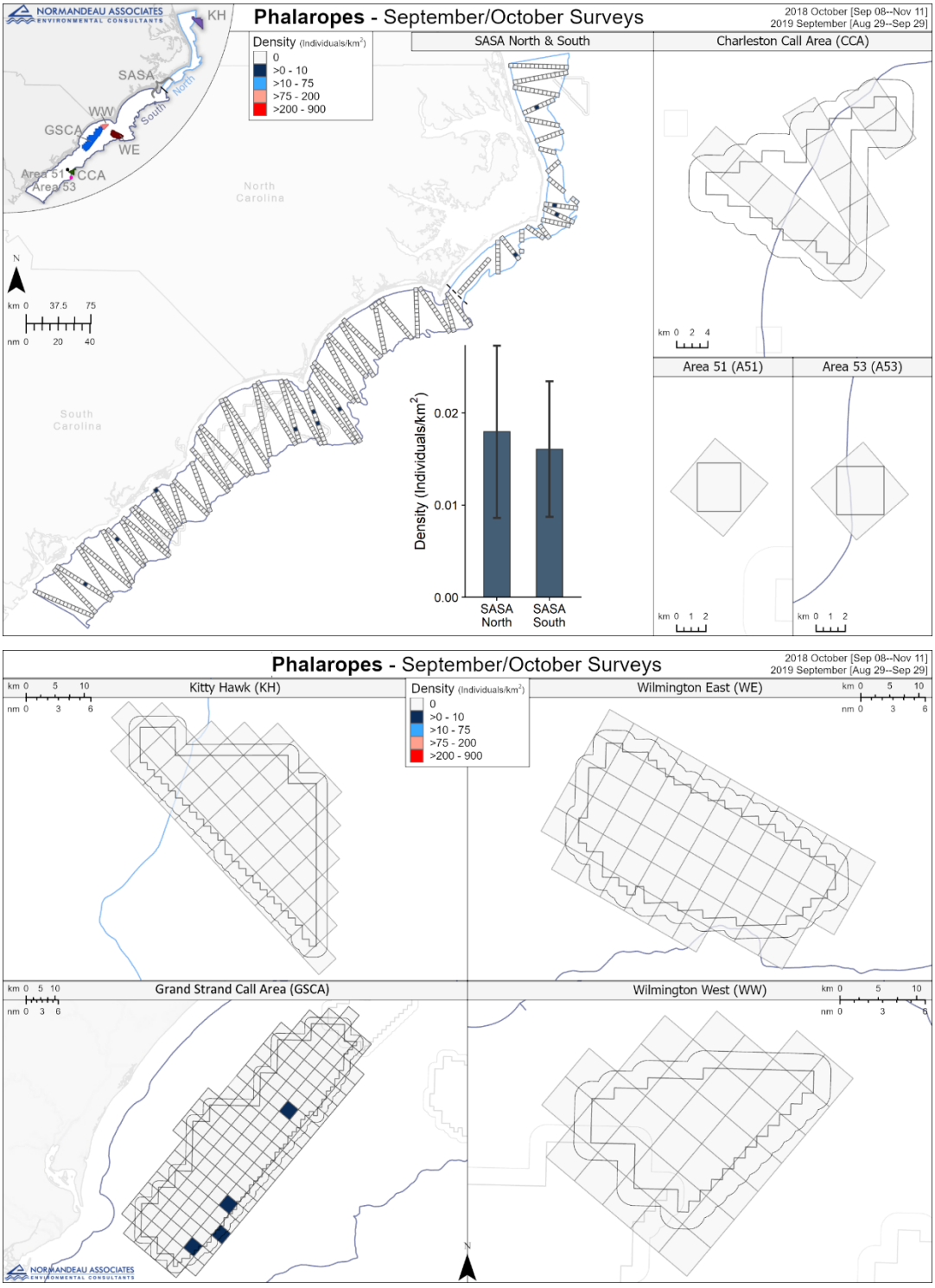


Figure C–128. Spatial distribution of all phalarope species during the September/ October surveys for all areas

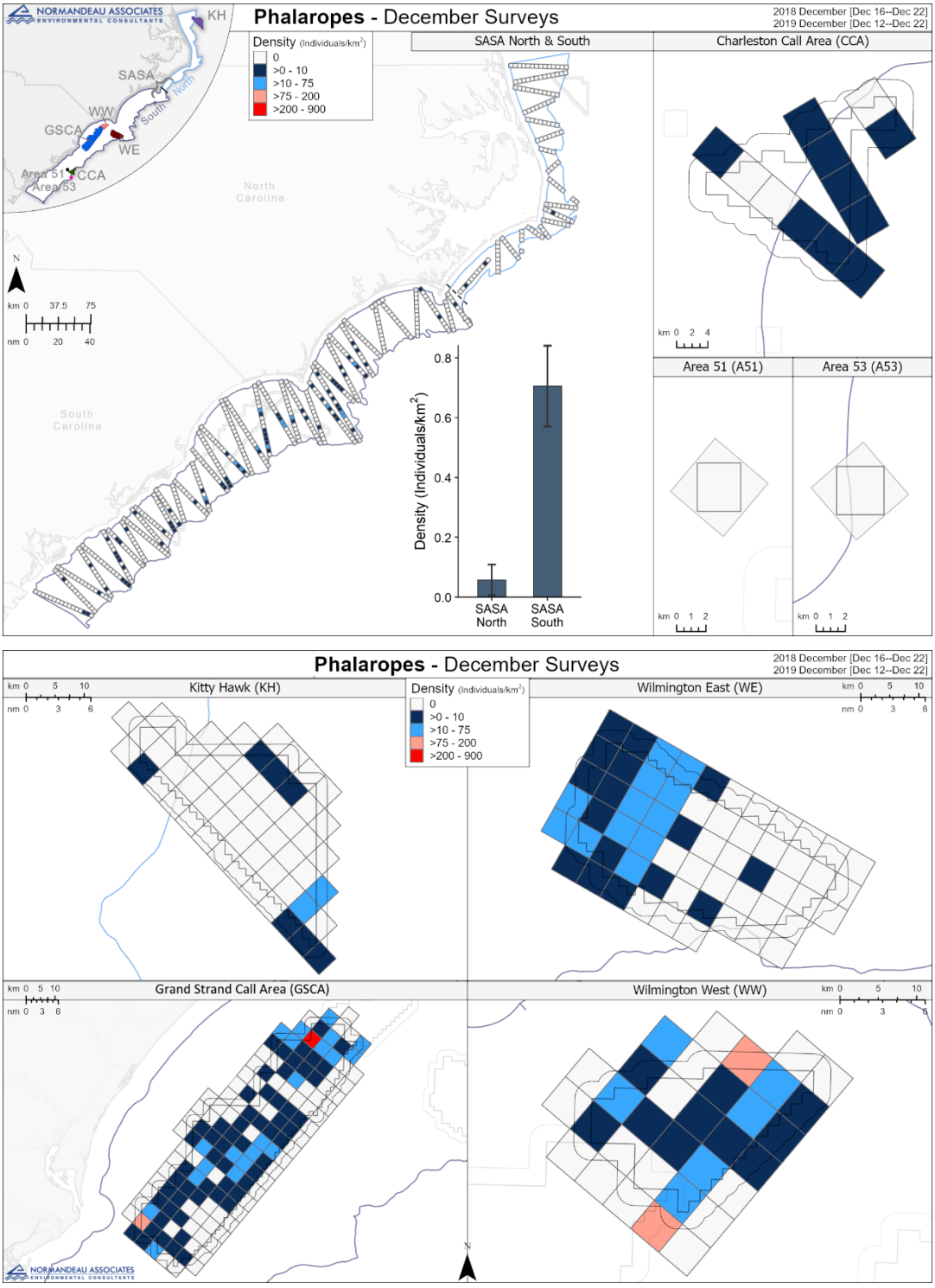


Figure C–129. Spatial distribution of all phalarope species during the December surveys for all areas

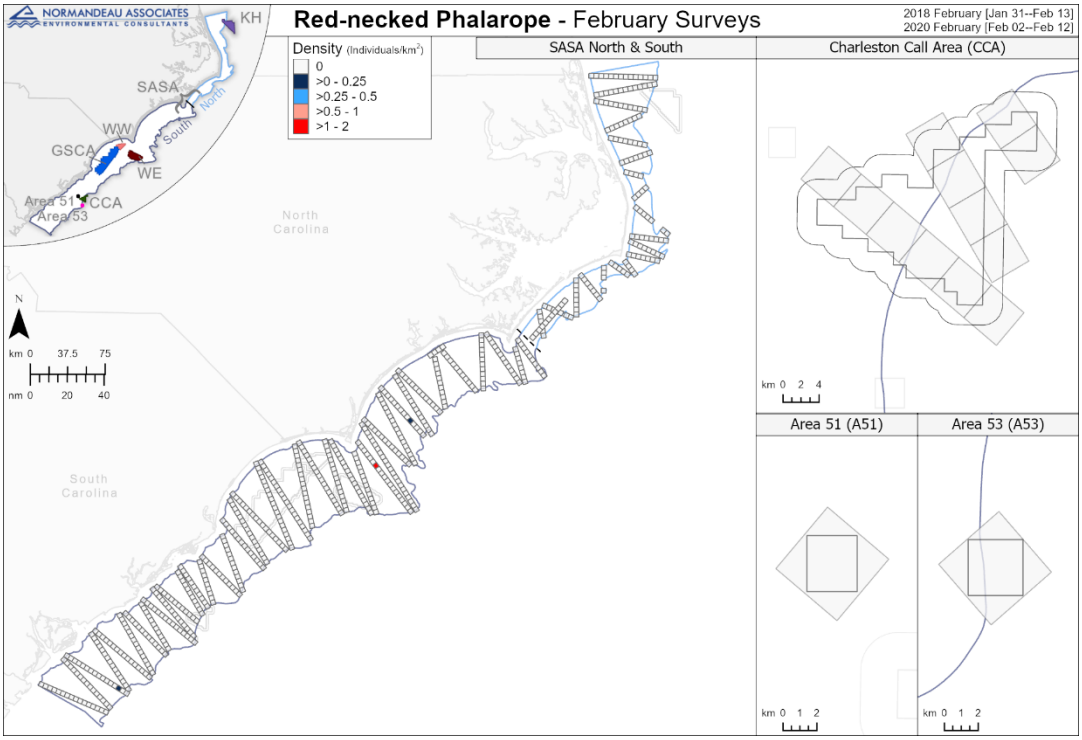


Figure C–130. Spatial distribution of red-necked phalaropes during the February surveys for all areas

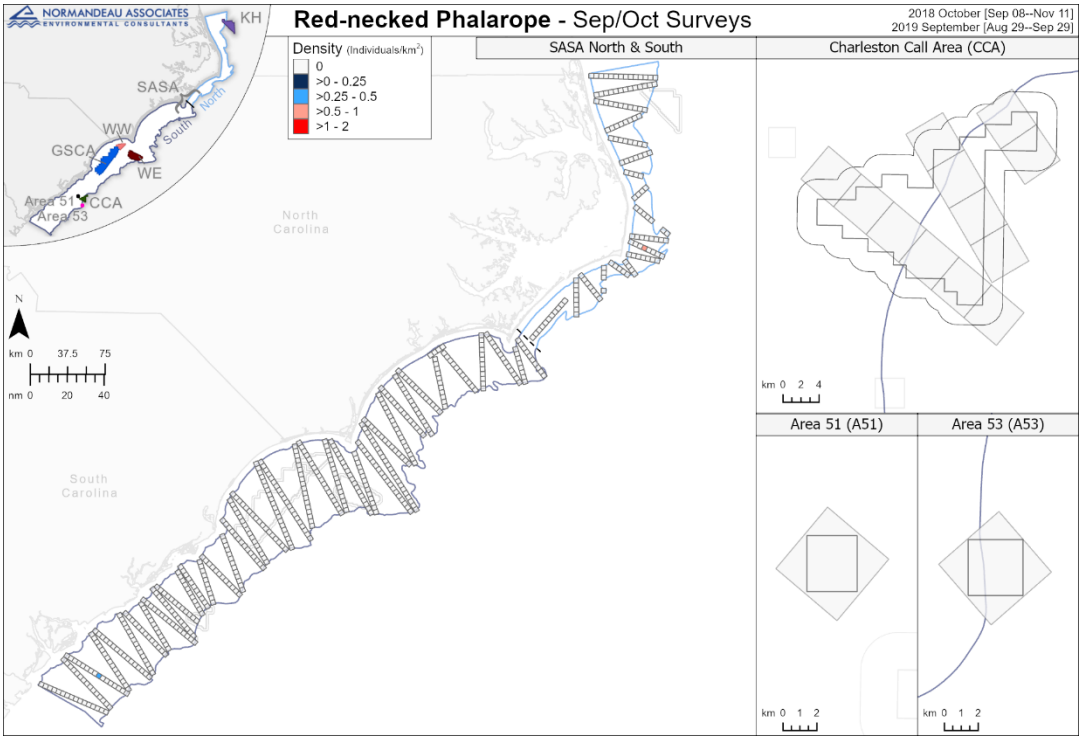


Figure C–131. Spatial distribution of red-necked phalaropes during the September/ October surveys for all areas

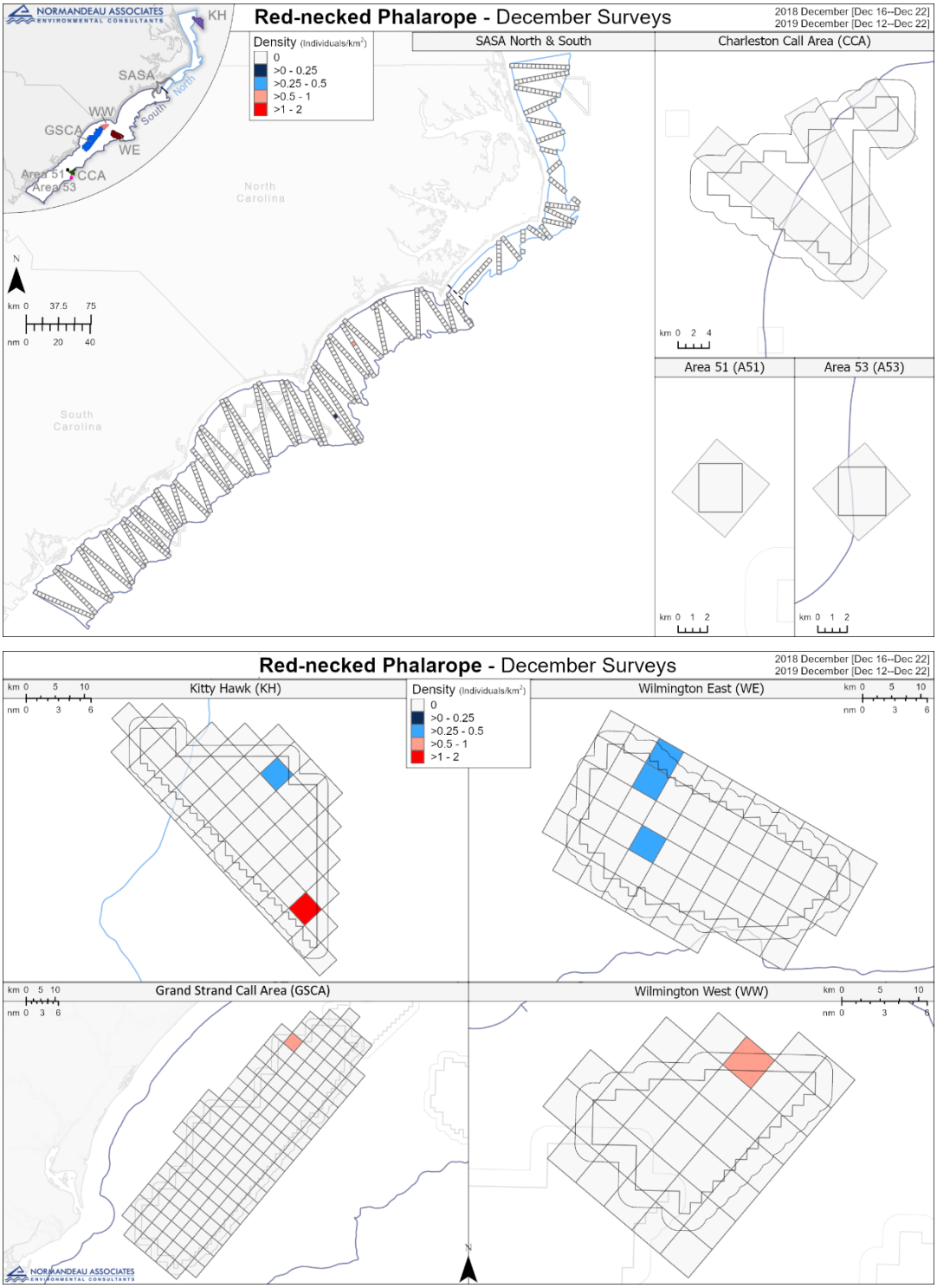


Figure C–132. Spatial distribution of red-necked phalaropes during the December surveys for all areas

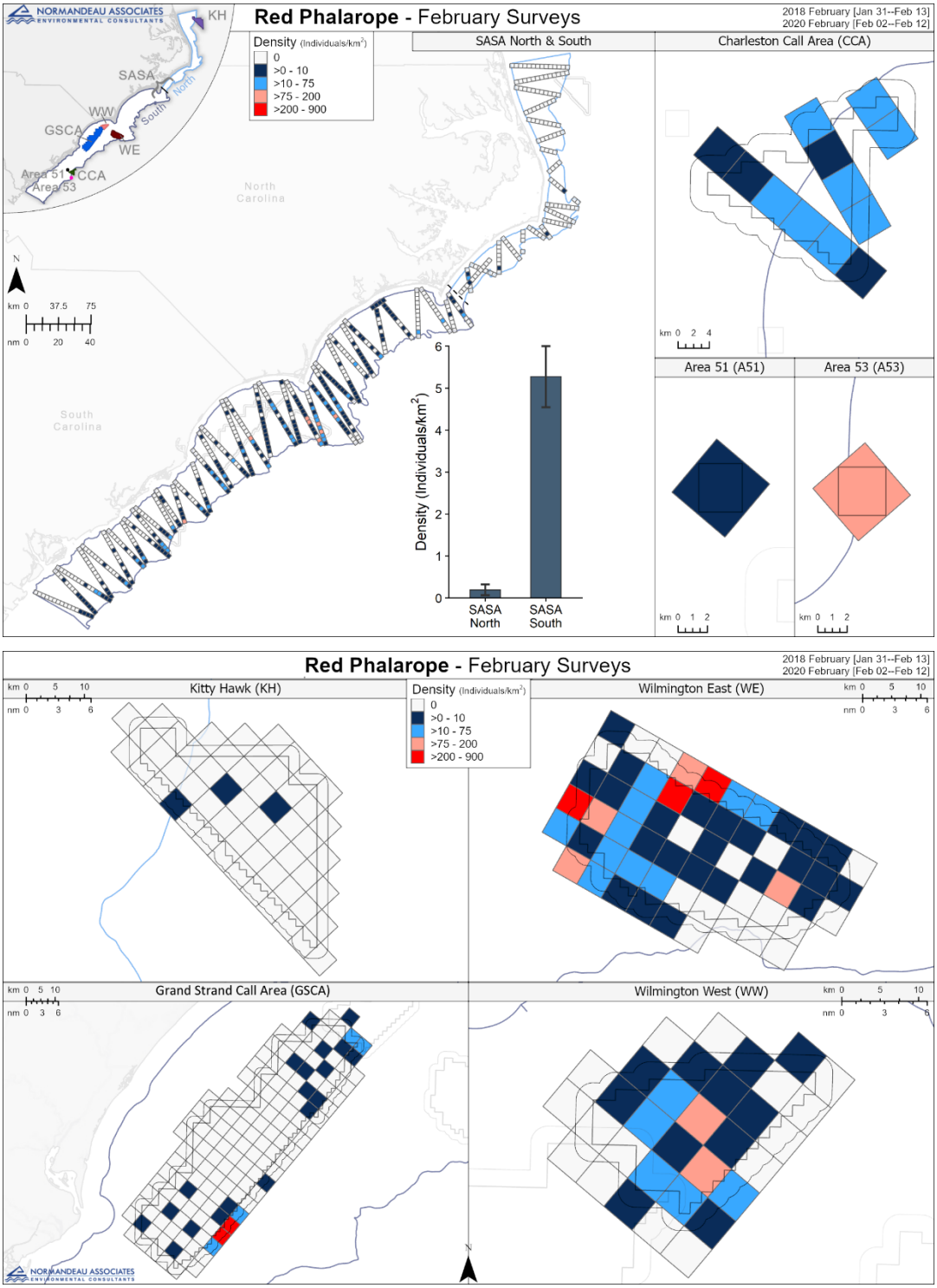


Figure C–133. Spatial distribution of red phalaropes during the February surveys for all areas

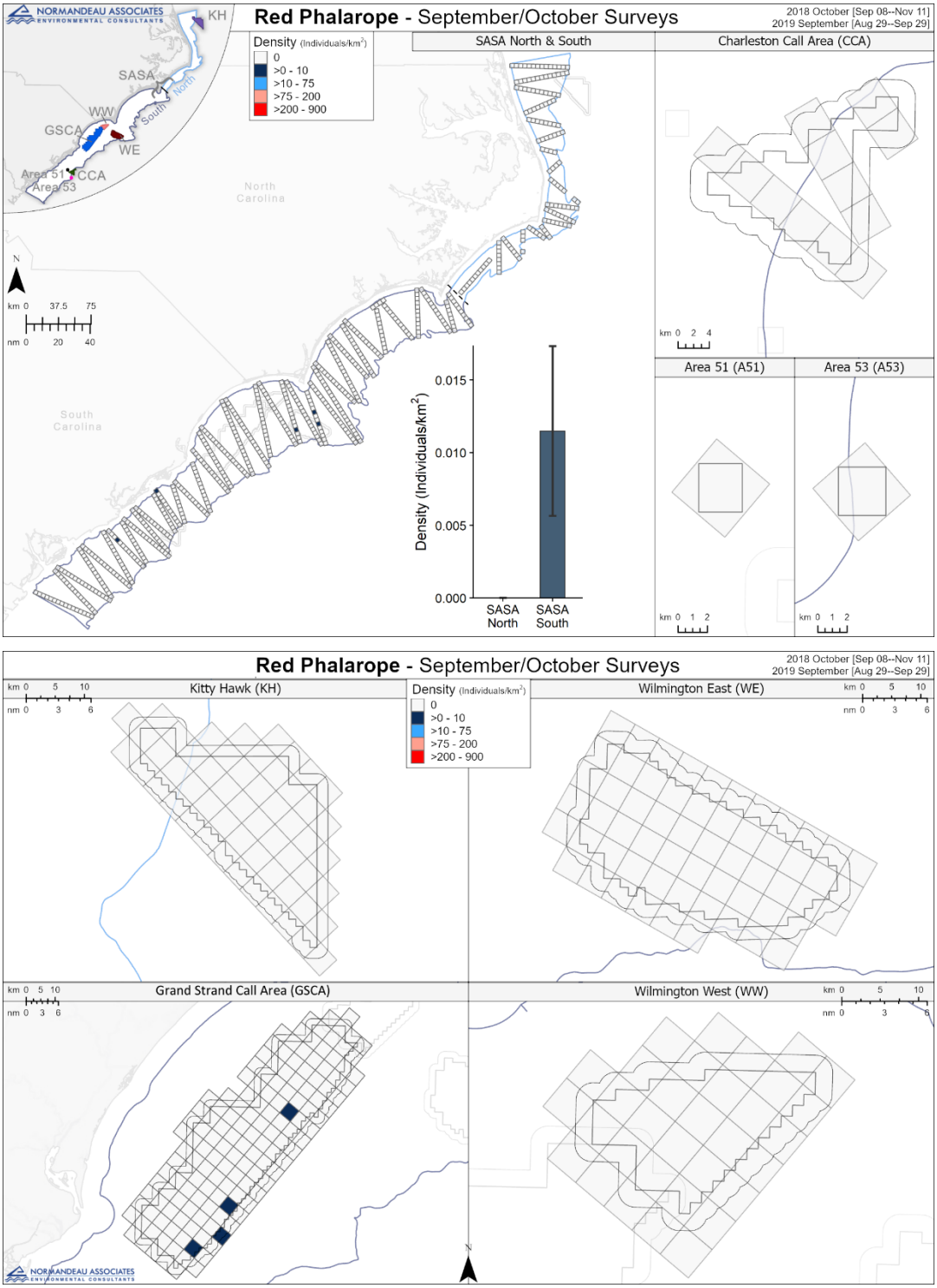


Figure C–134. Spatial distribution of red phalaropes during the September/October surveys for all areas

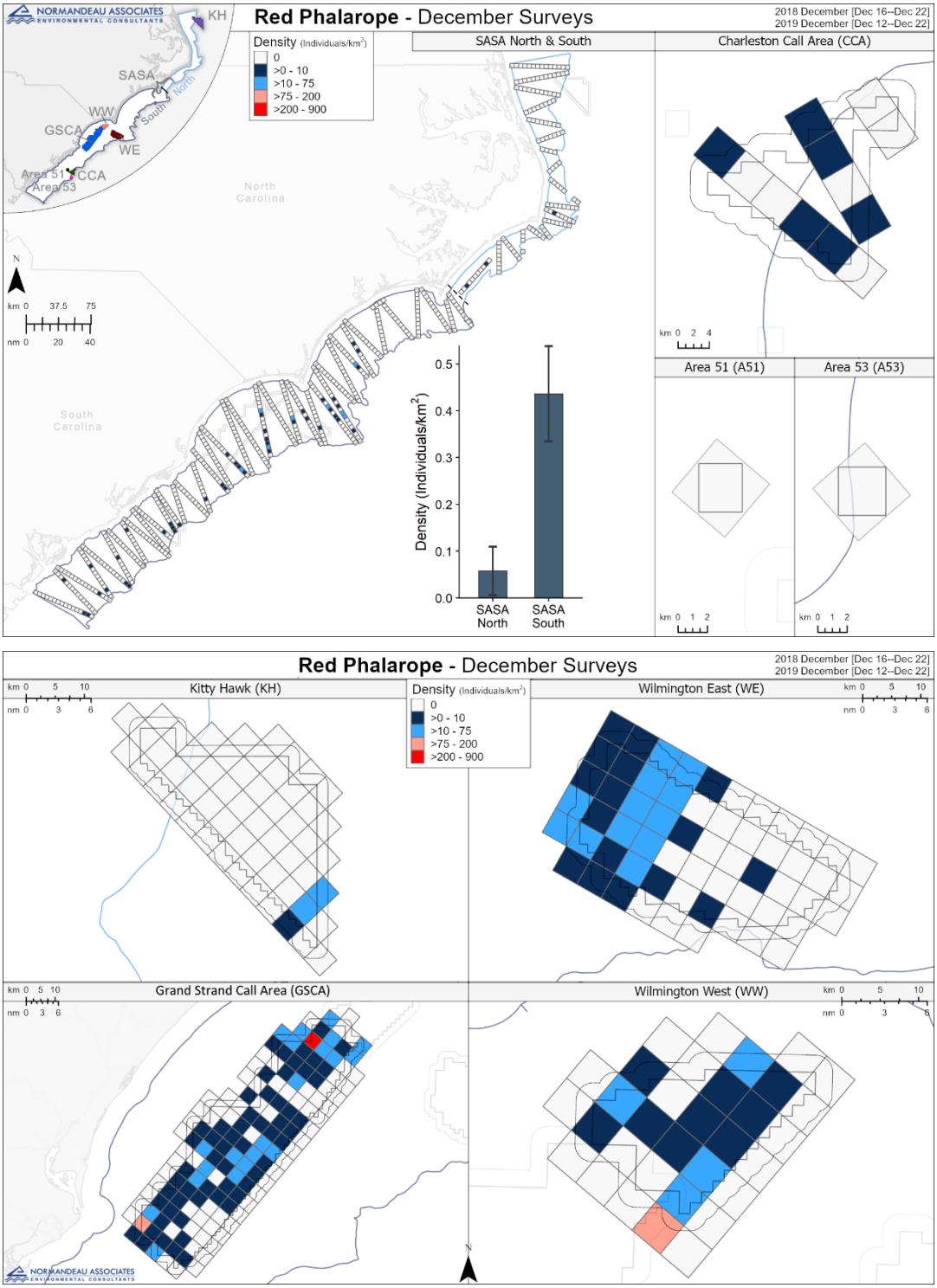


Figure C–135. Spatial distribution of red phalaropes during the December surveys for all areas

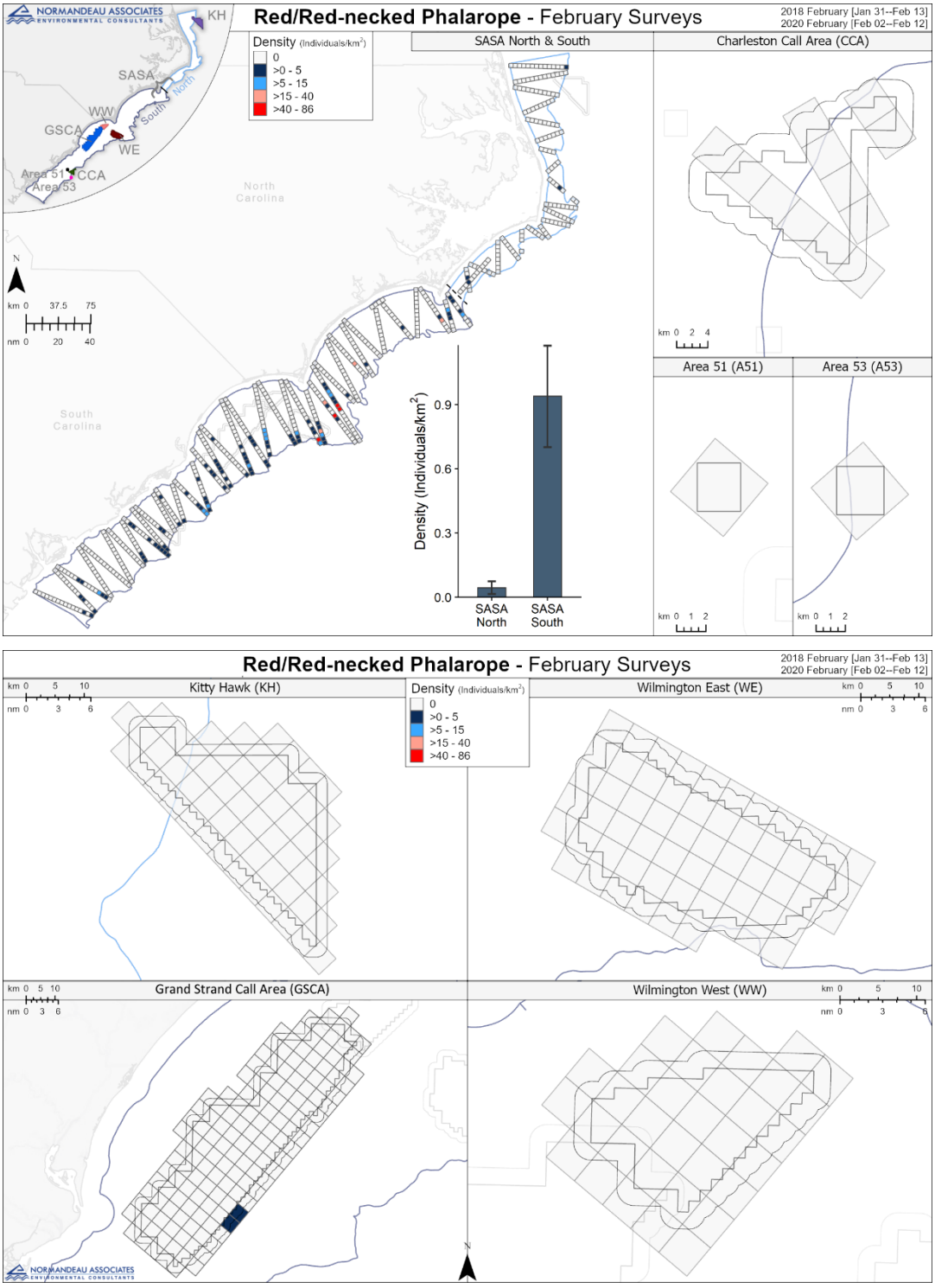


Figure C–136. Spatial distribution of red/red-necked phalaropes during the February surveys for all areas

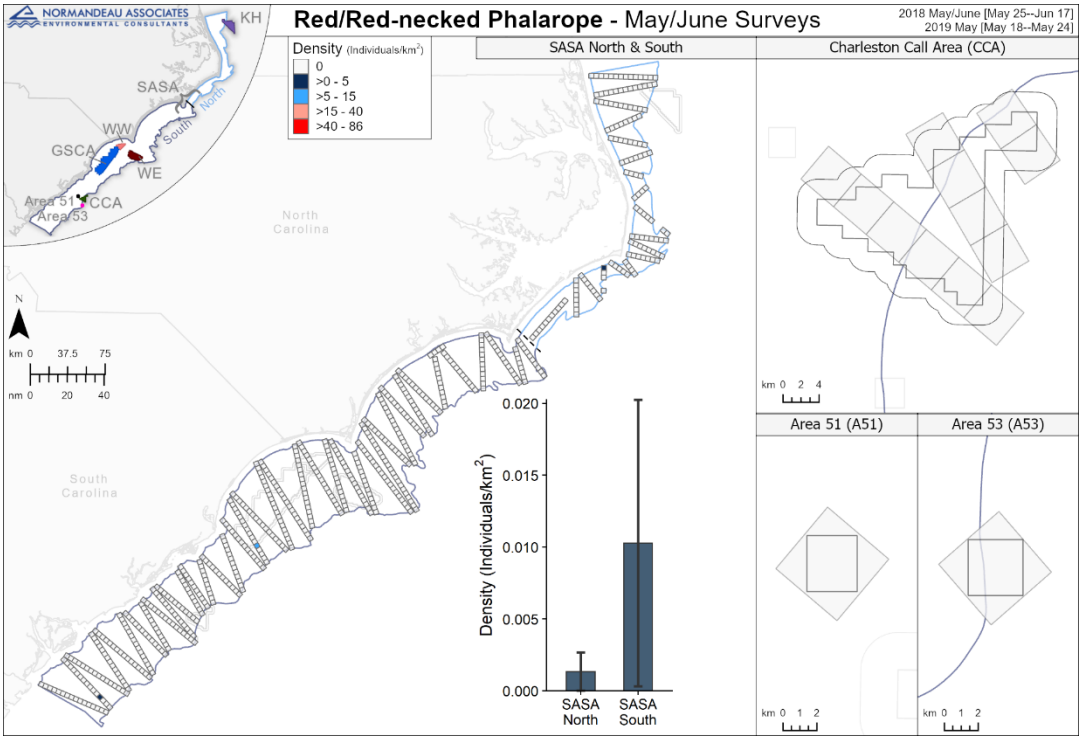


Figure C–137. Spatial distribution of red/red-necked phalaropes during the May/June surveys for all areas

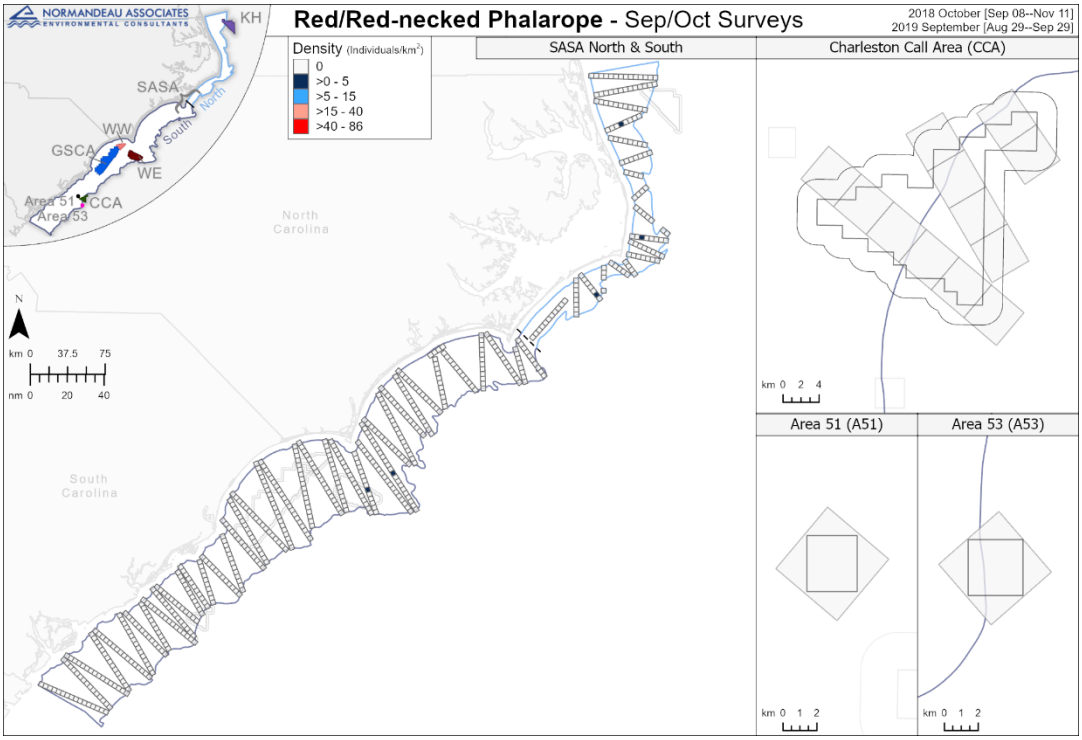


Figure C–138. Spatial distribution of red/red-necked phalaropes during the September/October surveys for all areas

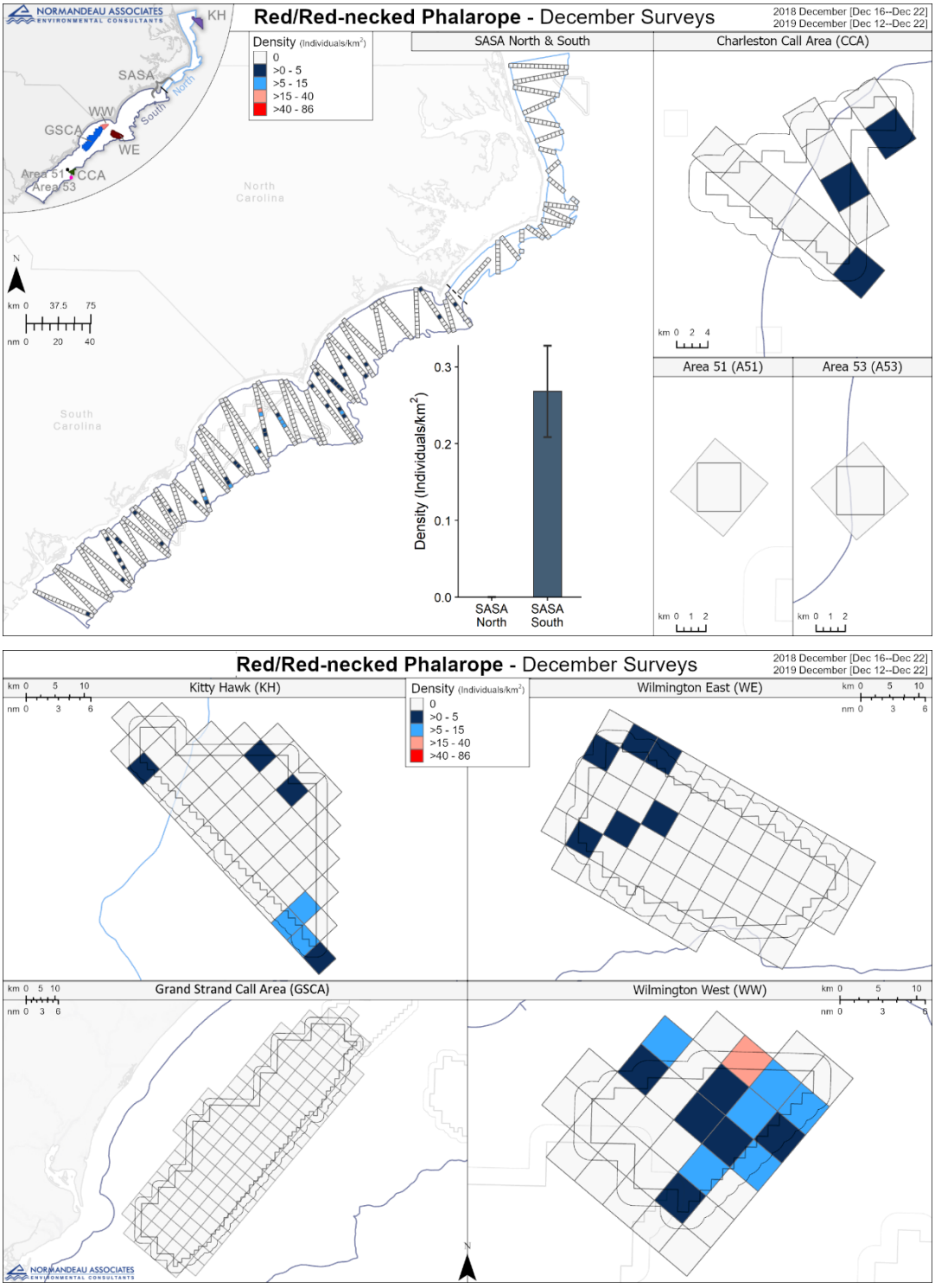


Figure C–139. Spatial distribution of red/red-necked phalaropes during the December surveys for all areas

C.4.15 Skua

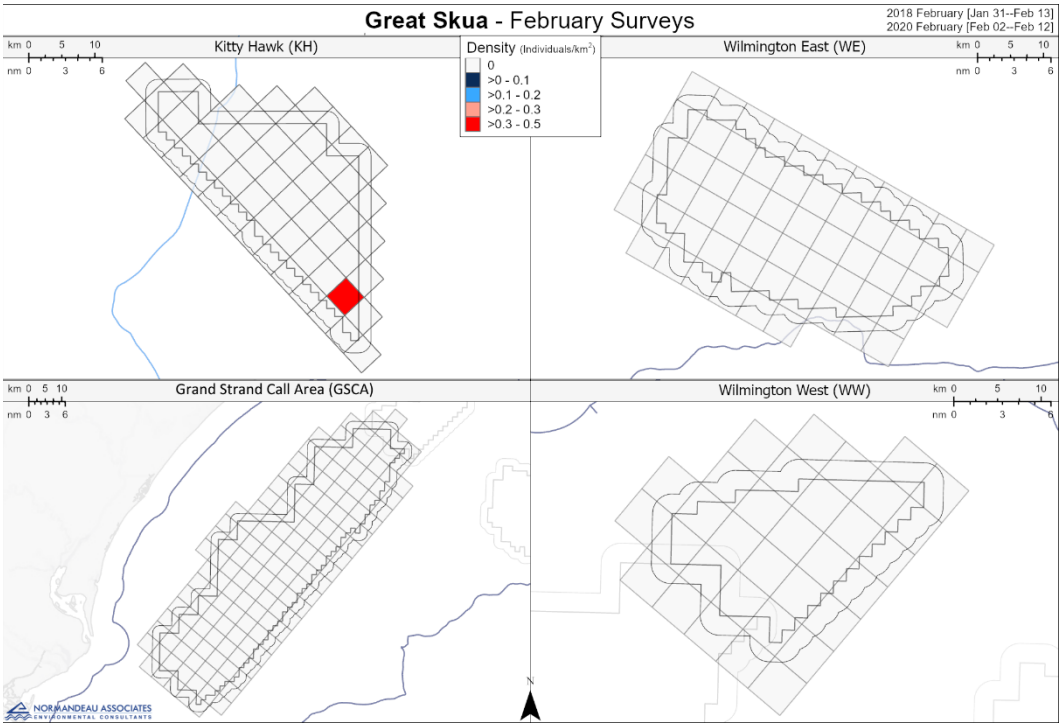


Figure C–140. Spatial distribution of great skuas during the February surveys for all areas

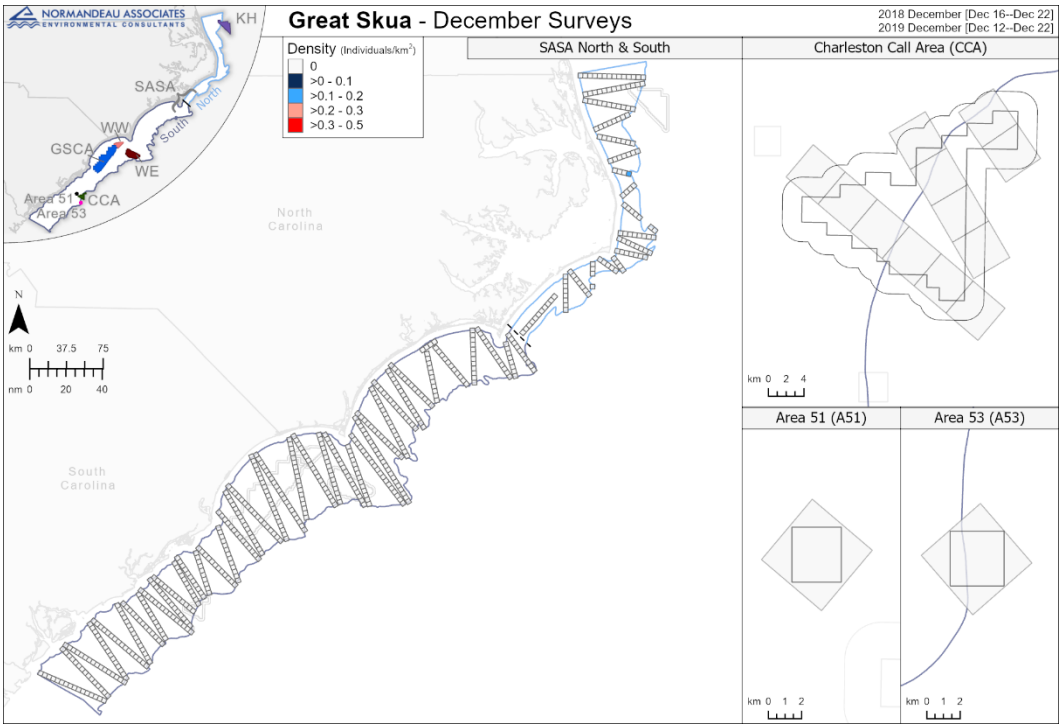


Figure C–141. Spatial distribution of great skuas during the December surveys for all areas

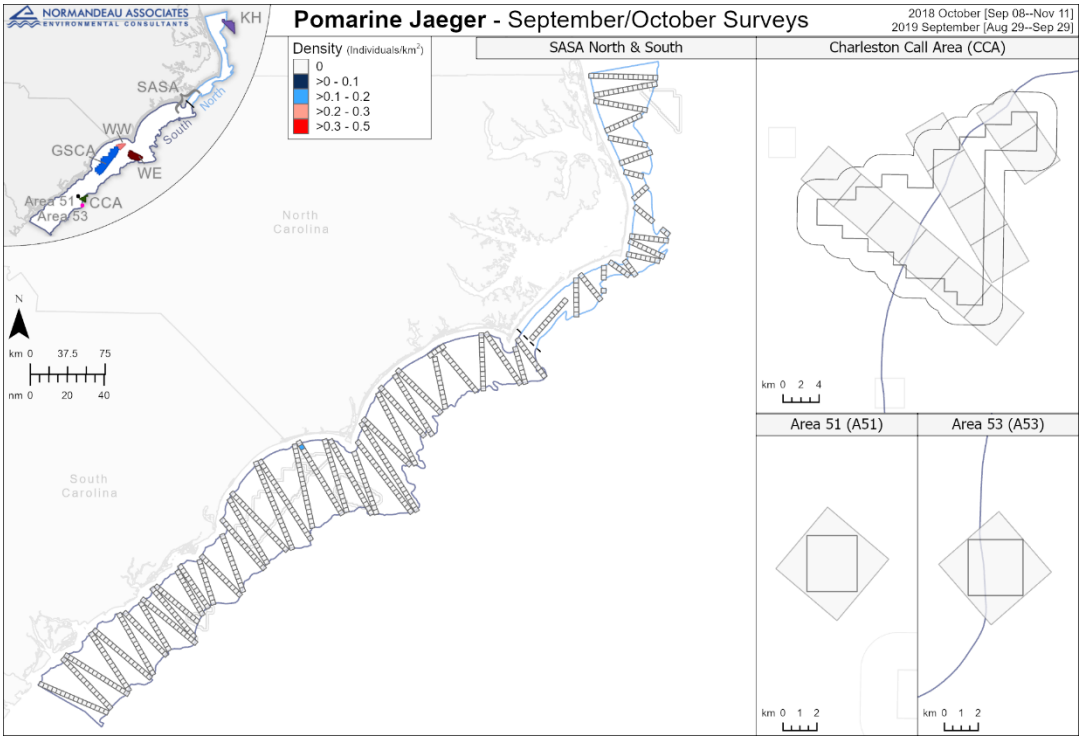


Figure C–142. Spatial distribution of pomarine jaegers during the September/ October surveys for all areas

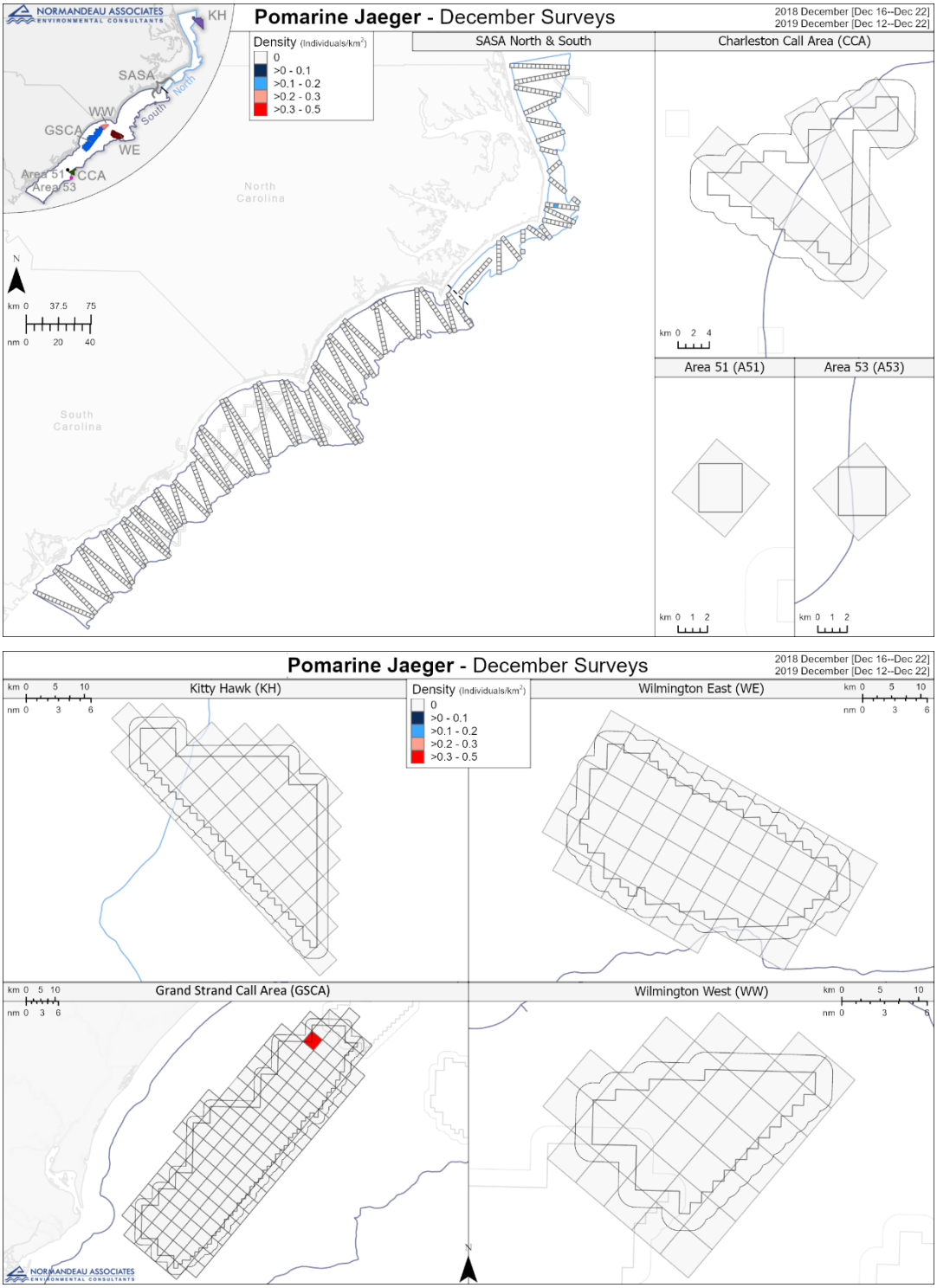


Figure C–143. Spatial distribution of pomarine jaegers during the December surveys for all areas

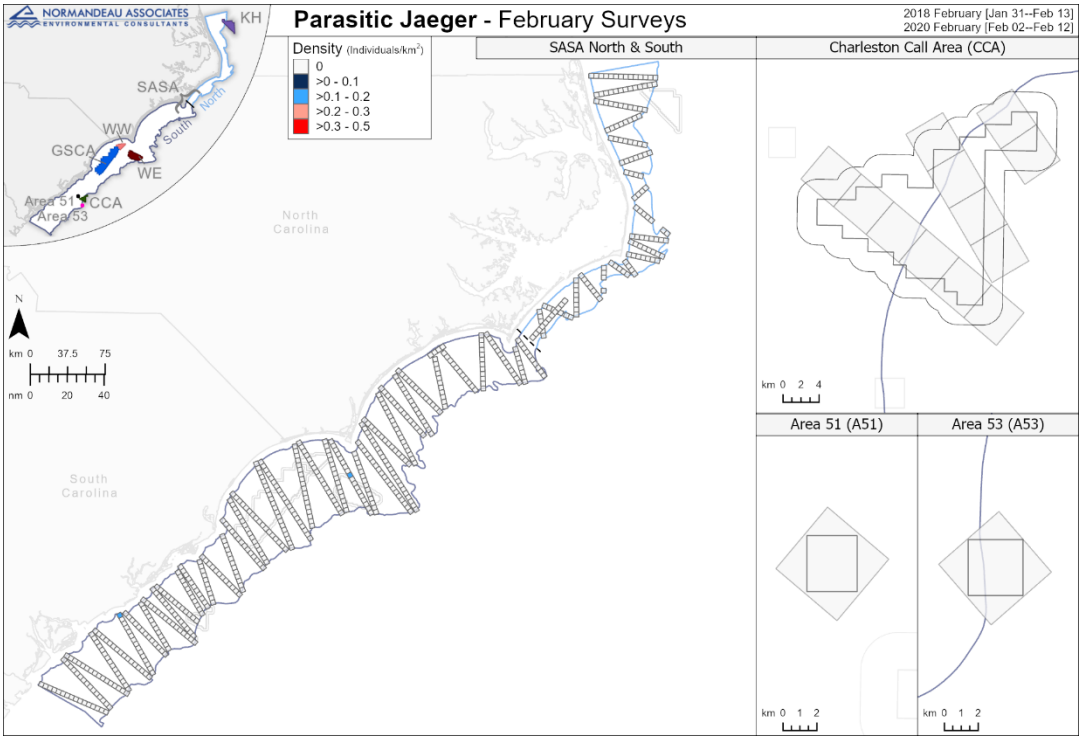


Figure C–144. Spatial distribution of parasitic jaegers during the February surveys for all areas

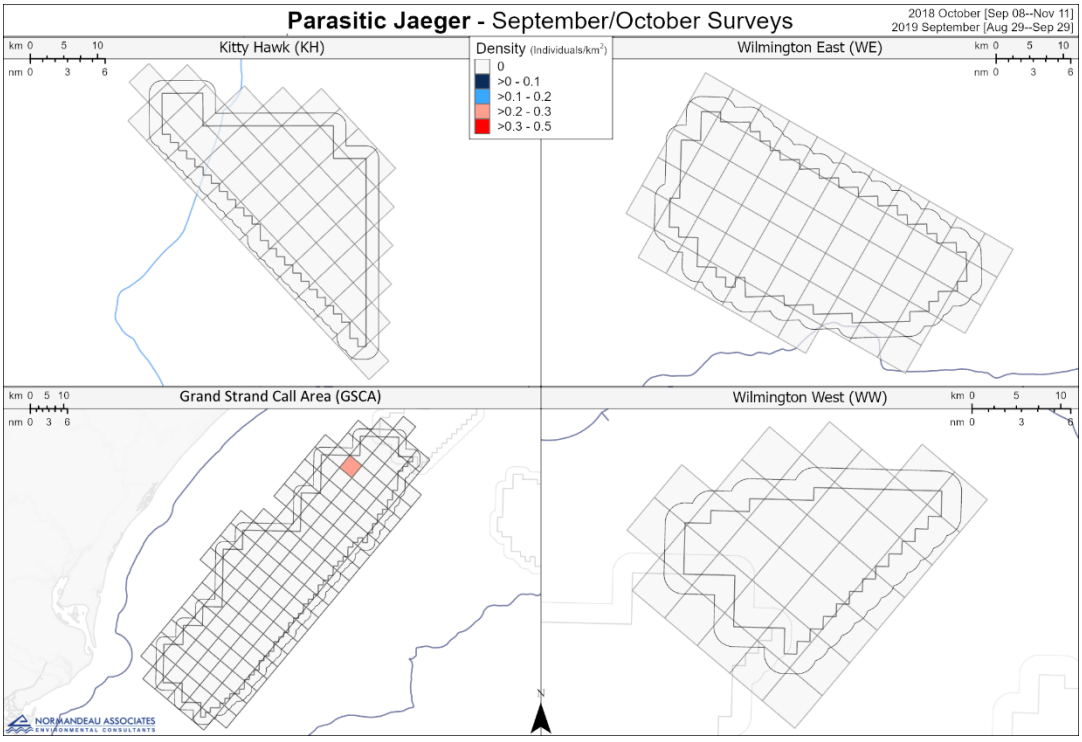


Figure C–145. Spatial distribution of parasitic jaegers during the September/ October surveys for all areas

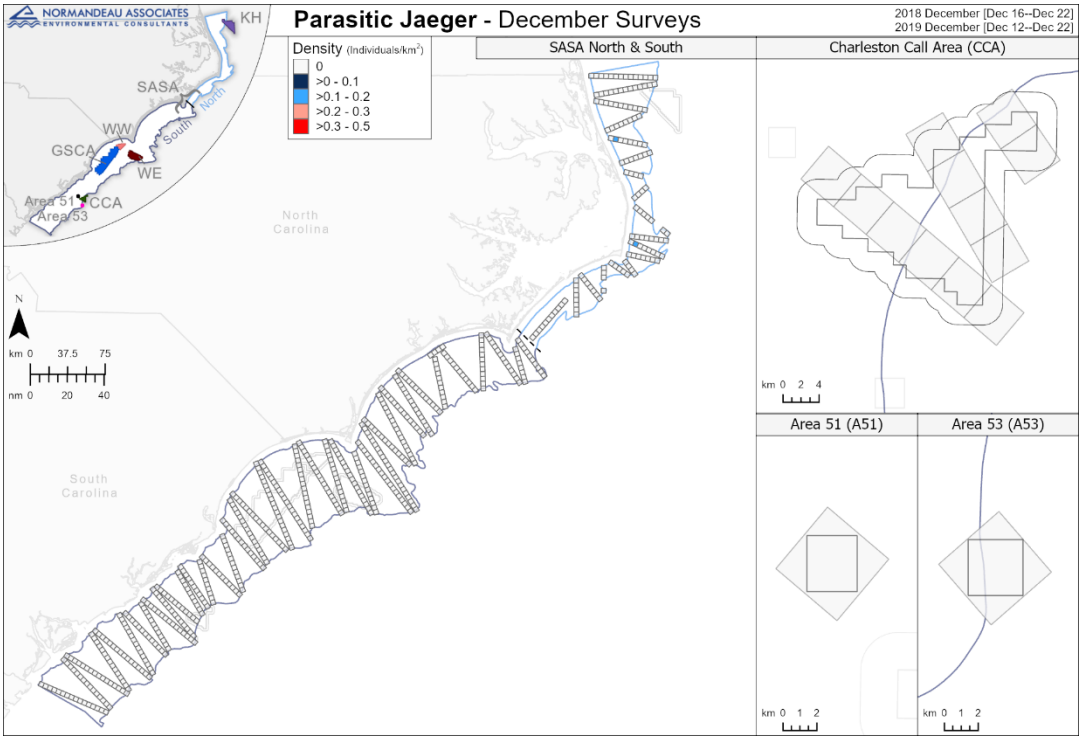


Figure C–146. Spatial distribution of parasitic jaegers during the December surveys for all areas

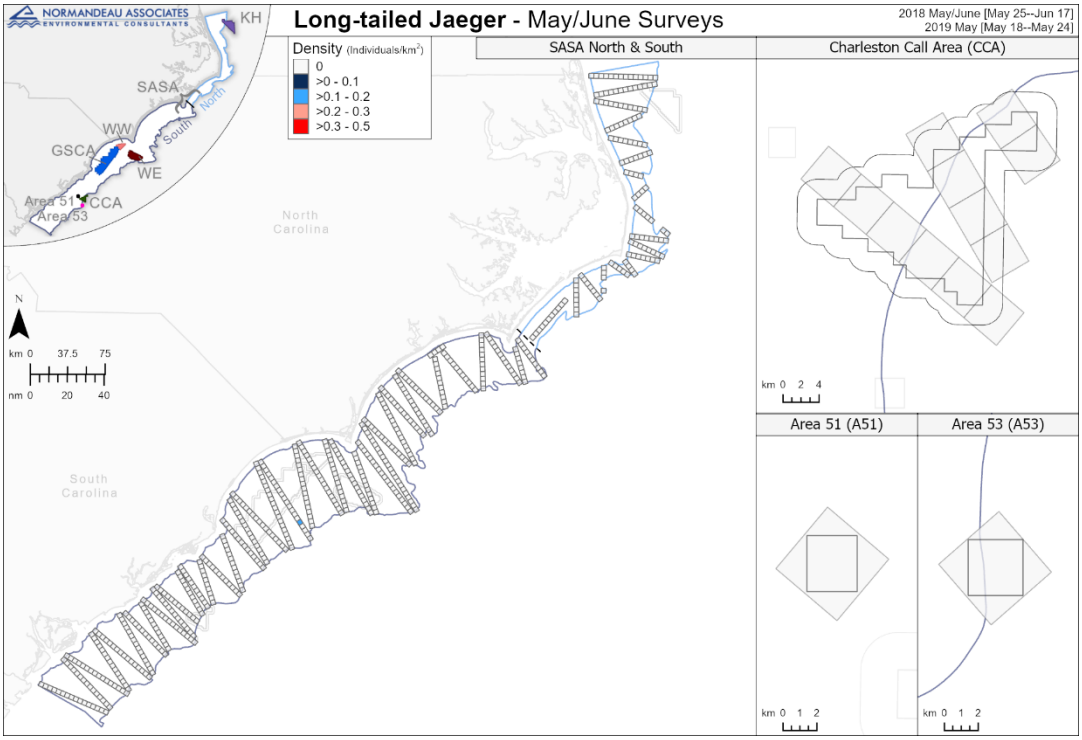


Figure C–147. Spatial distribution of long-tailed jaegers during the May/June surveys for all areas

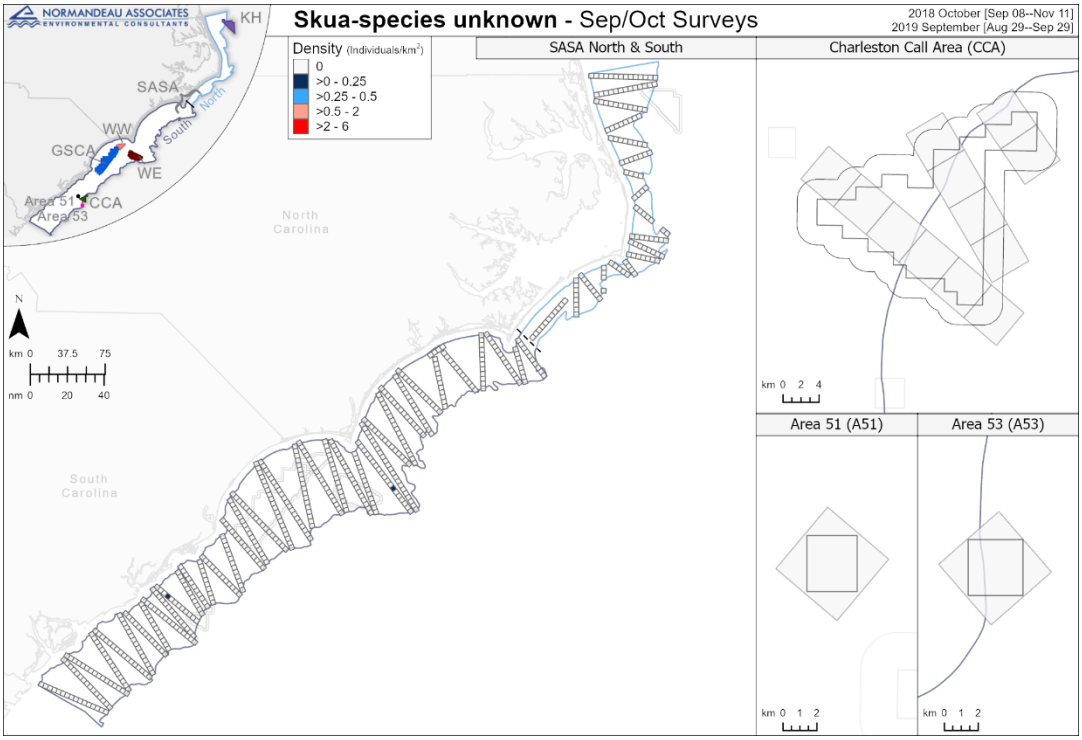


Figure C–148. Spatial distribution of skua-species unknown during the September/ October surveys for all areas

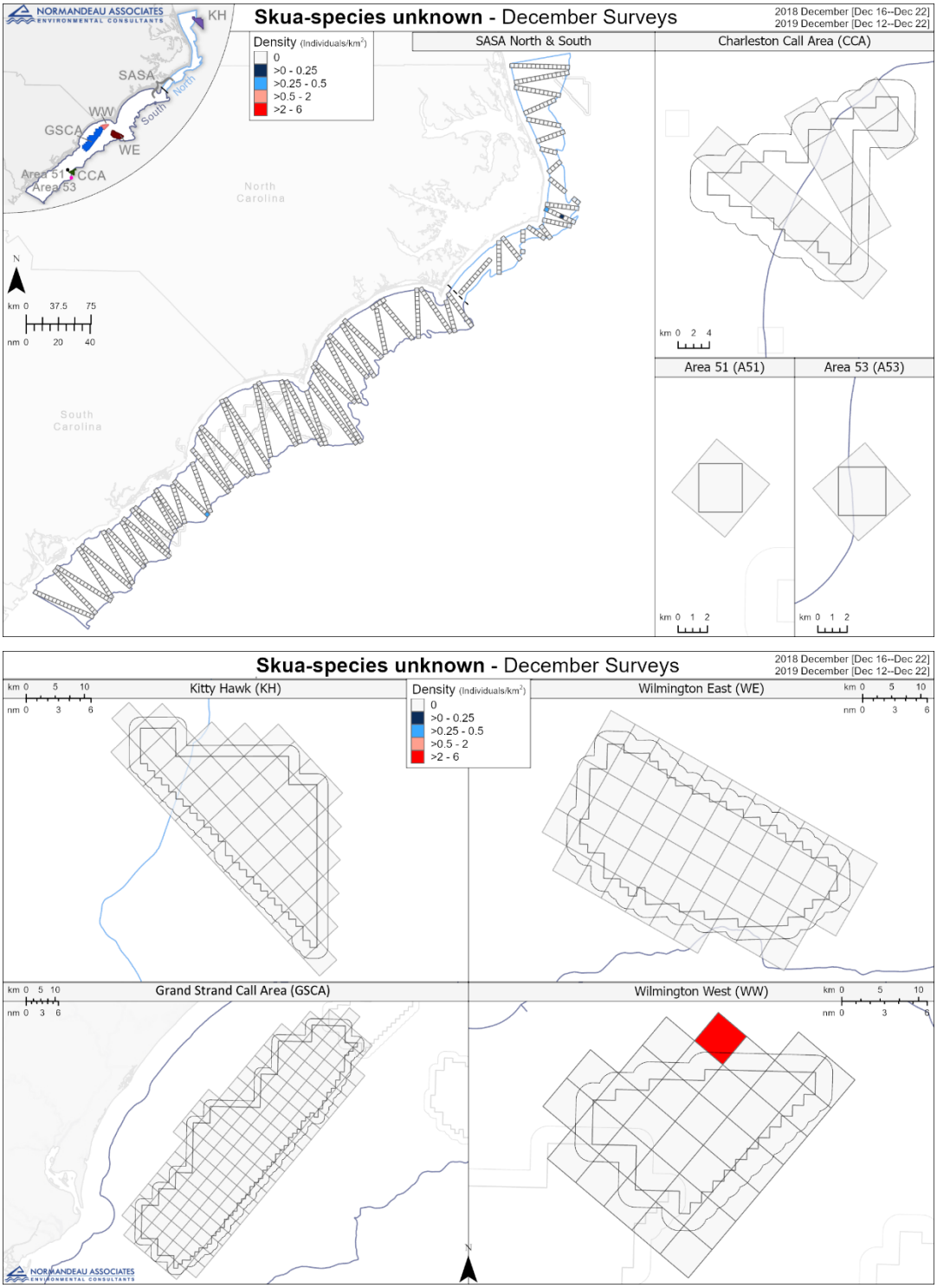


Figure C–149. Spatial distribution of skua-species unknown during the December surveys for all areas

C.4.16 Auk

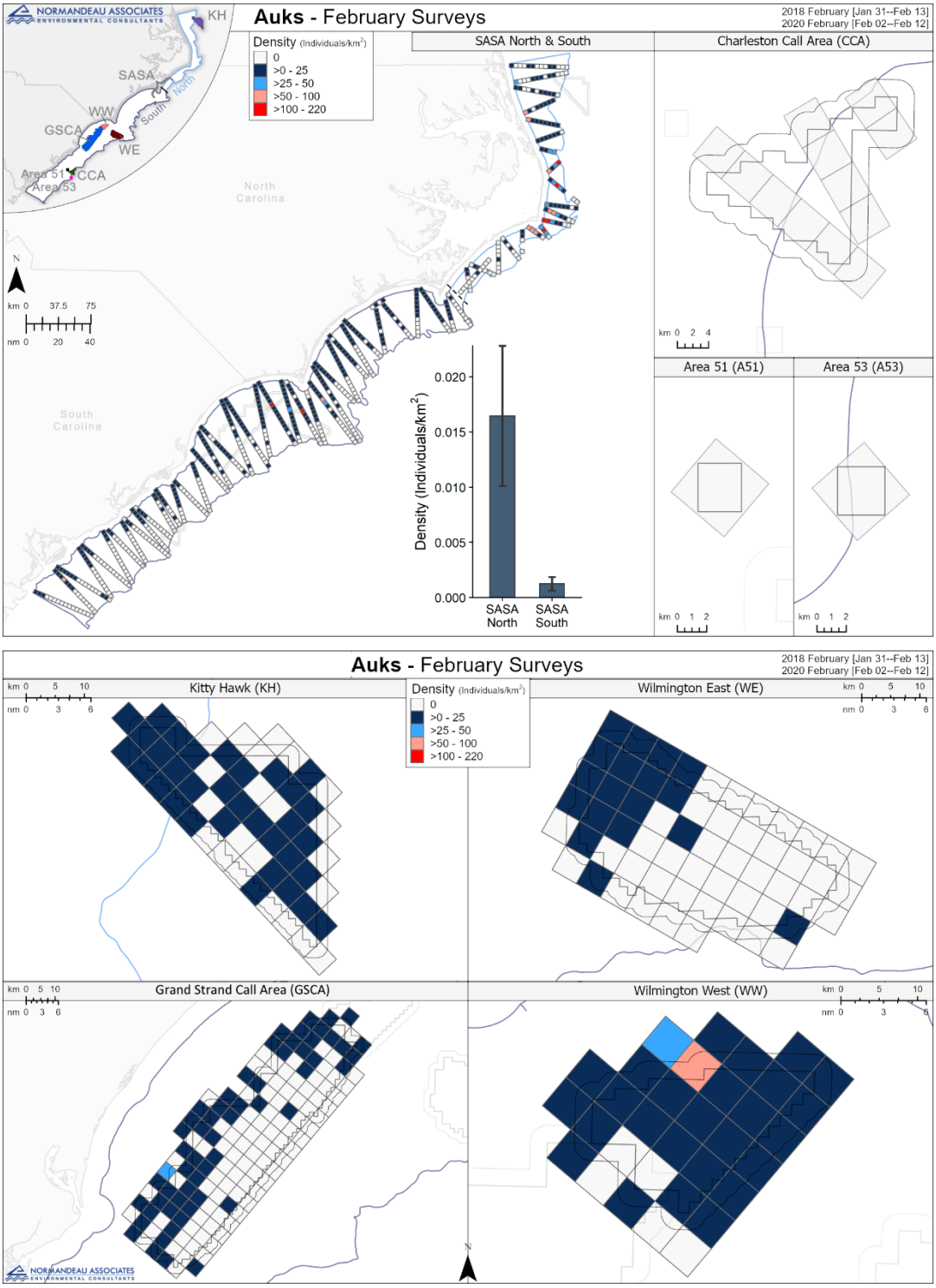


Figure C–150. Spatial distribution of all auk species during the February surveys for all areas

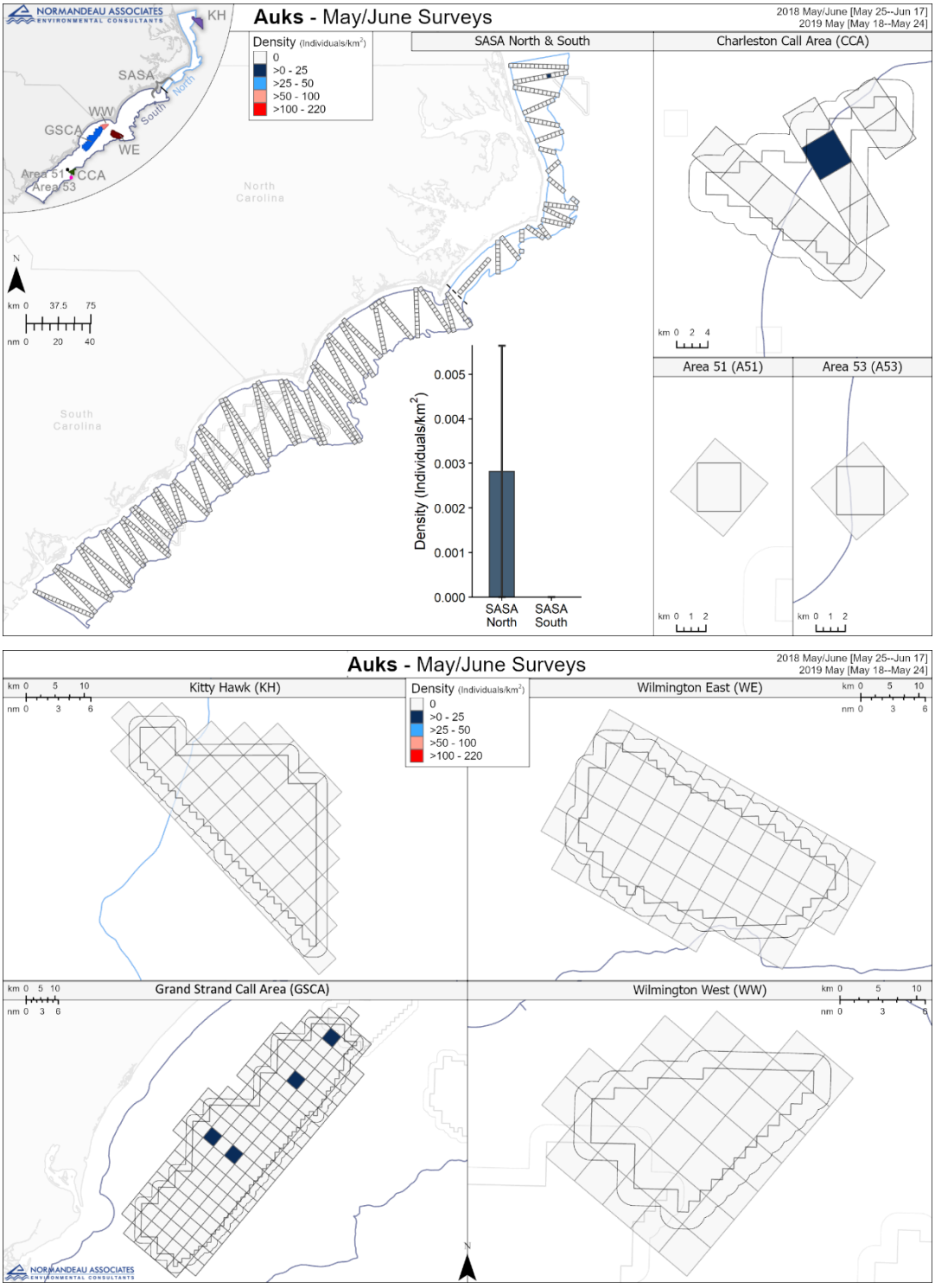


Figure C–151. Spatial distribution of all auk species during the May/June surveys for all areas

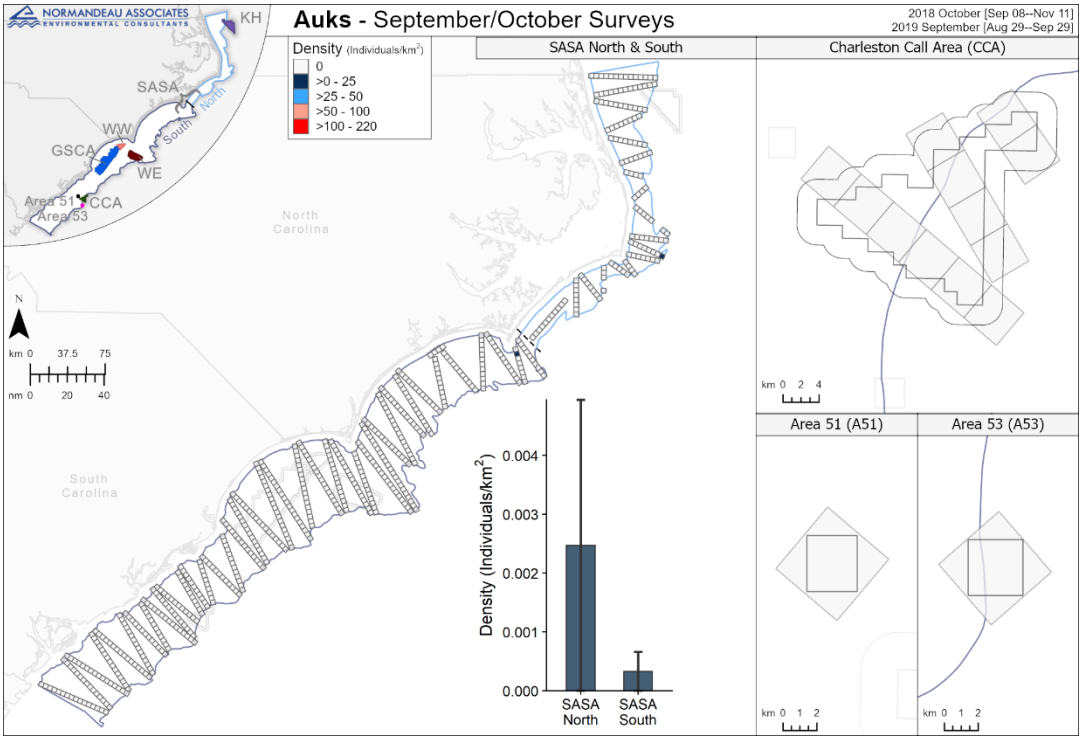


Figure C–152. Spatial distribution of all auk species during the September/October surveys for all areas

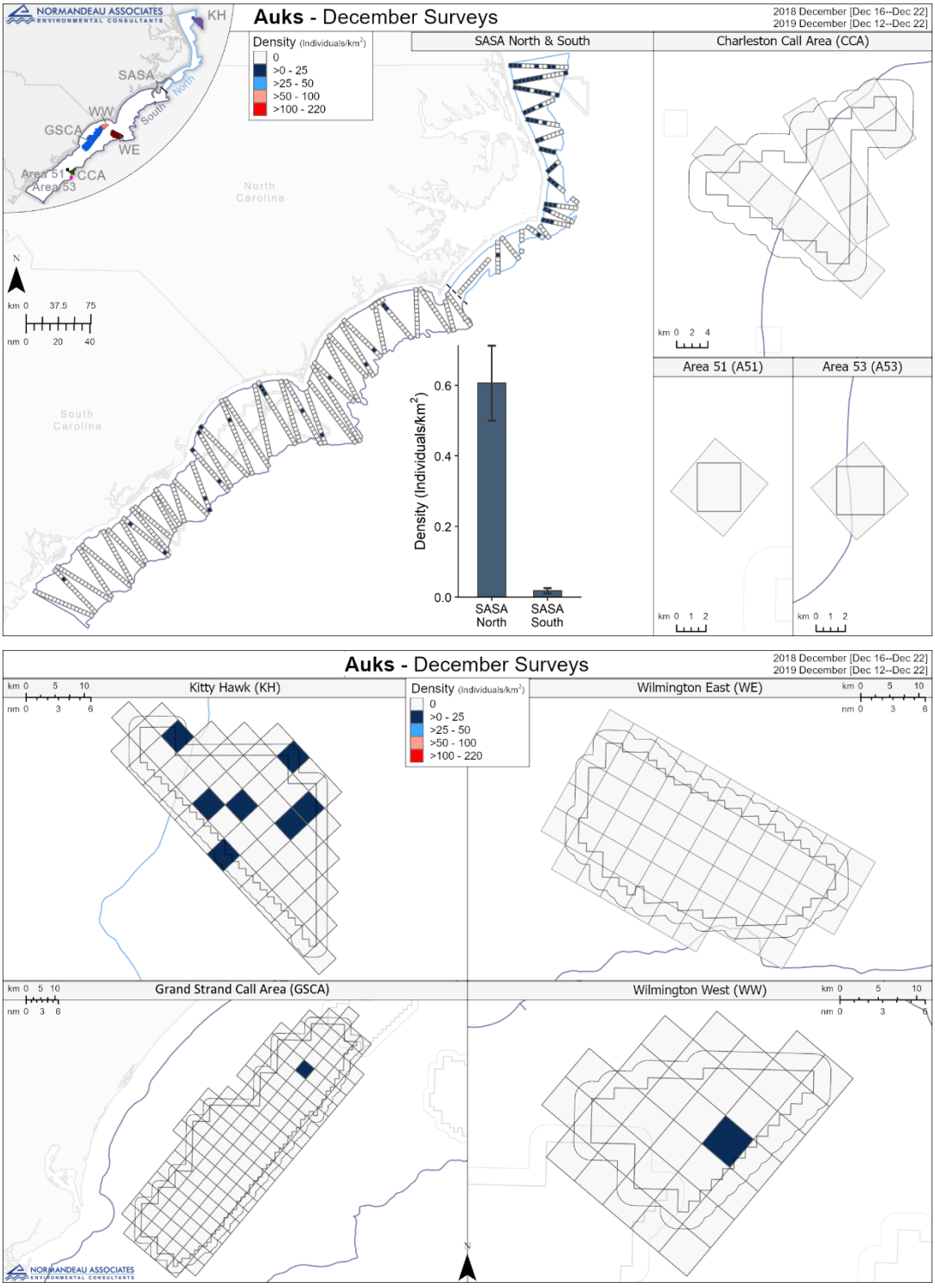


Figure C–153. Spatial distribution of all auk species during the December surveys for all areas

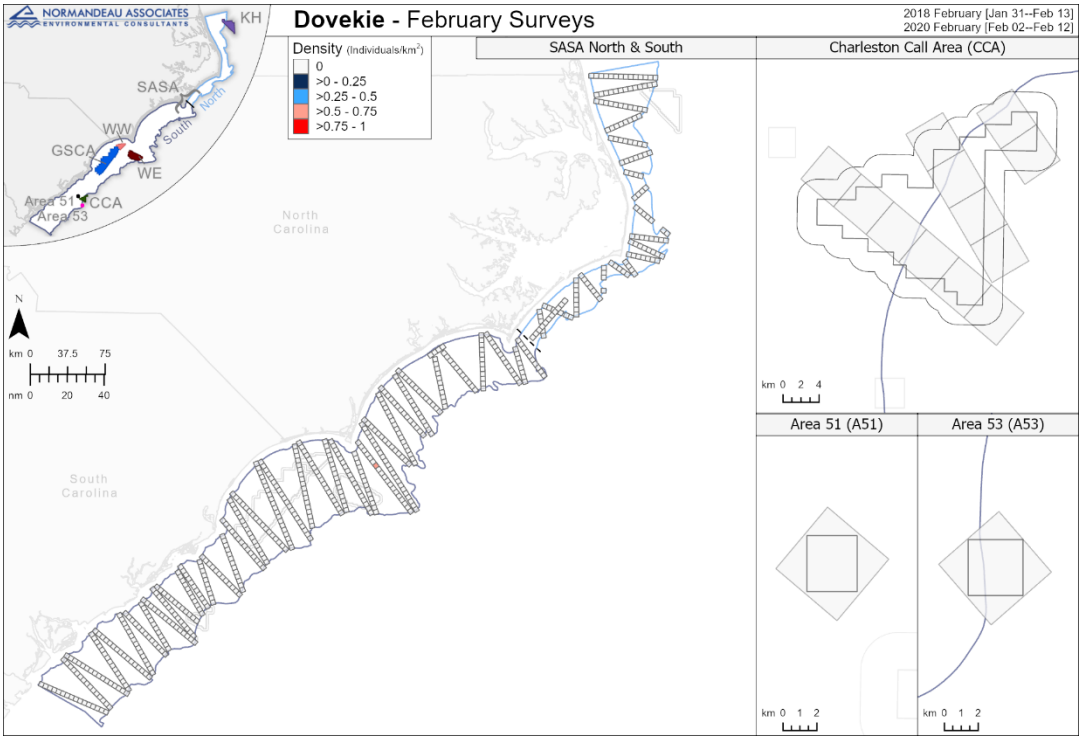


Figure C–154. Spatial distribution of dovekies during the February surveys for all areas

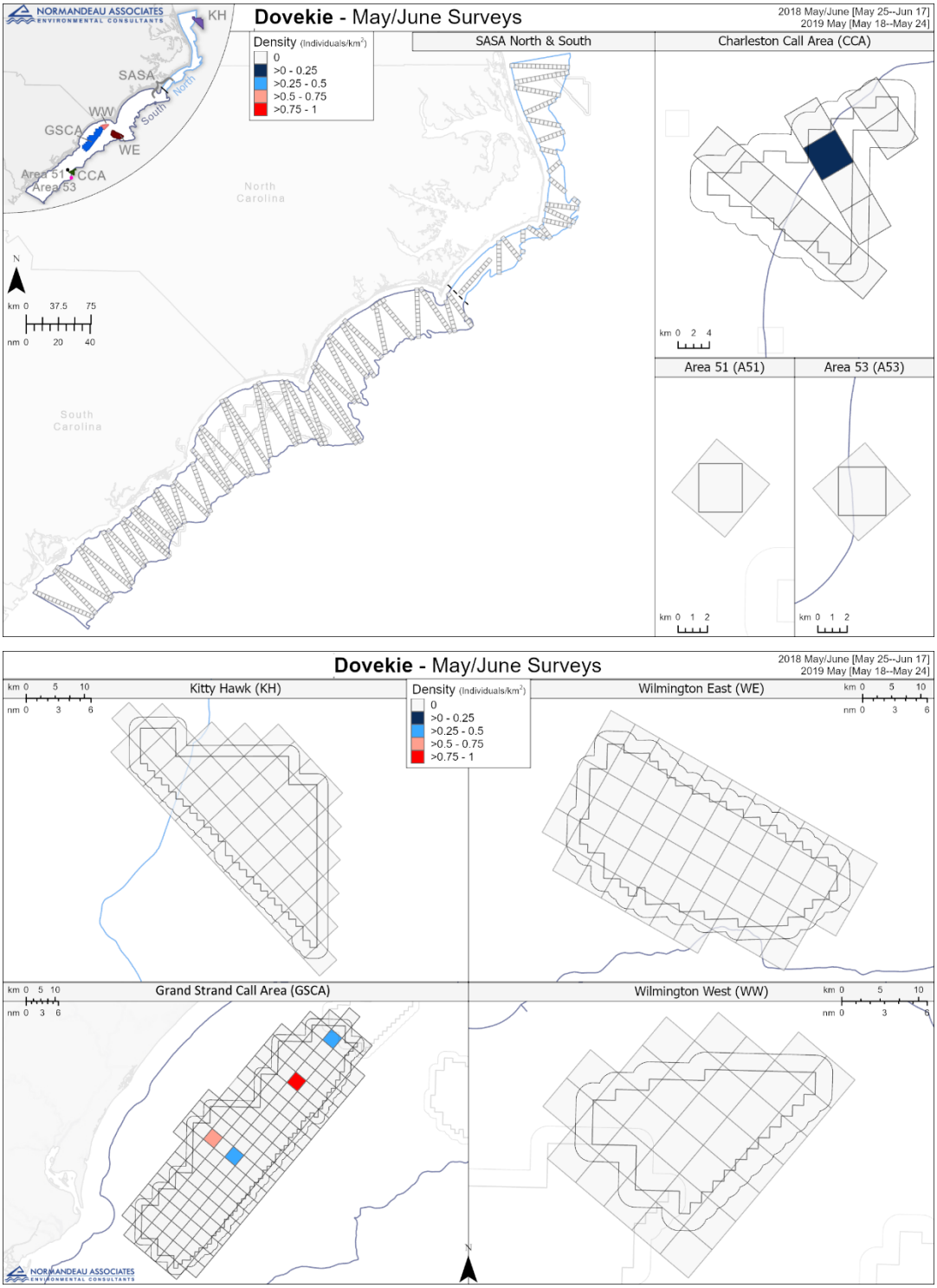


Figure C–155. Spatial distribution of dovekies during the May/June surveys for all areas

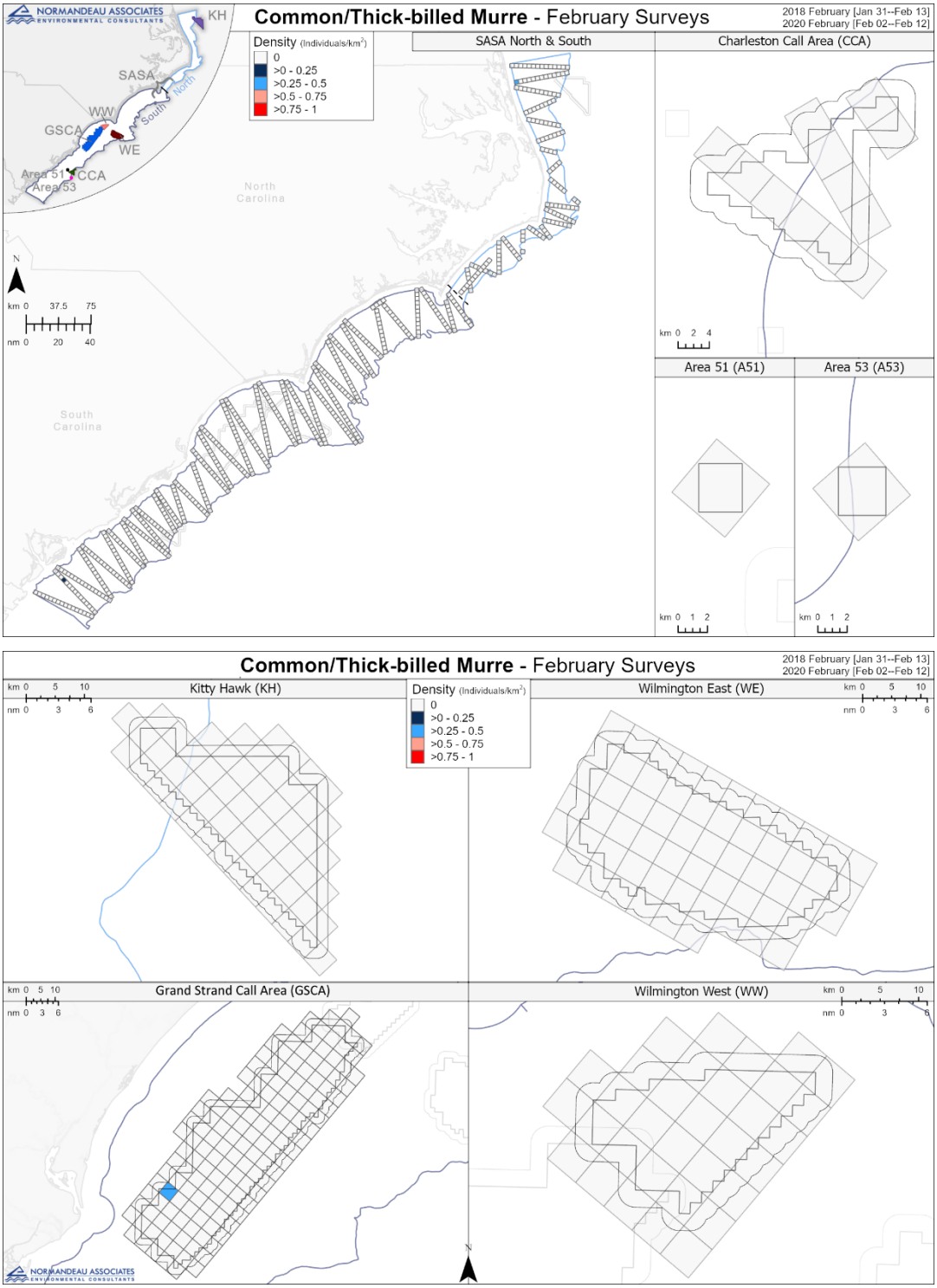


Figure C–156. Spatial distribution of common/thick-billed murres during the February surveys for all areas

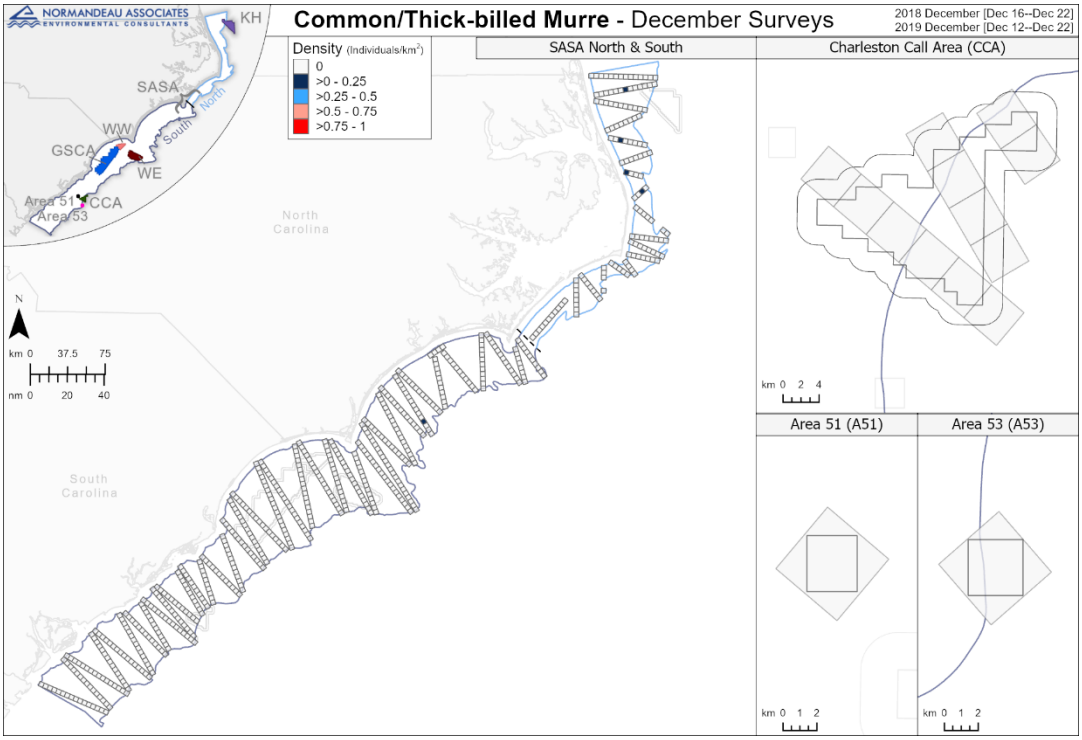


Figure C–157. Spatial distribution of common/thick-billed murres during the December surveys for all areas

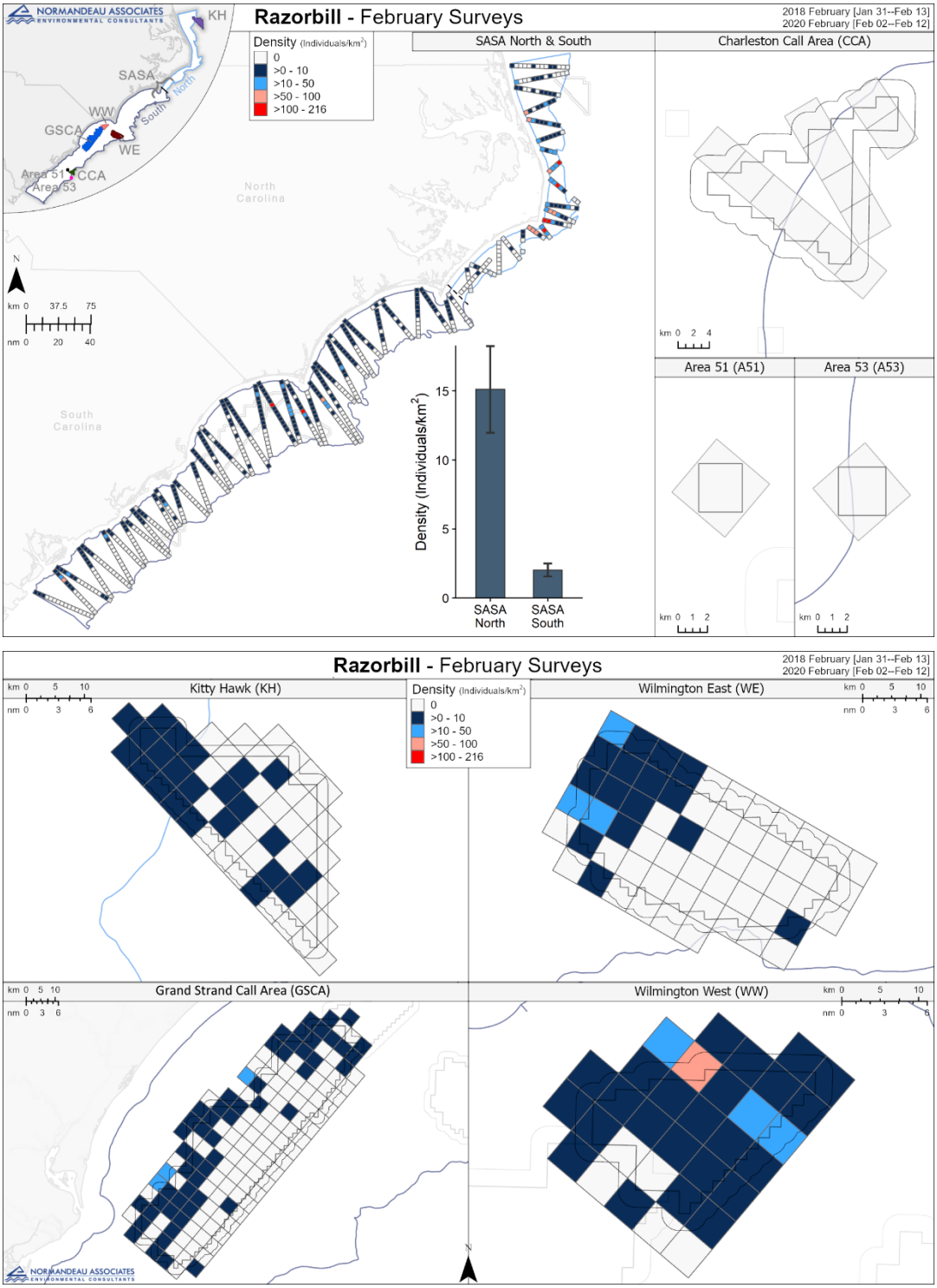


Figure C–158. Spatial distribution of razorbills during the February surveys for all areas

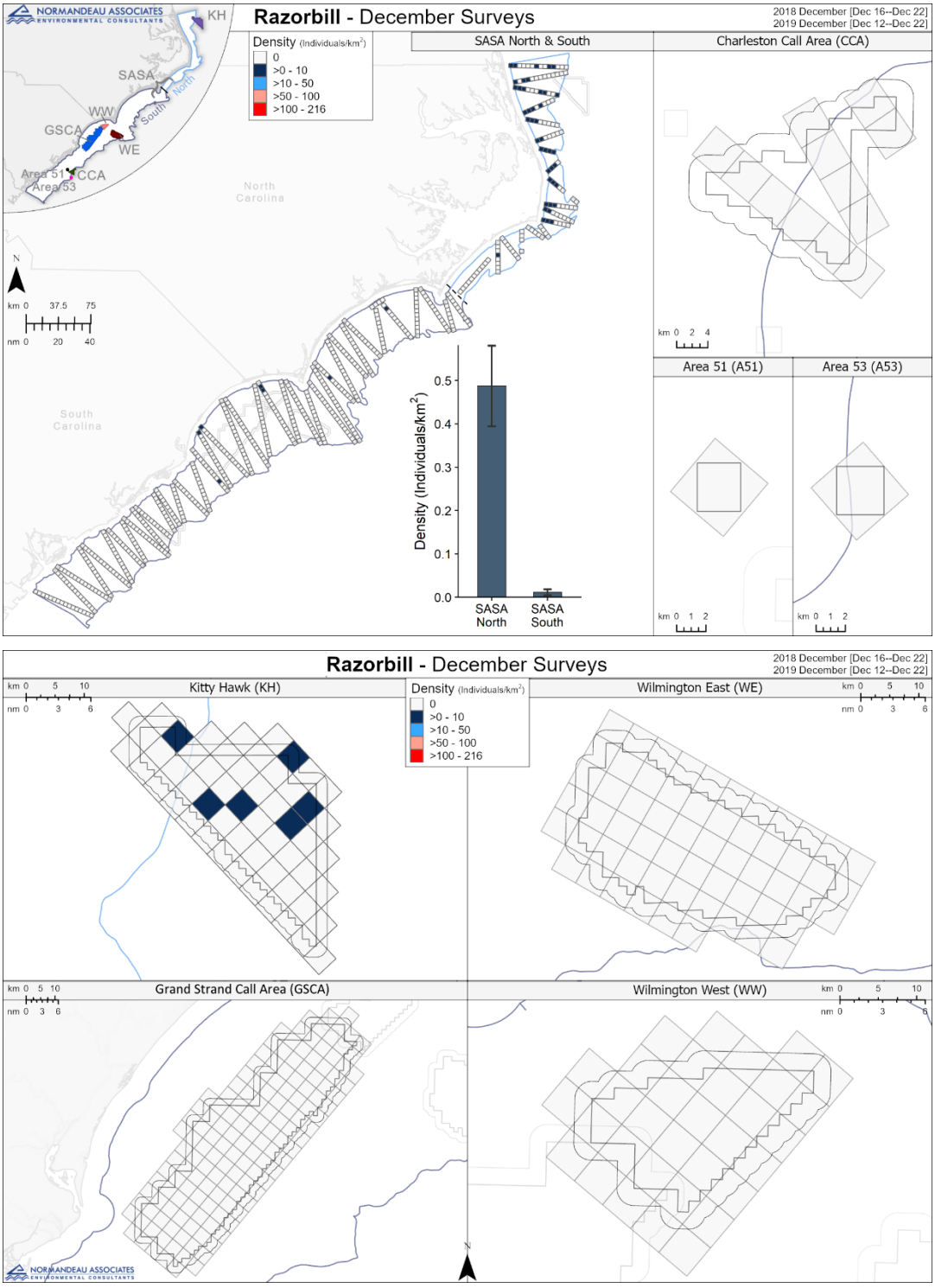


Figure C–159. Spatial distribution of razorbills during the December surveys for all areas

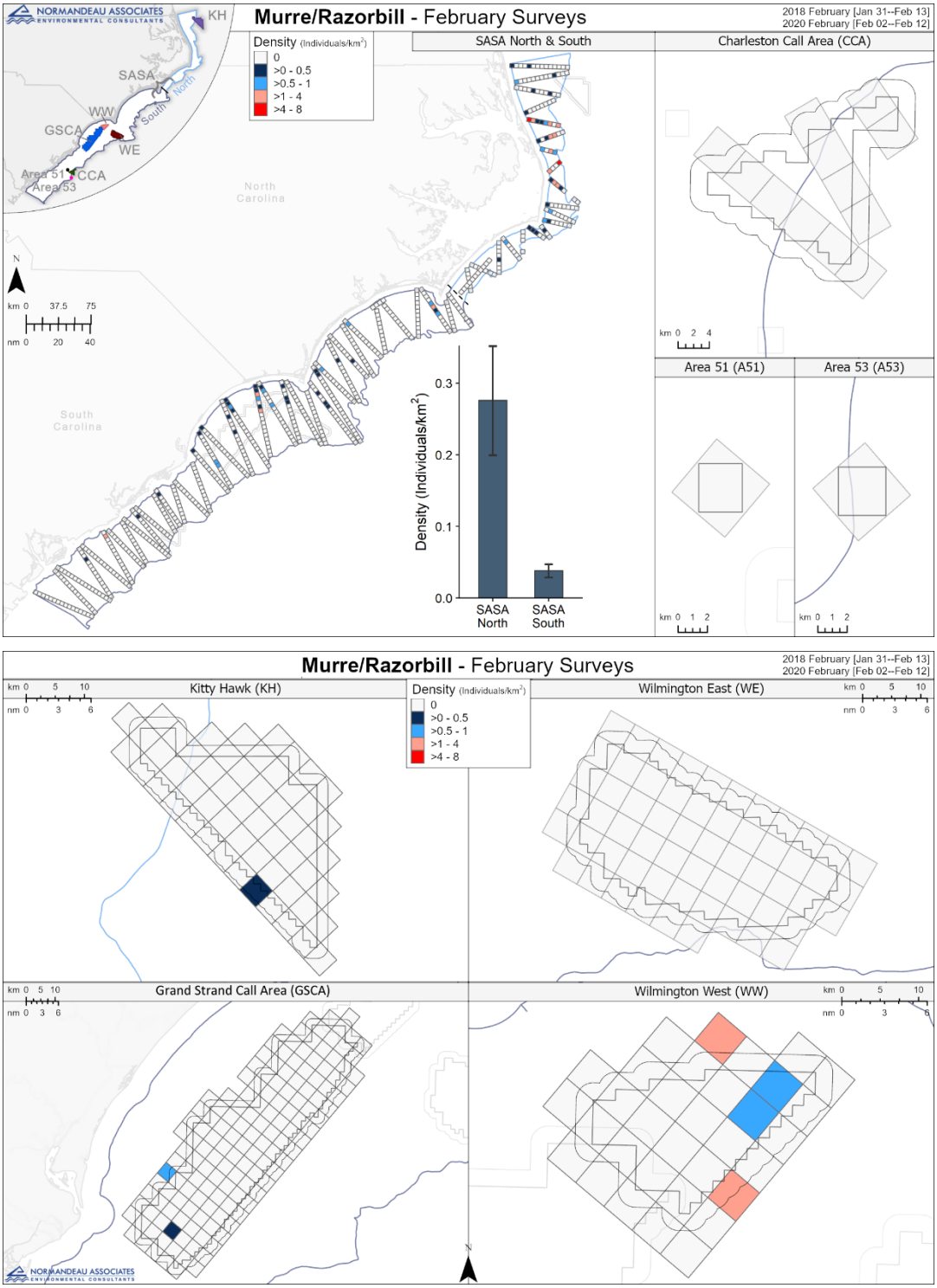


Figure C–160. Spatial distribution of murre/razorbills during the February surveys for all areas

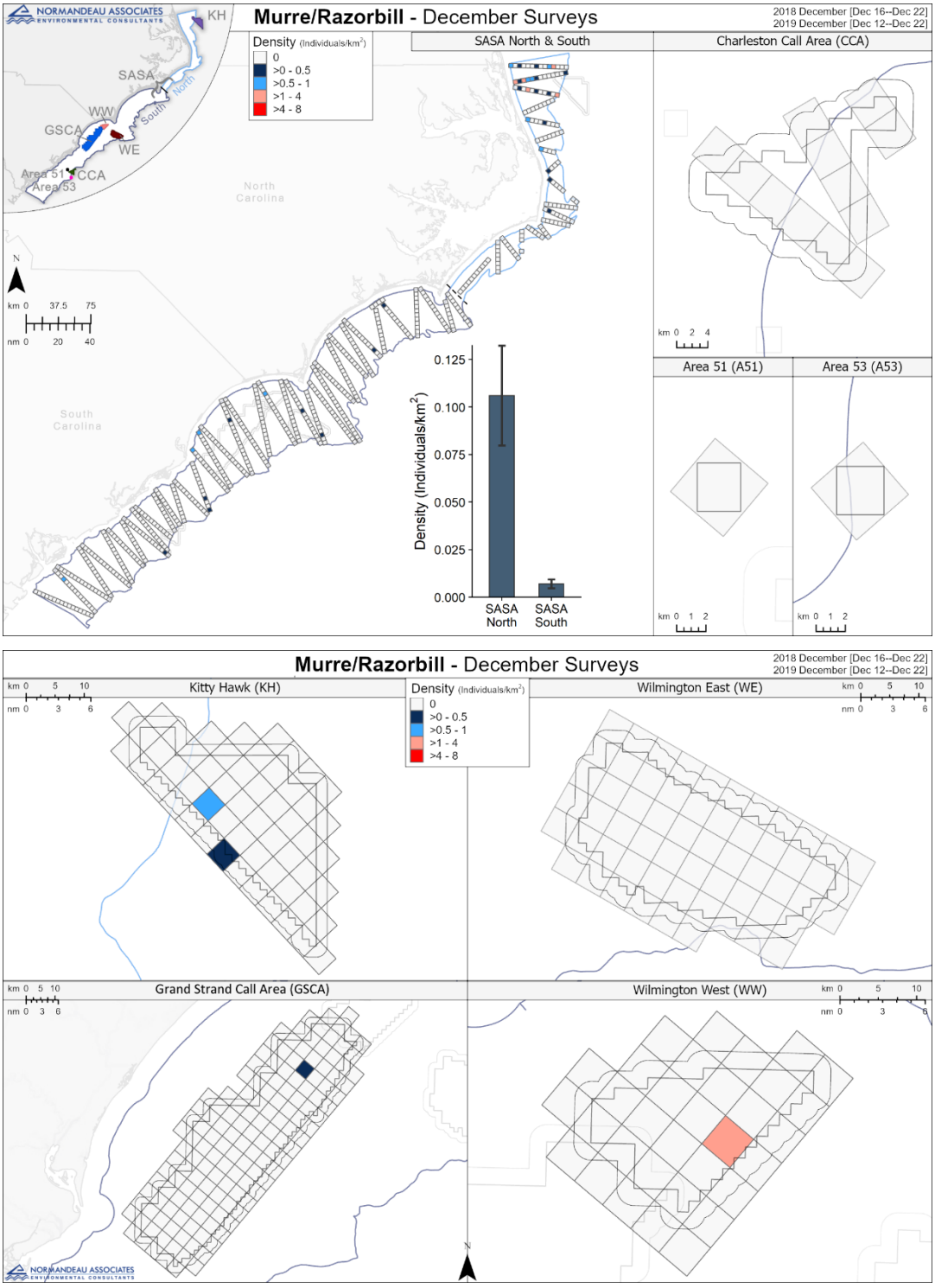


Figure C–161. Spatial distribution of murre/razorbills during the December surveys for all areas

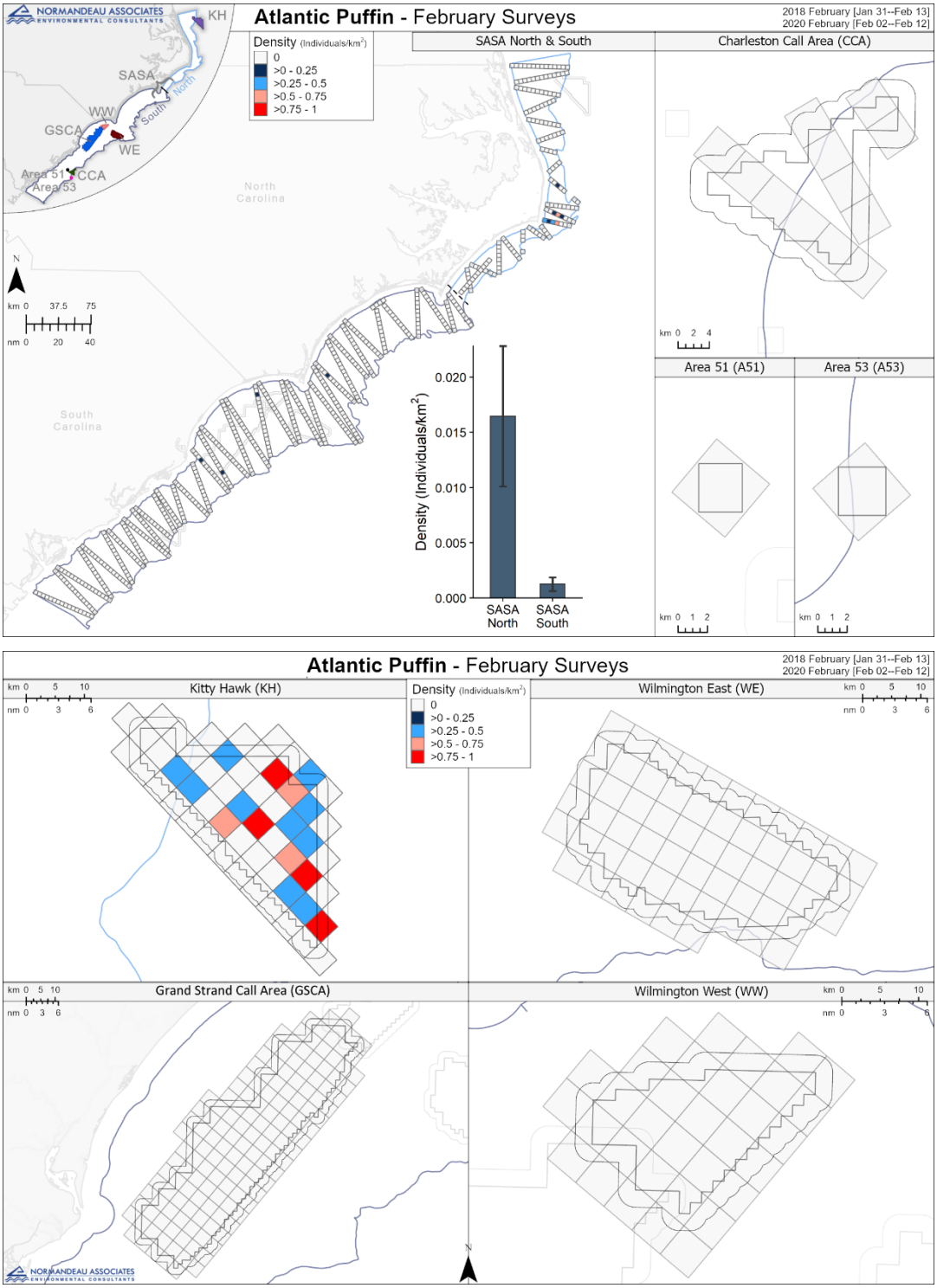


Figure C–162. Spatial distribution of Atlantic puffins during the February surveys for all areas

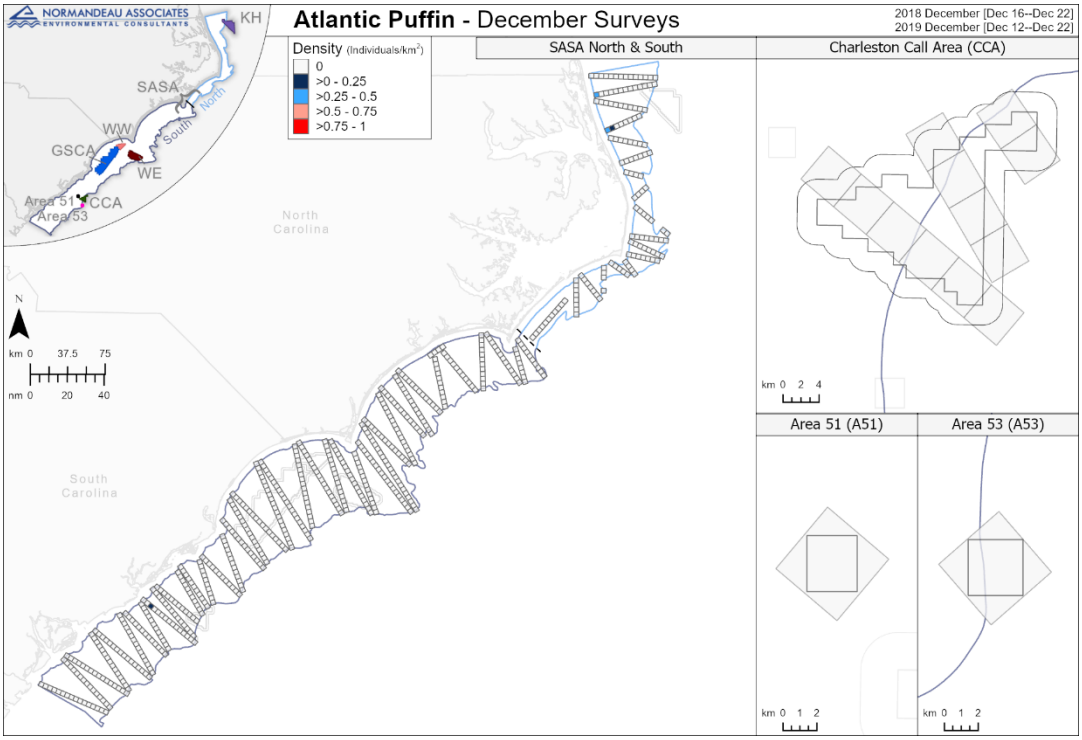


Figure C–163. Spatial distribution of Atlantic puffins during the December surveys for all areas

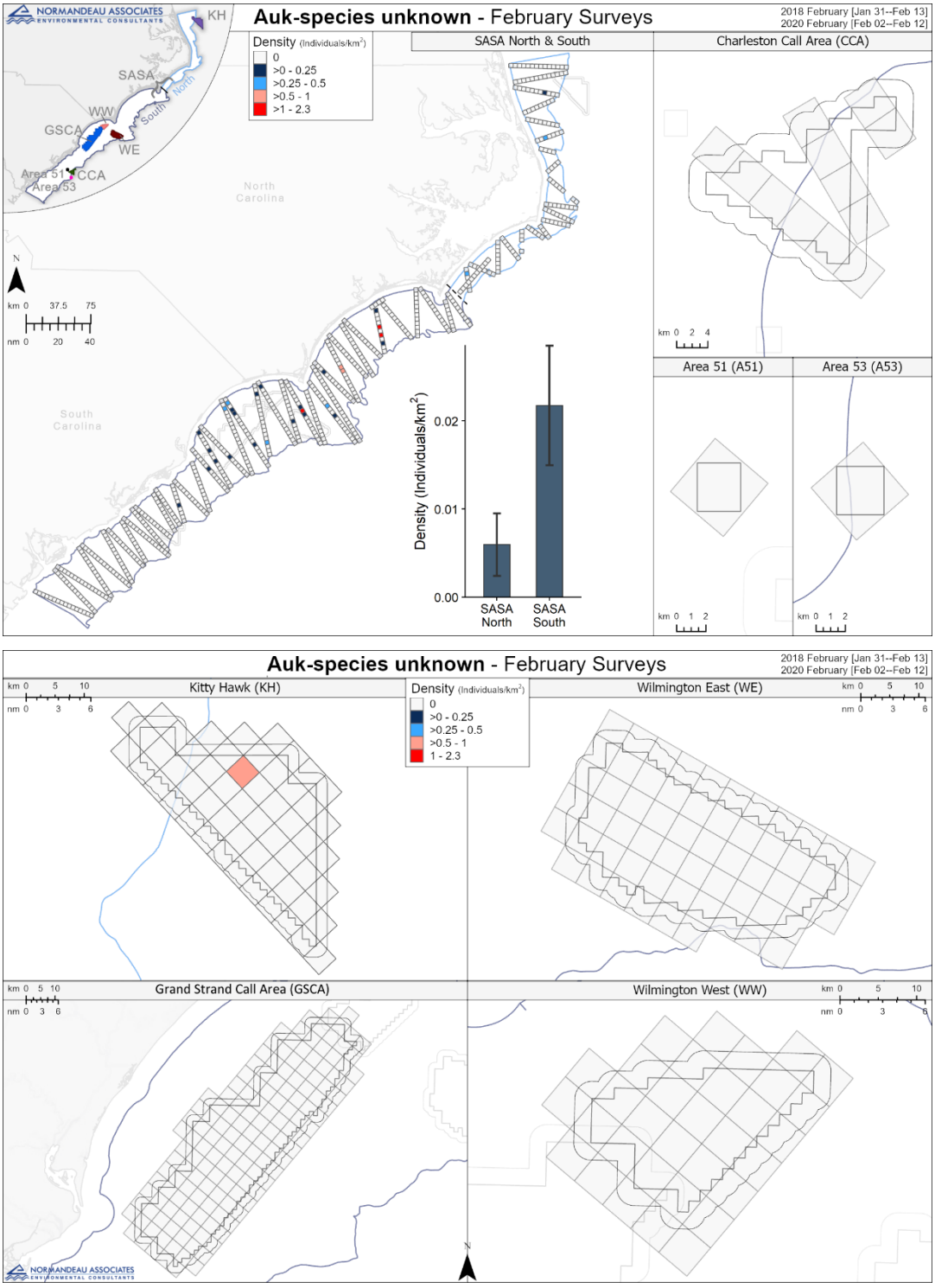


Figure C–164. Spatial distribution of auk-species unknown during the February surveys for all areas

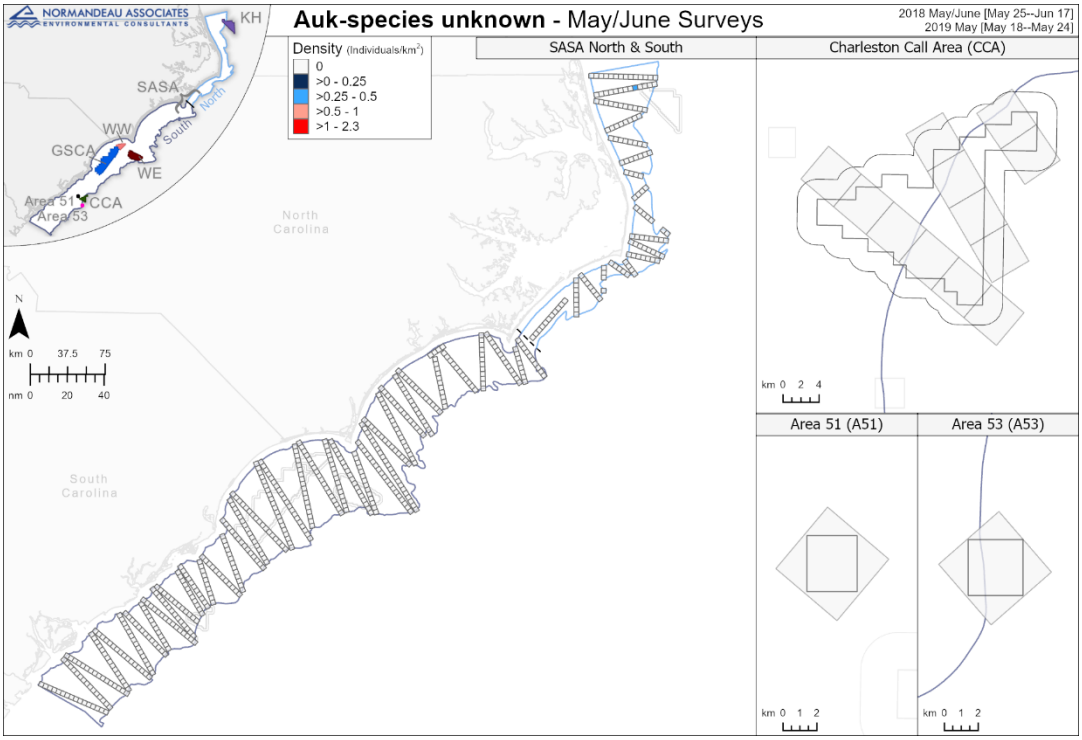


Figure C–165. Spatial distribution of auk-species unknown during the May/June surveys for all areas

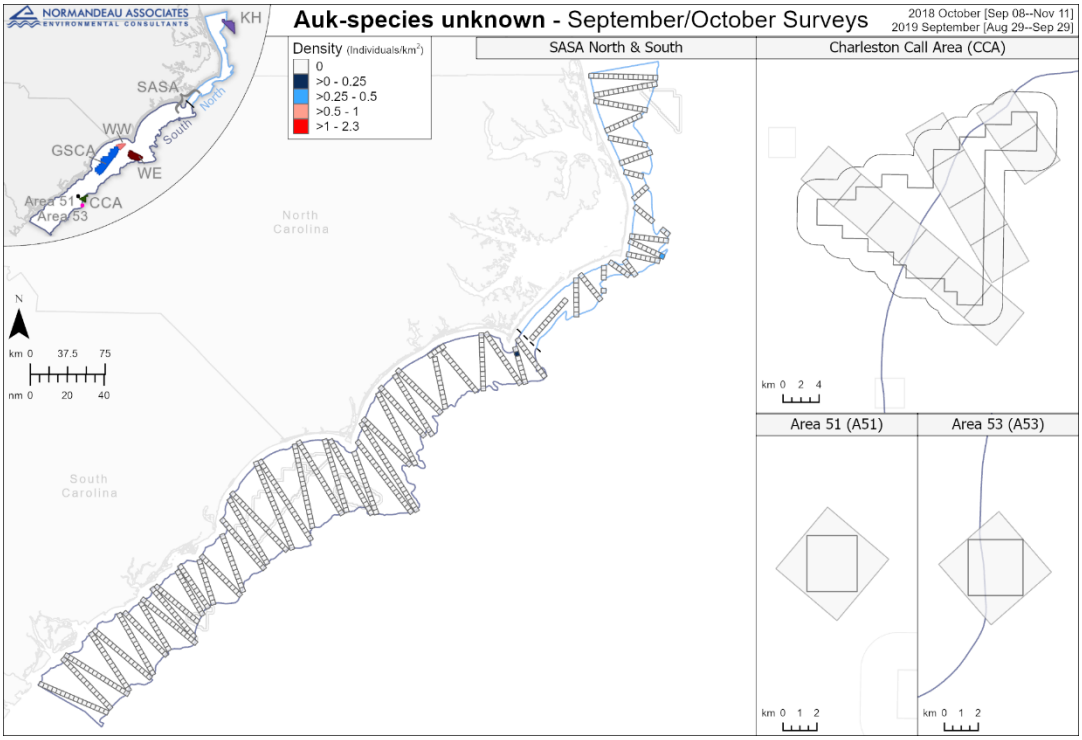


Figure C–166. Spatial distribution of auk-species unknown during the September/ October surveys for all areas

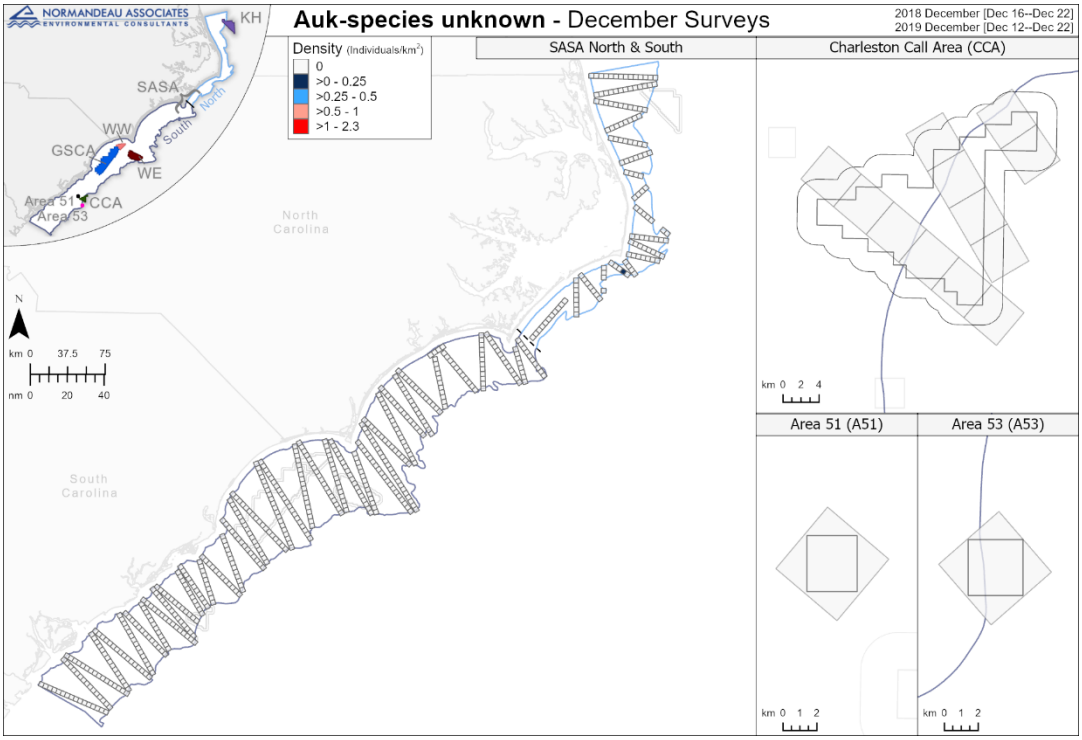


Figure C–167. Spatial distribution of auk-species unknown during the December surveys for all areas

C.4.17 Gull

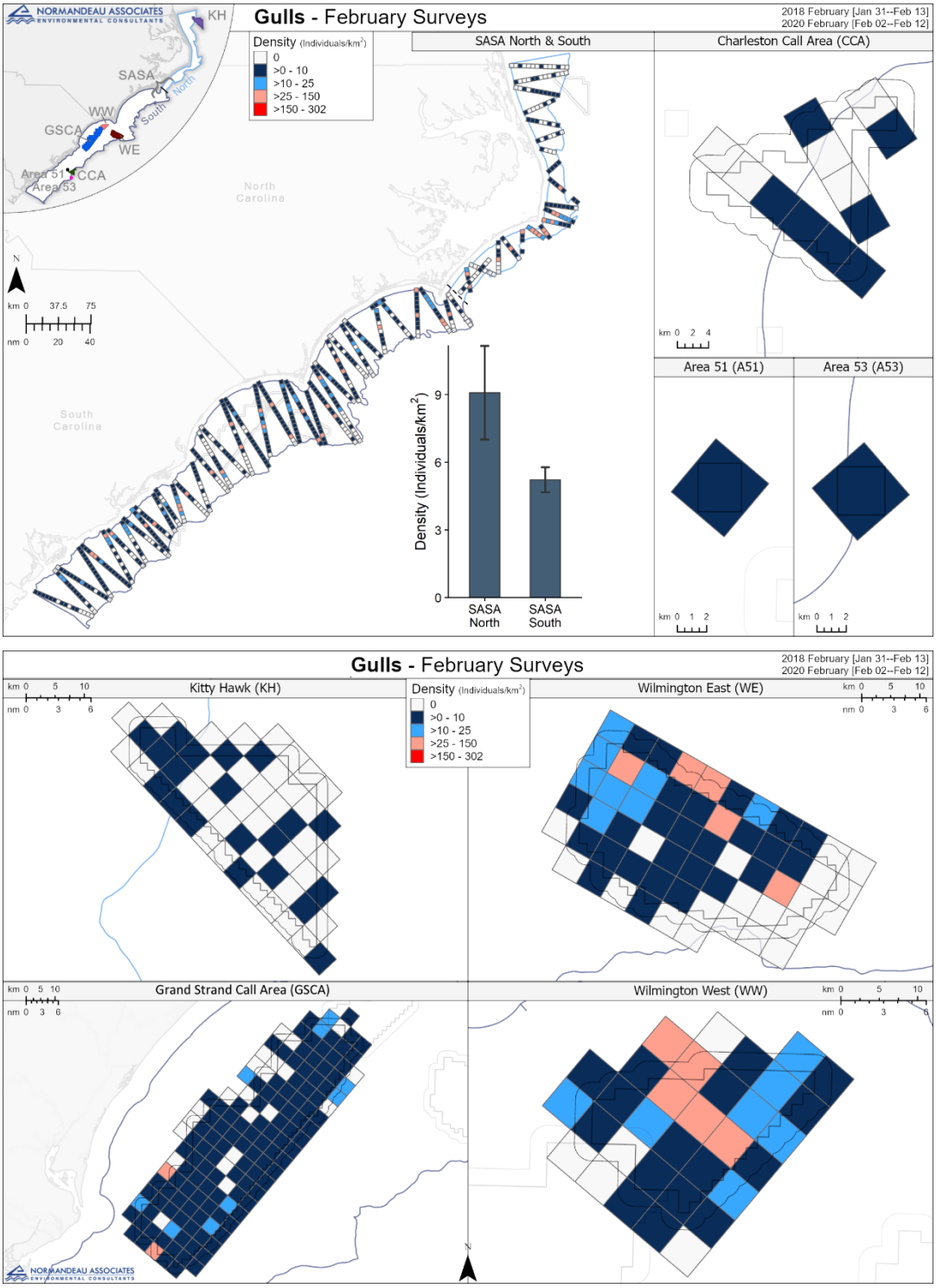


Figure C–168. Spatial distribution of all gull species during the February surveys for all areas

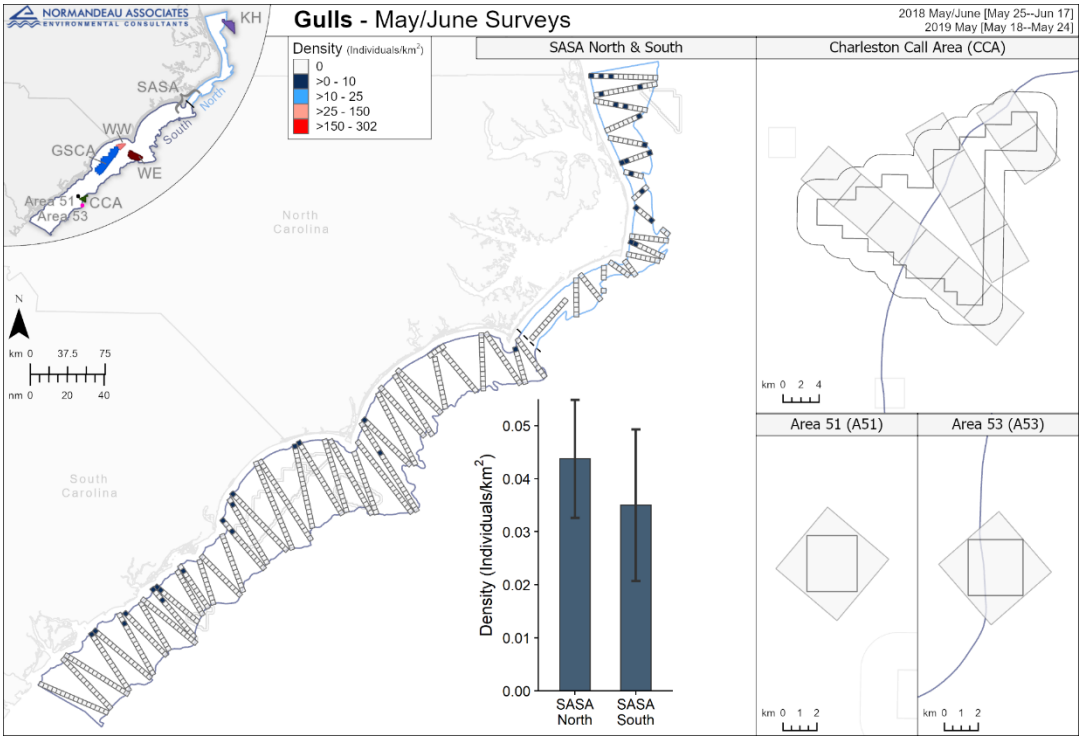


Figure C–169. Spatial distribution of all gull species during the May/June surveys for all areas

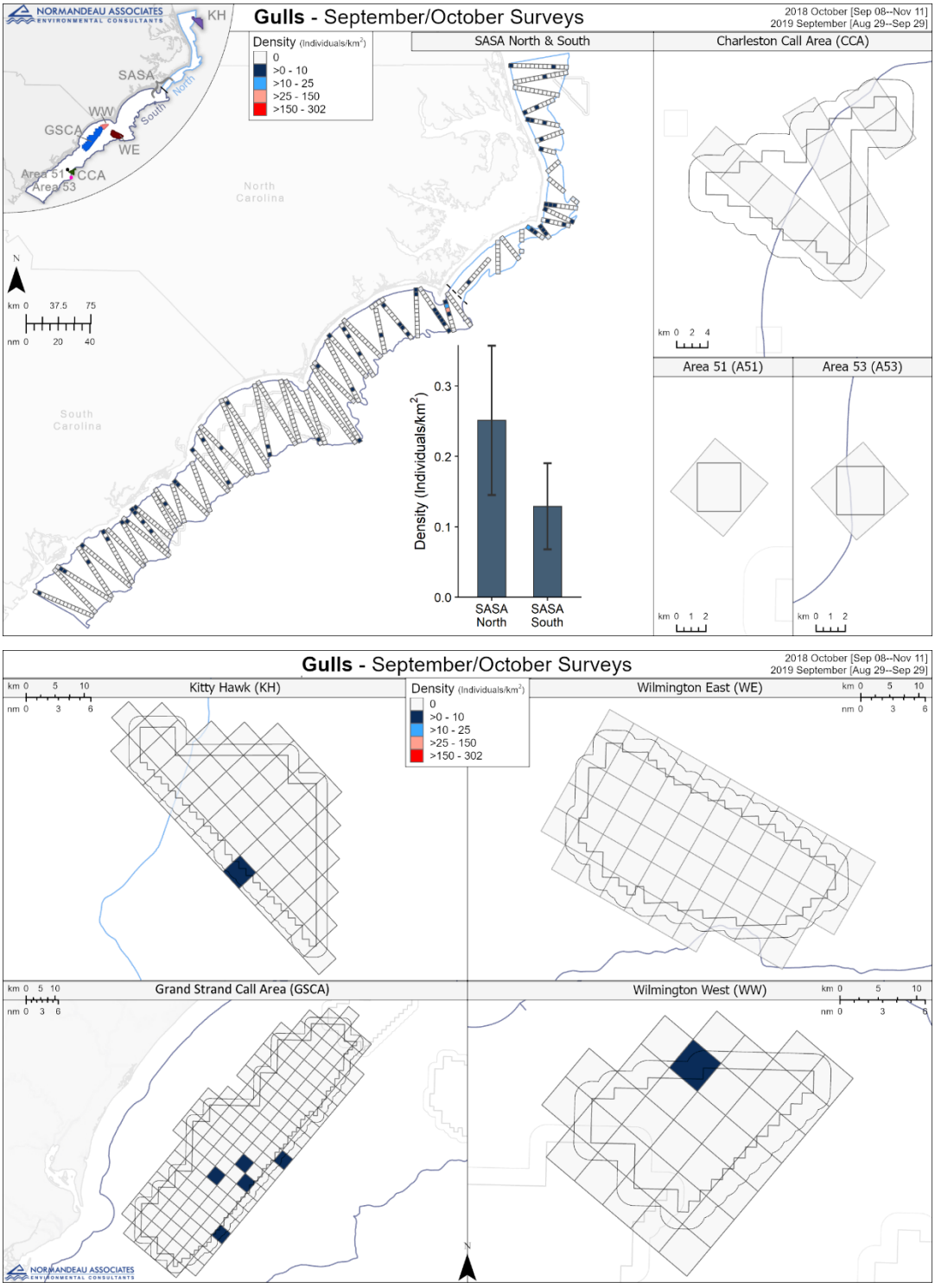


Figure C–170. Spatial distribution of all gull species during the September/October surveys for all areas

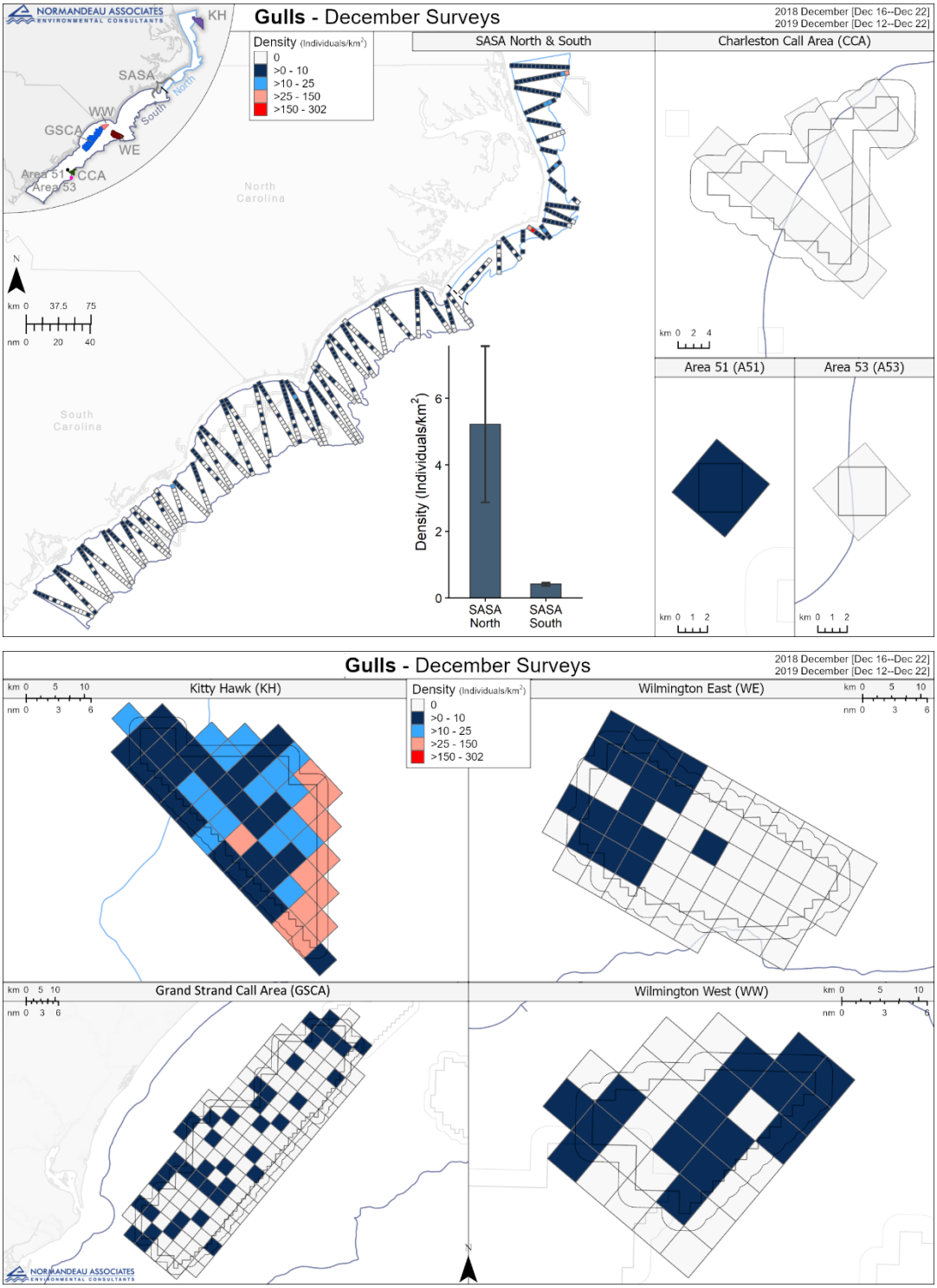


Figure C–171. Spatial distribution of all gull species during the December surveys for all areas

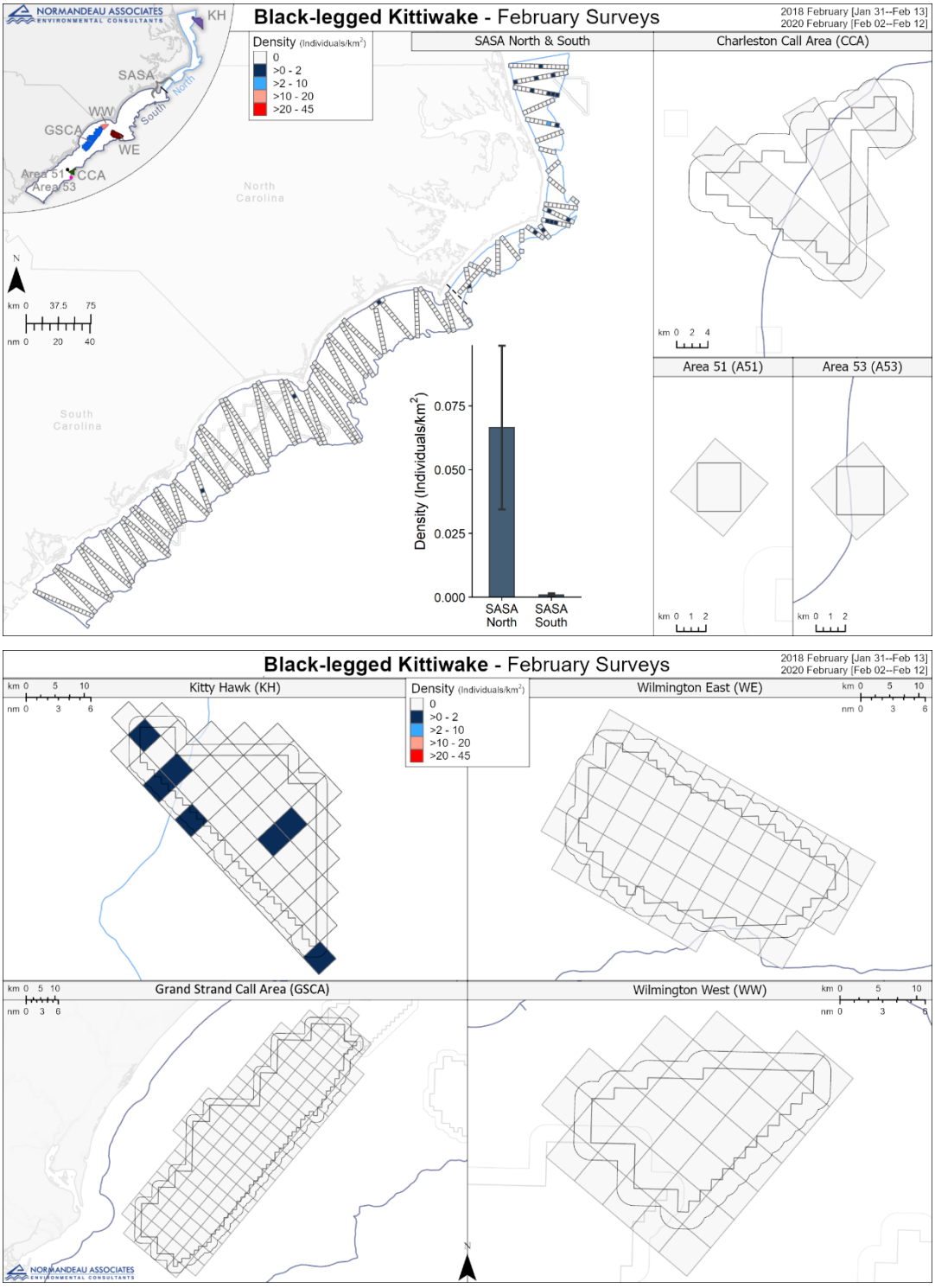


Figure C–172. Spatial distribution of black-legged kittiwakes during the February surveys for all areas

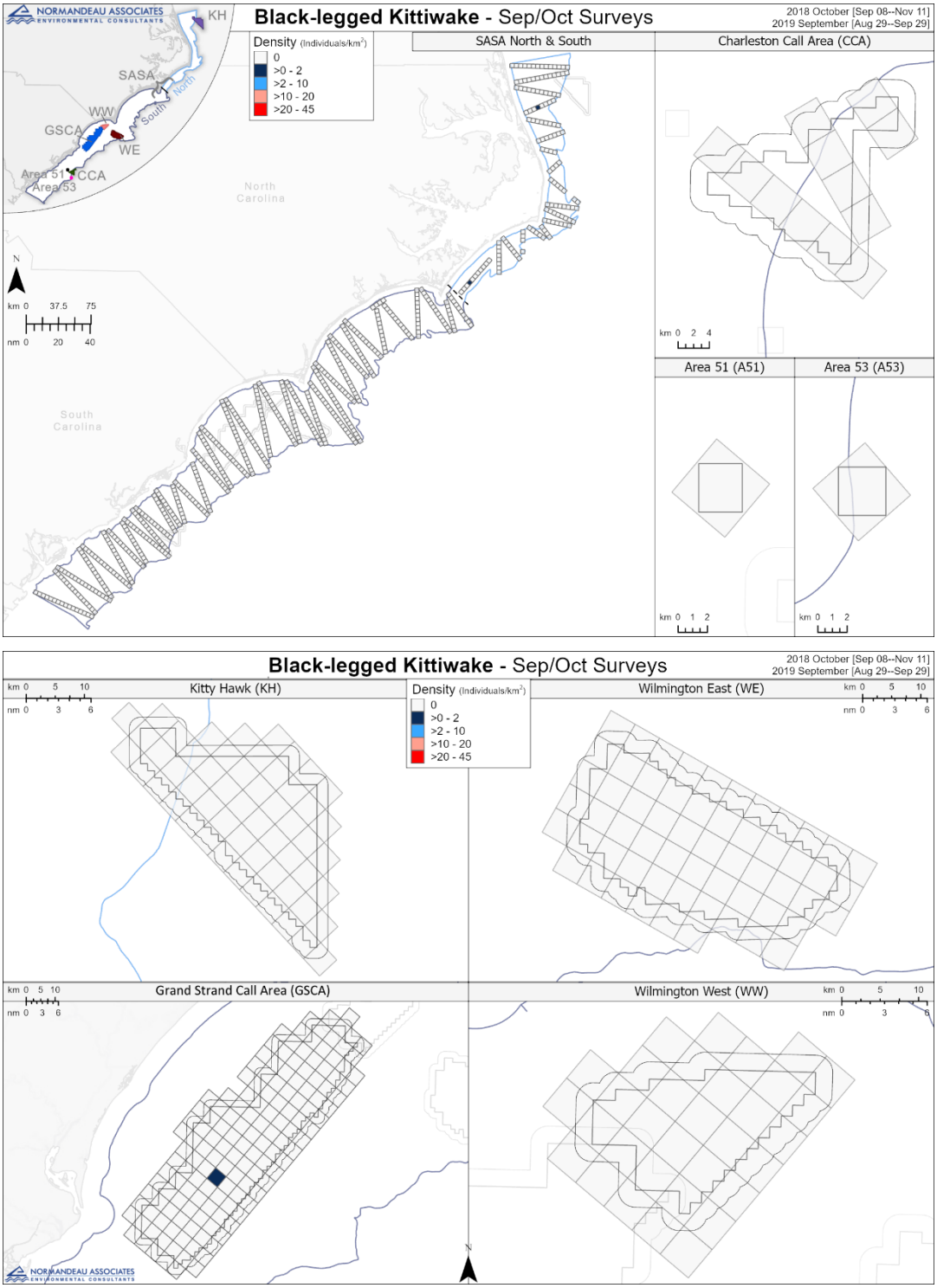


Figure C–173. Spatial distribution of black-legged kittiwakes during the September/ October surveys for all areas

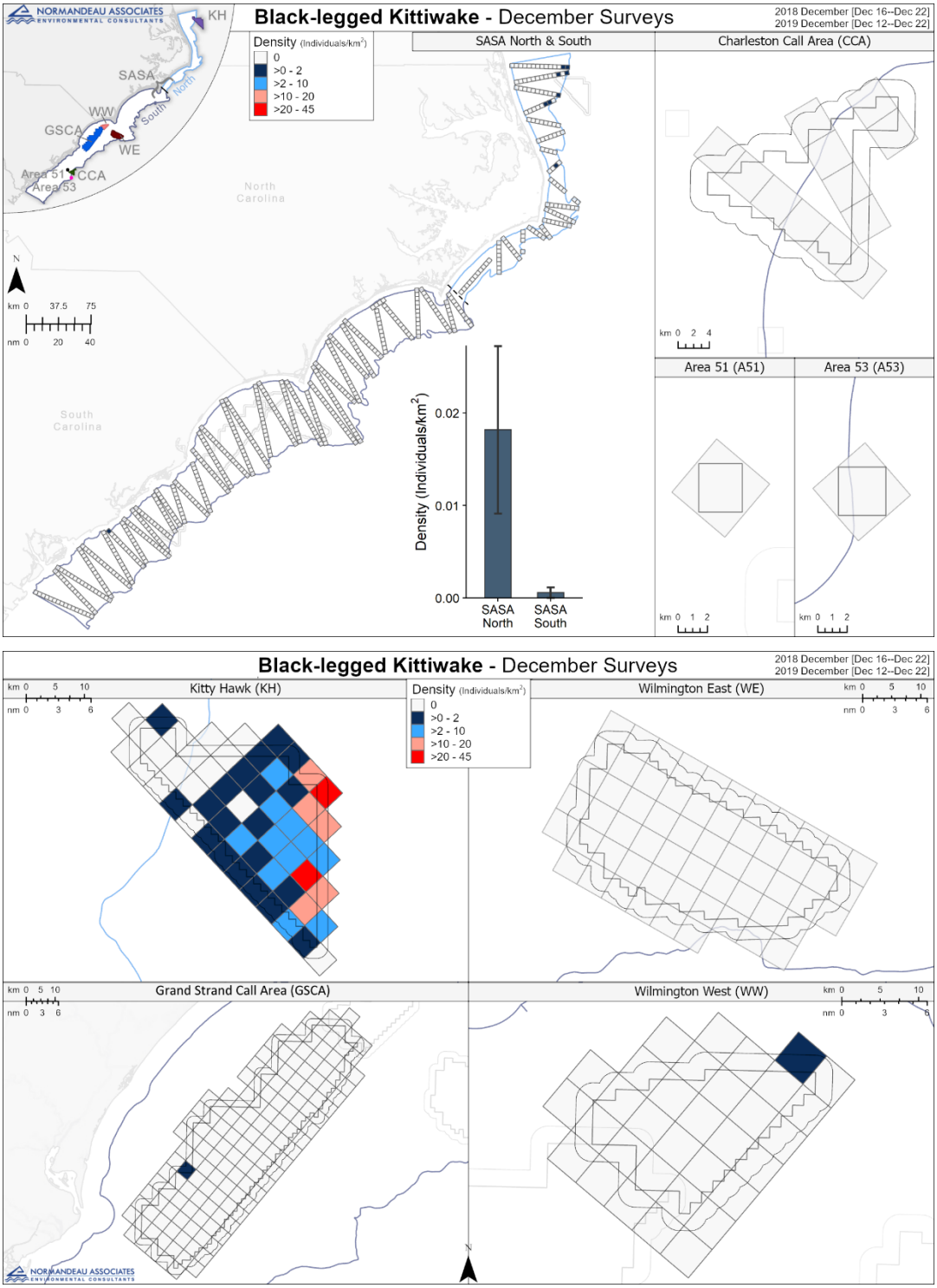


Figure C–174. Spatial distribution of black-legged kittiwakes during the December surveys for all areas

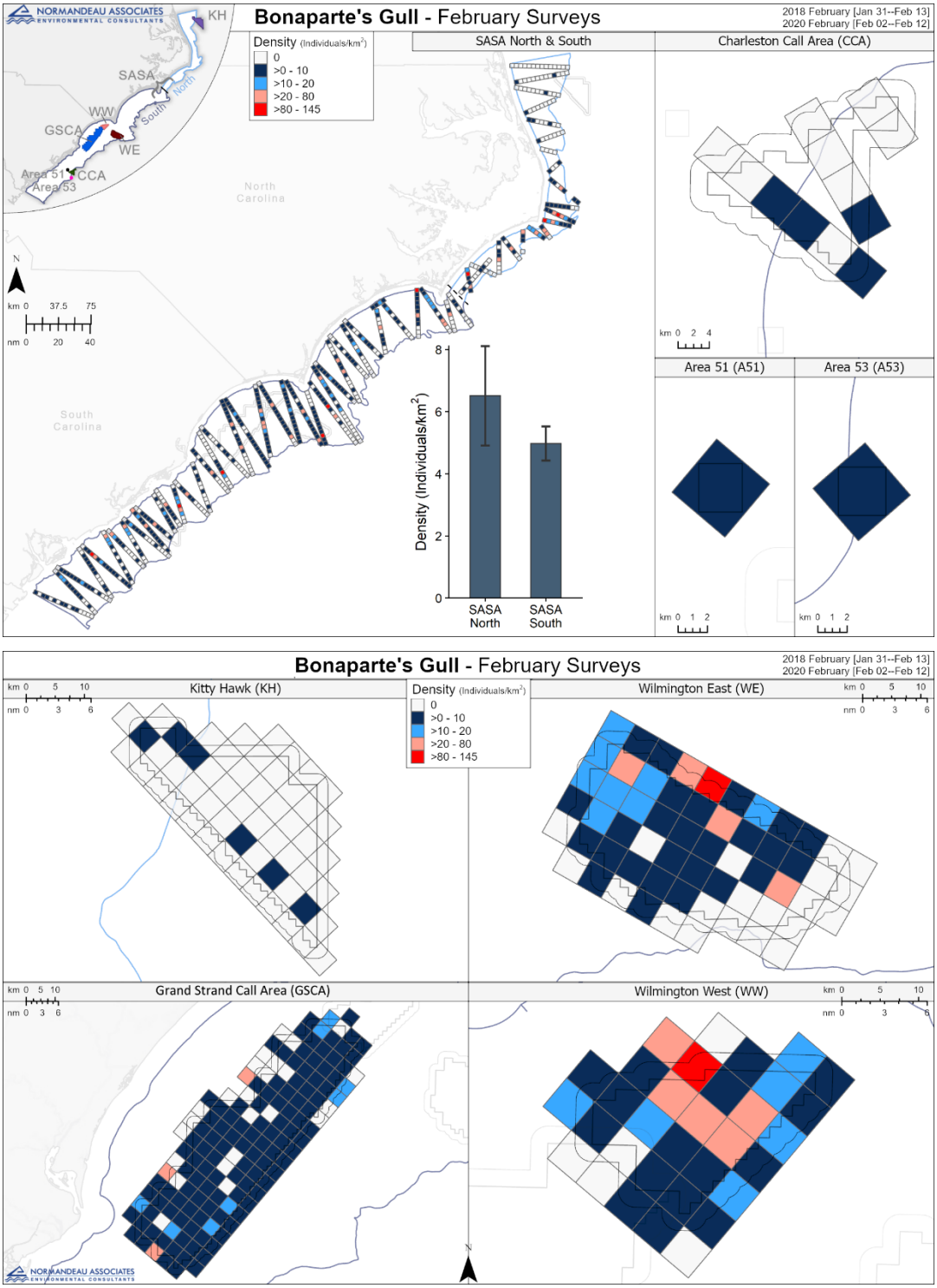


Figure C–175. Spatial distribution of Bonaparte's gulls during the February surveys for all areas

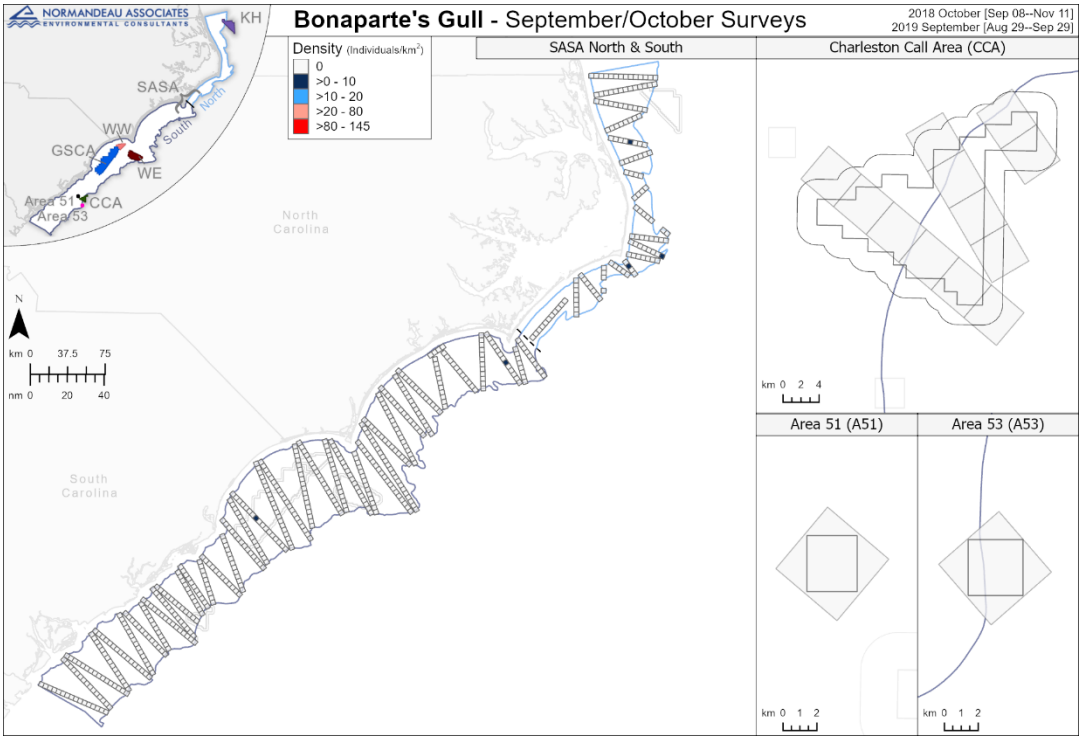


Figure C–176. Spatial distribution of Bonaparte's gulls during the September/ October surveys for all areas

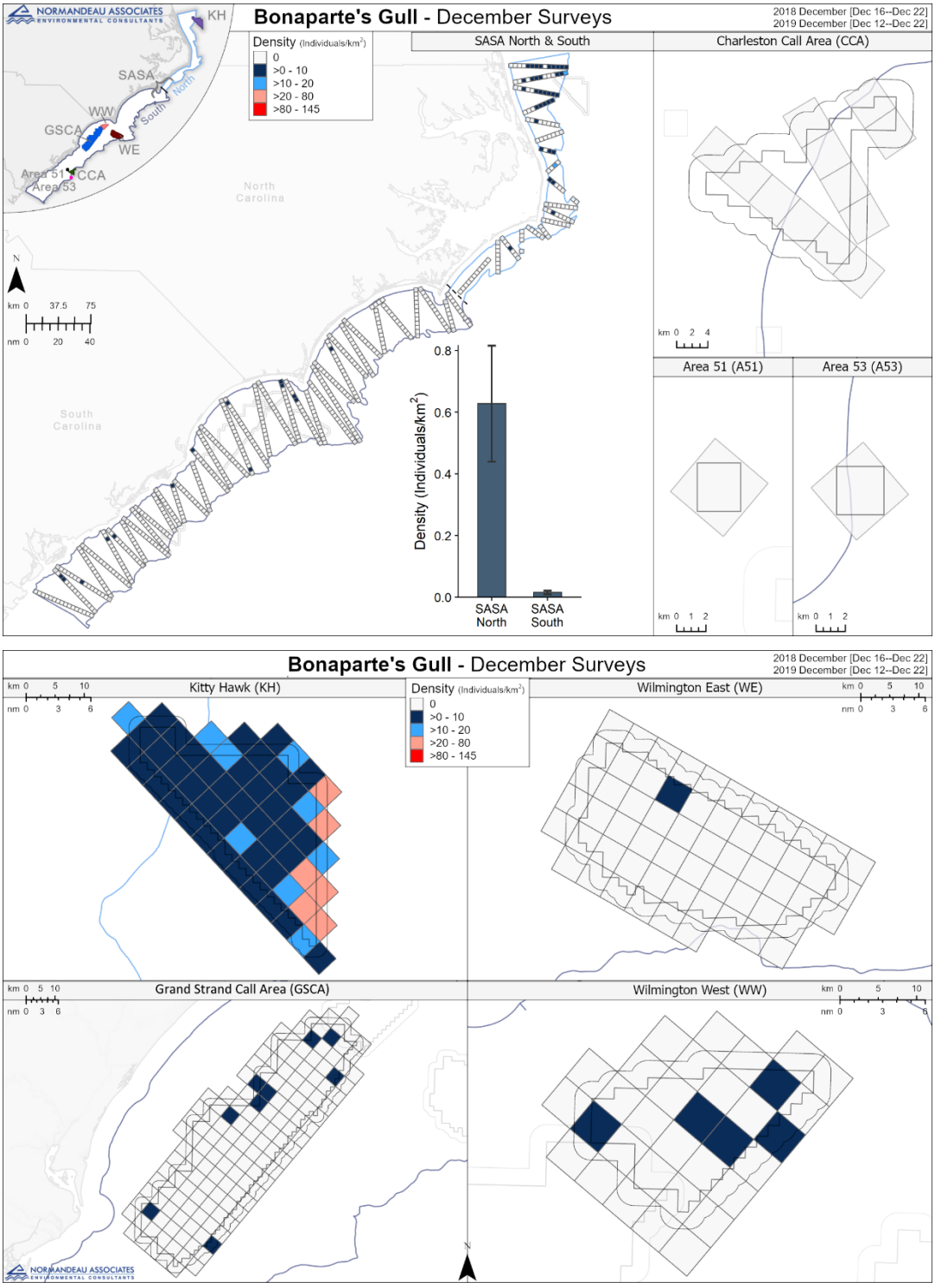


Figure C–177. Spatial distribution of Bonaparte's gulls during the December surveys for all areas

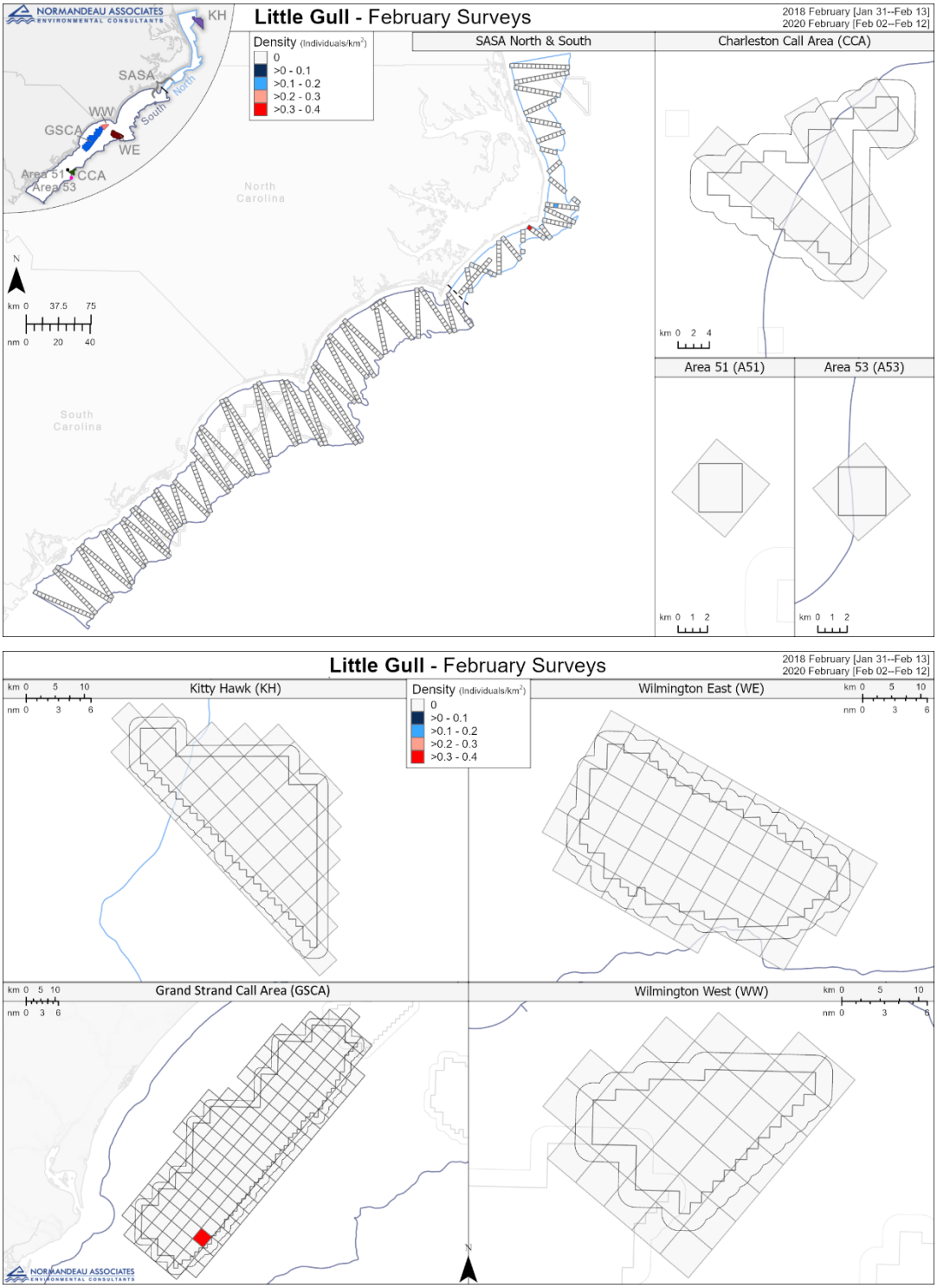


Figure C–178. Spatial distribution of little gulls during the February surveys for all areas

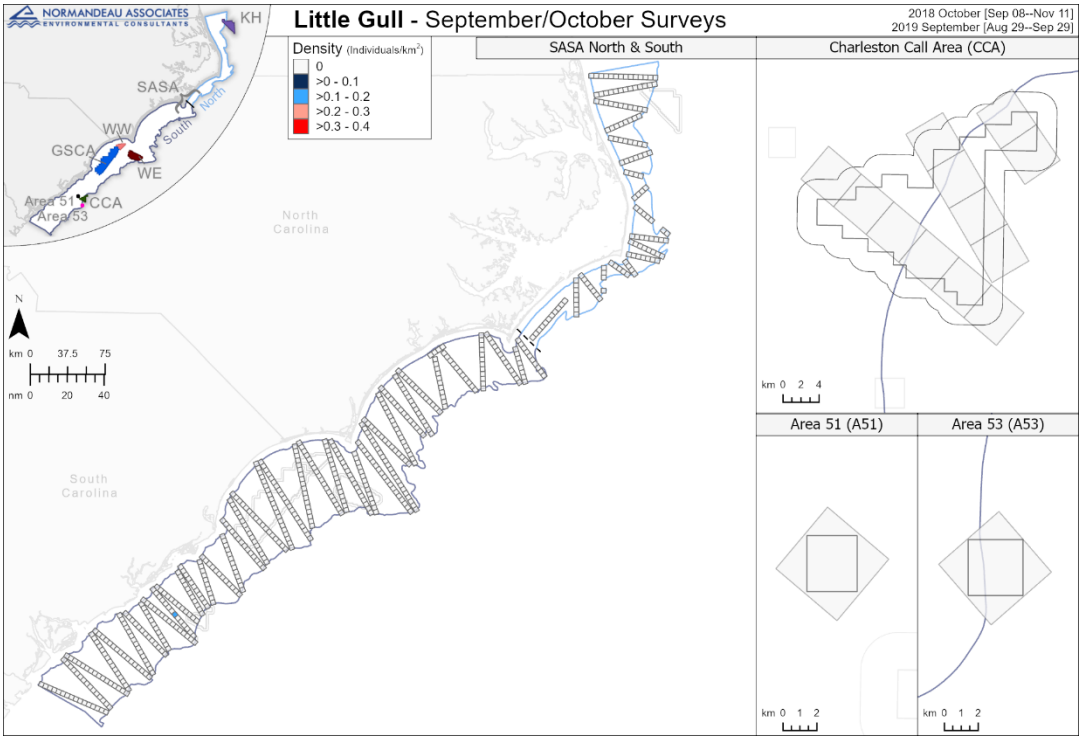


Figure C–179. Spatial distribution of little gulls during the September/October surveys for all areas

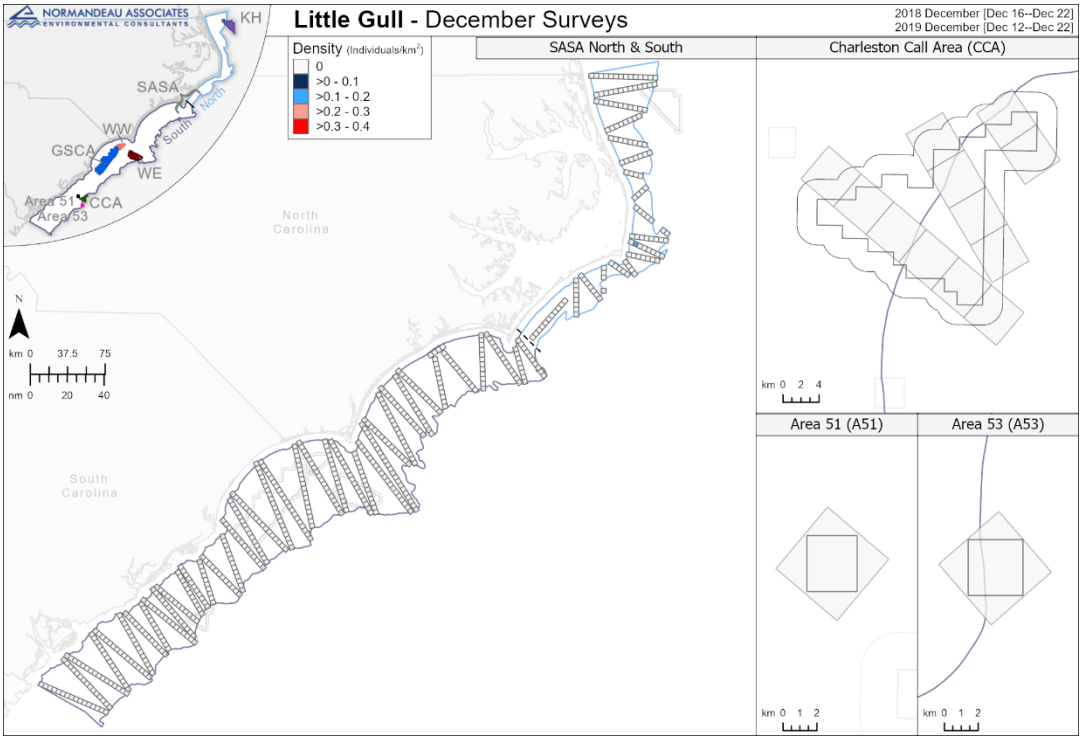


Figure C–180. Spatial distribution of little gulls during the December surveys for all areas

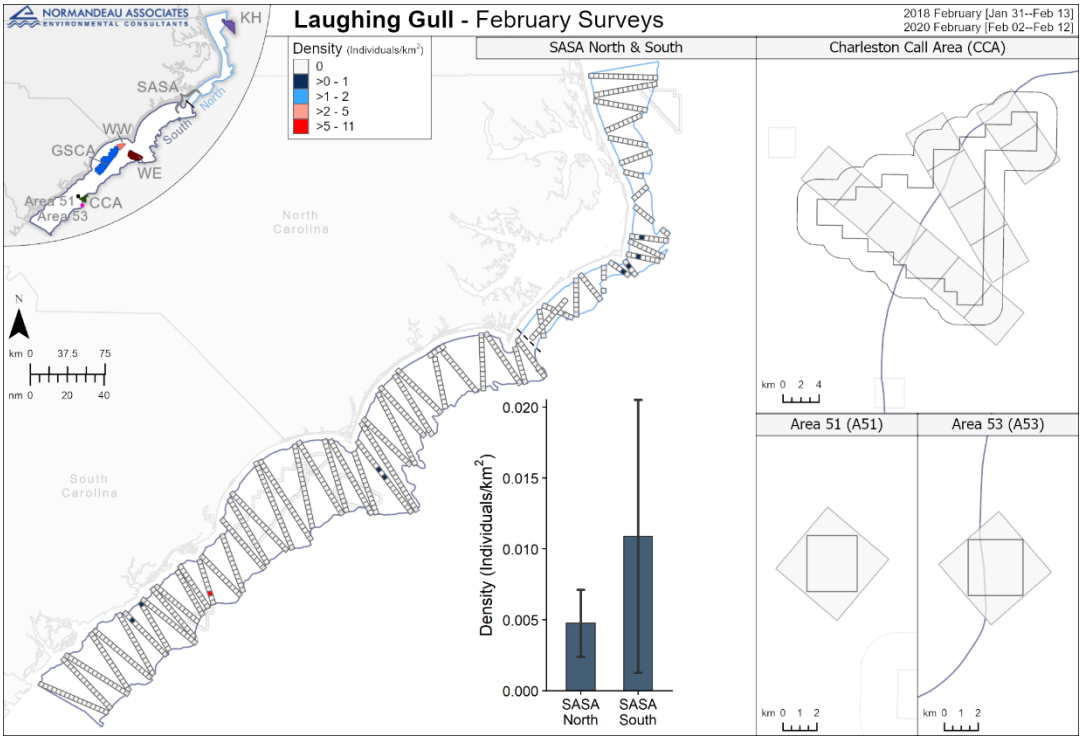


Figure C–181. Spatial distribution of laughing gulls during the February surveys for all areas

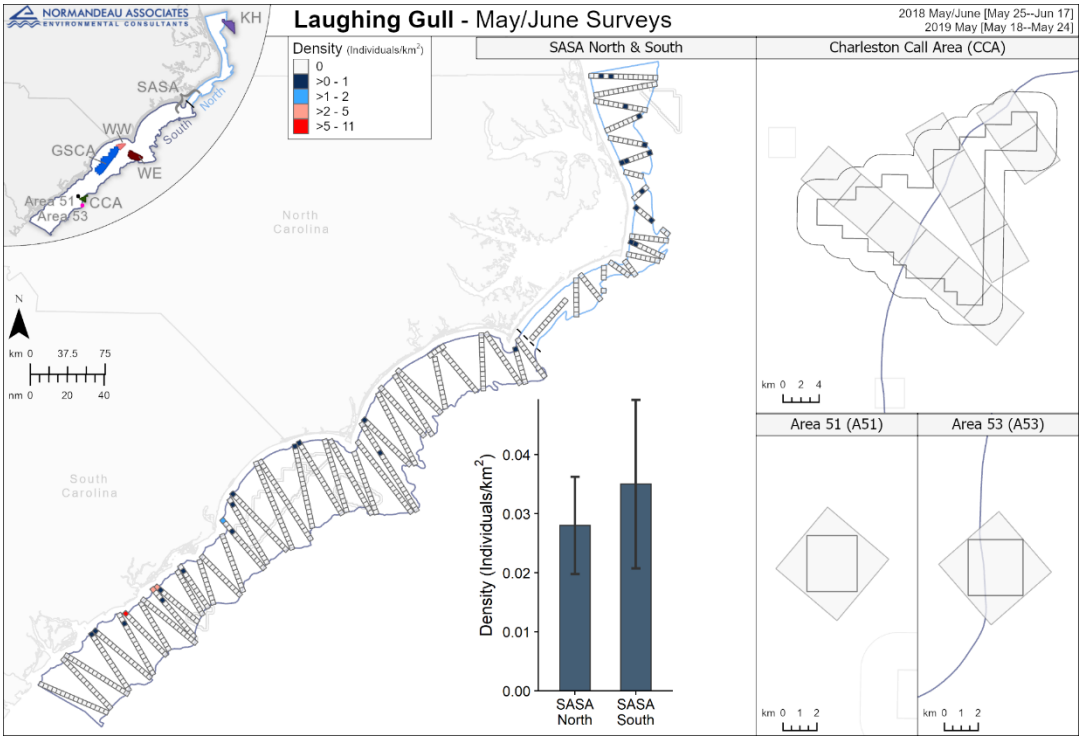


Figure C–182. Spatial distribution of laughing gulls during the May/June surveys for all areas

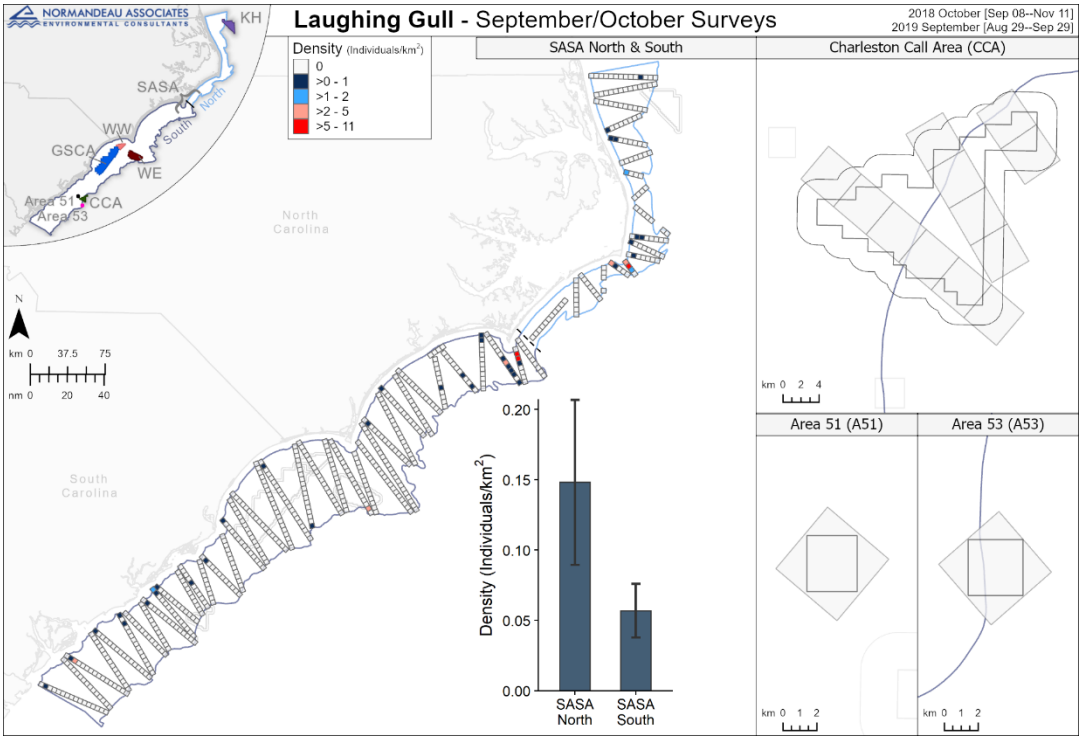


Figure C–183. Spatial distribution of laughing gulls during the September/October surveys for all areas

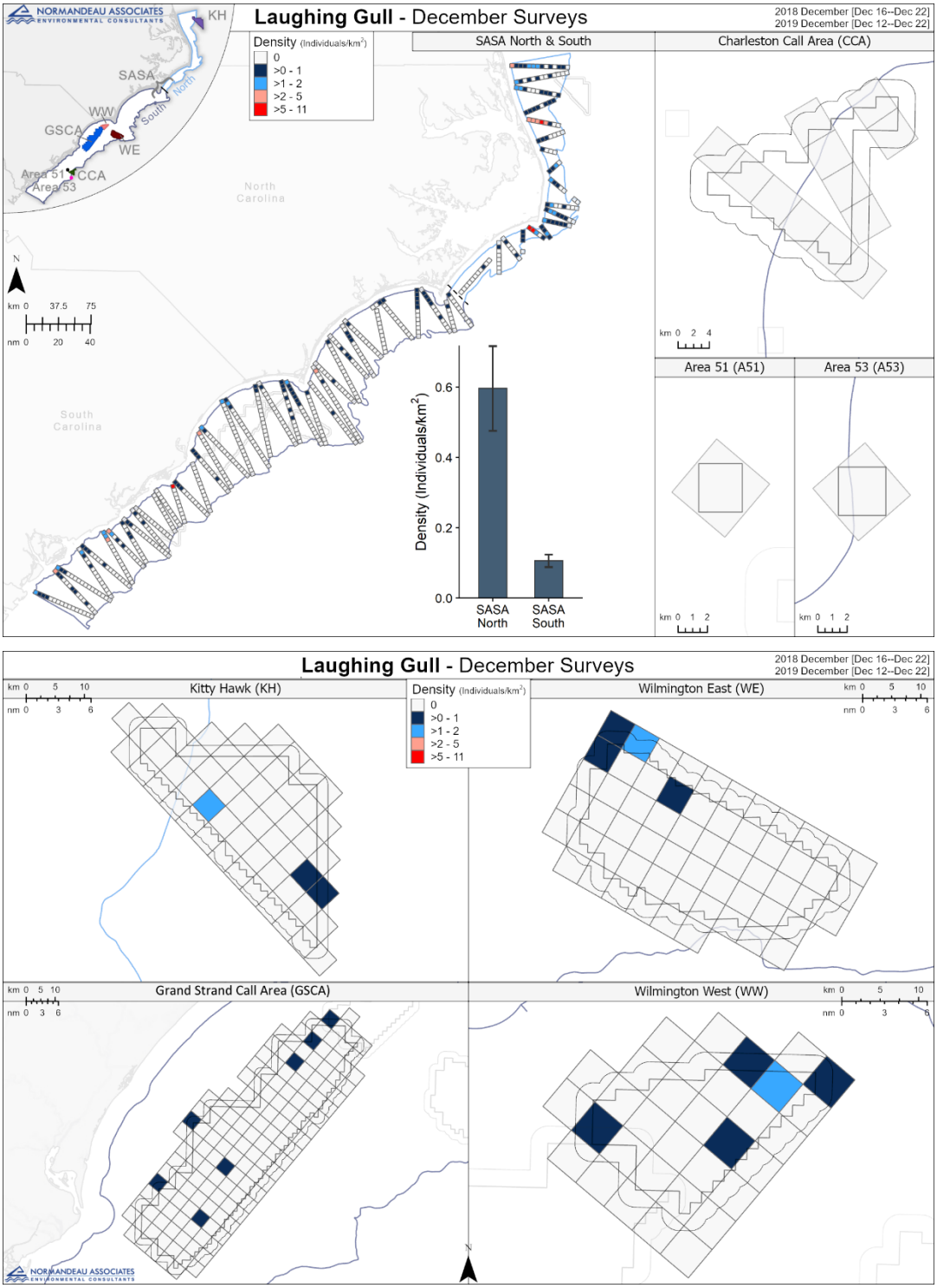


Figure C–184. Spatial distribution of laughing gulls during the December surveys for all areas

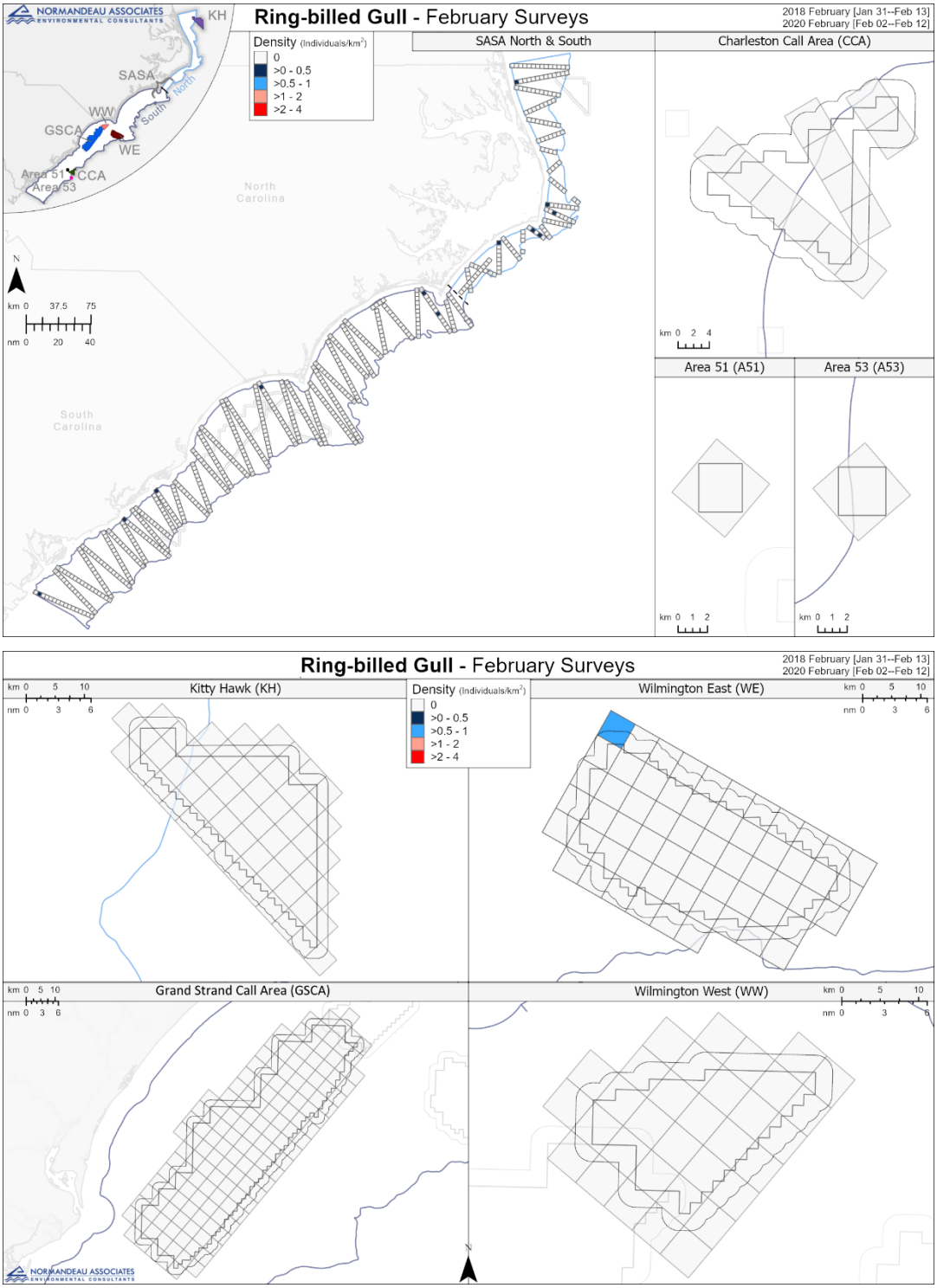


Figure C–185. Spatial distribution of ring-billed gulls during the February surveys for all areas

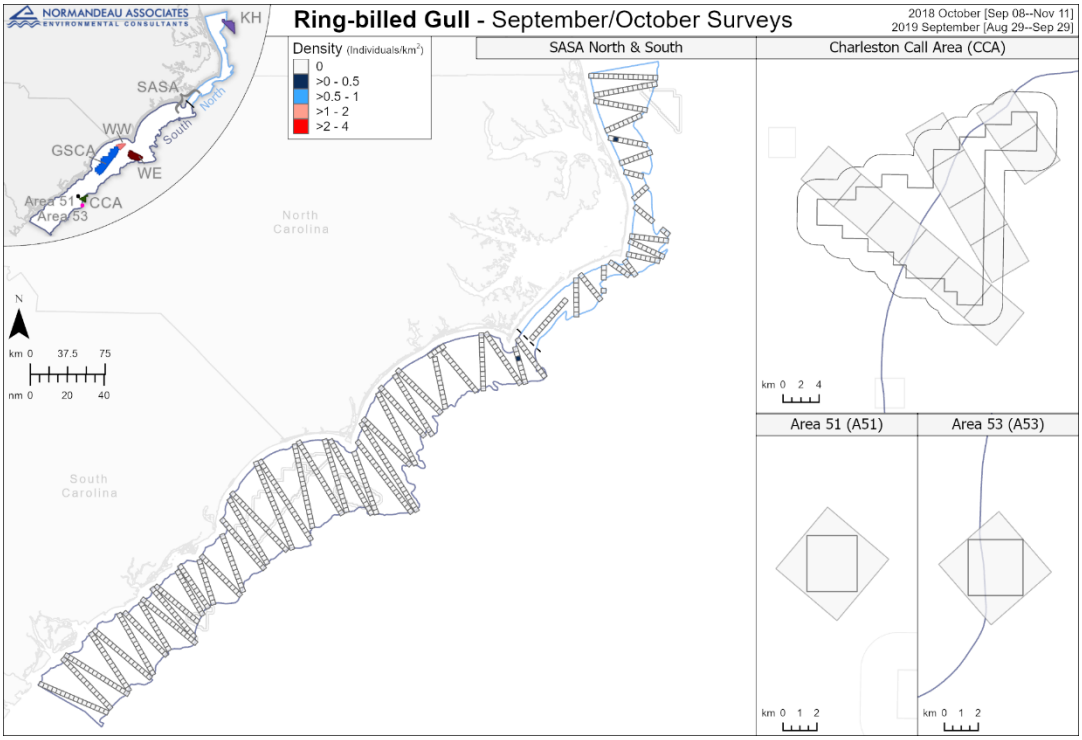


Figure C–186. Spatial distribution of ring-billed gulls during the September/October surveys for all areas

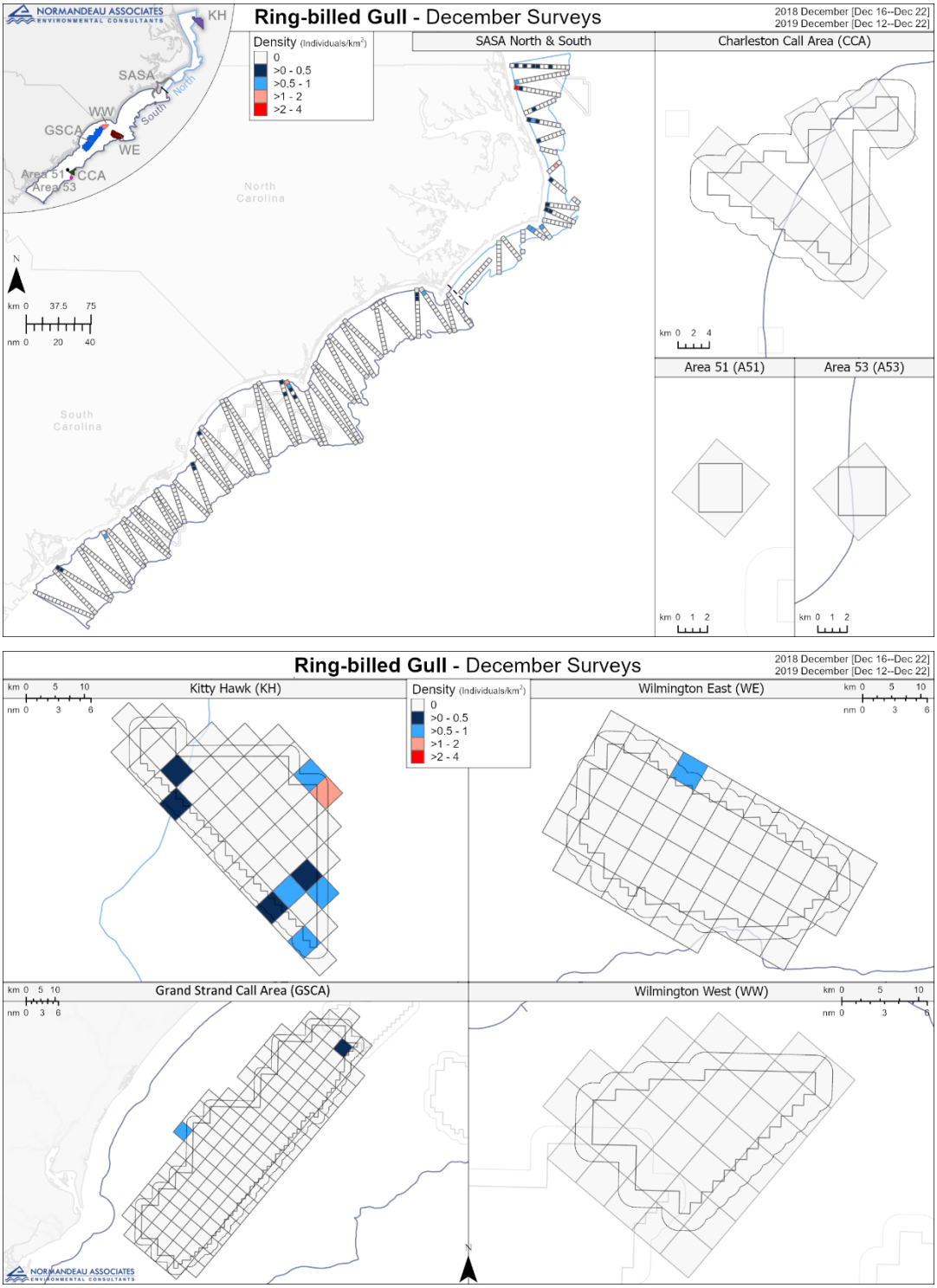


Figure C–187. Spatial distribution of ring-billed gulls during the December surveys for all areas

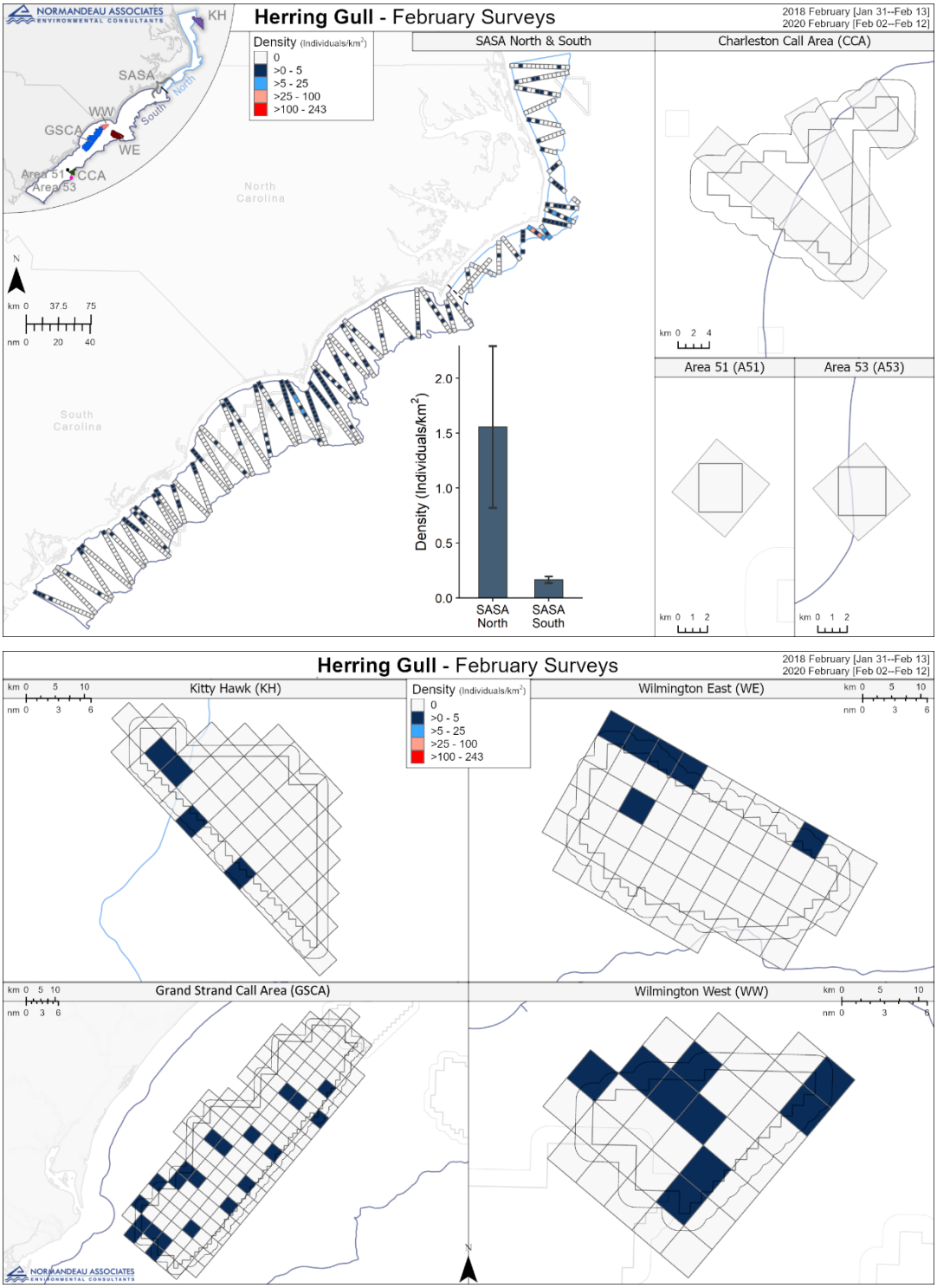


Figure C–188. Spatial distribution of herring gulls during the February surveys for all areas

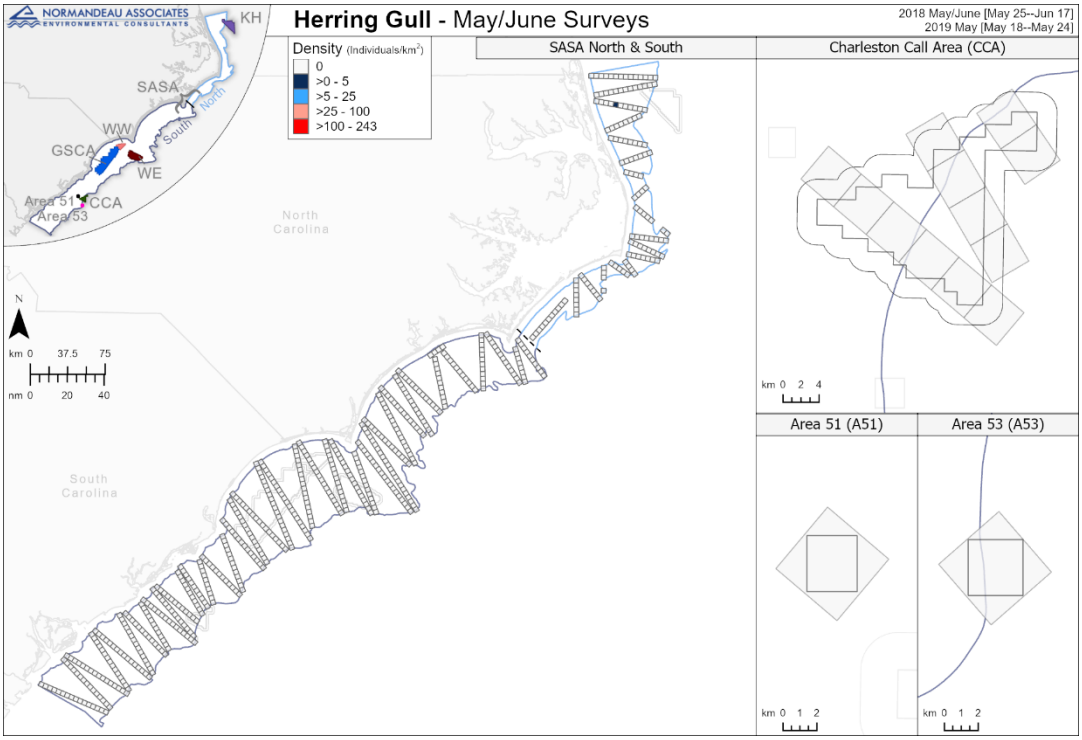


Figure C–189. Spatial distribution of herring gulls during the May/June surveys for all areas

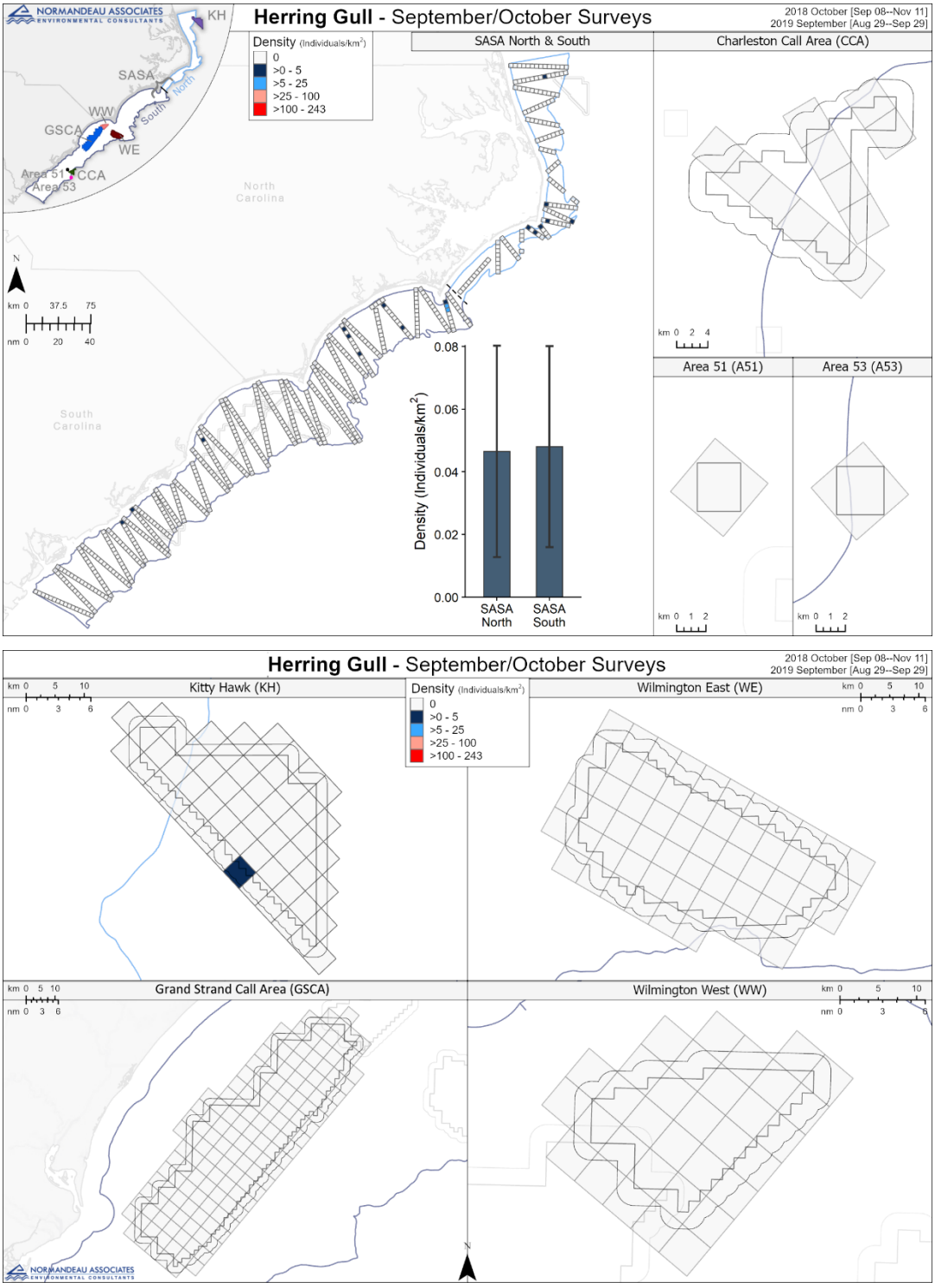


Figure C–190. Spatial distribution of herring gulls during the September/October surveys for all areas

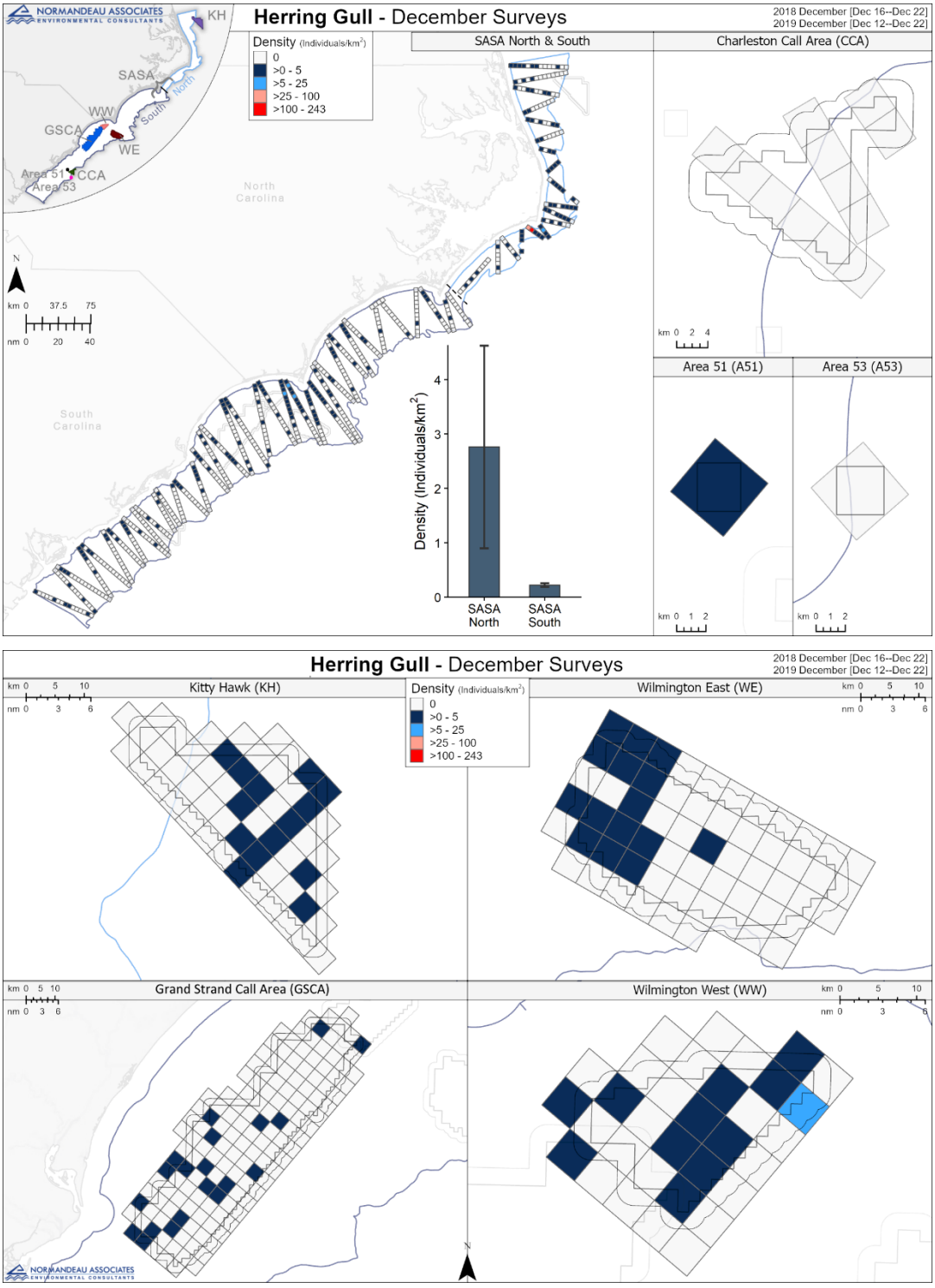


Figure C–191. Spatial distribution of herring gulls during the December surveys for all areas

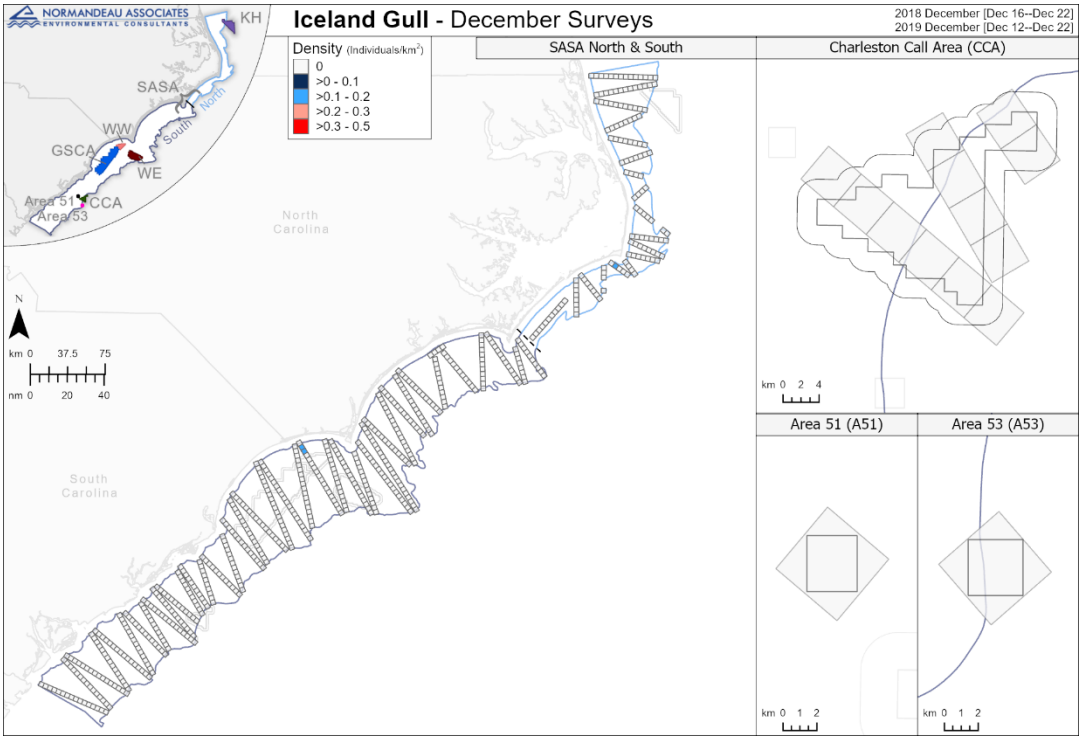


Figure C–192. Spatial distribution of Iceland gulls during the December surveys for all areas

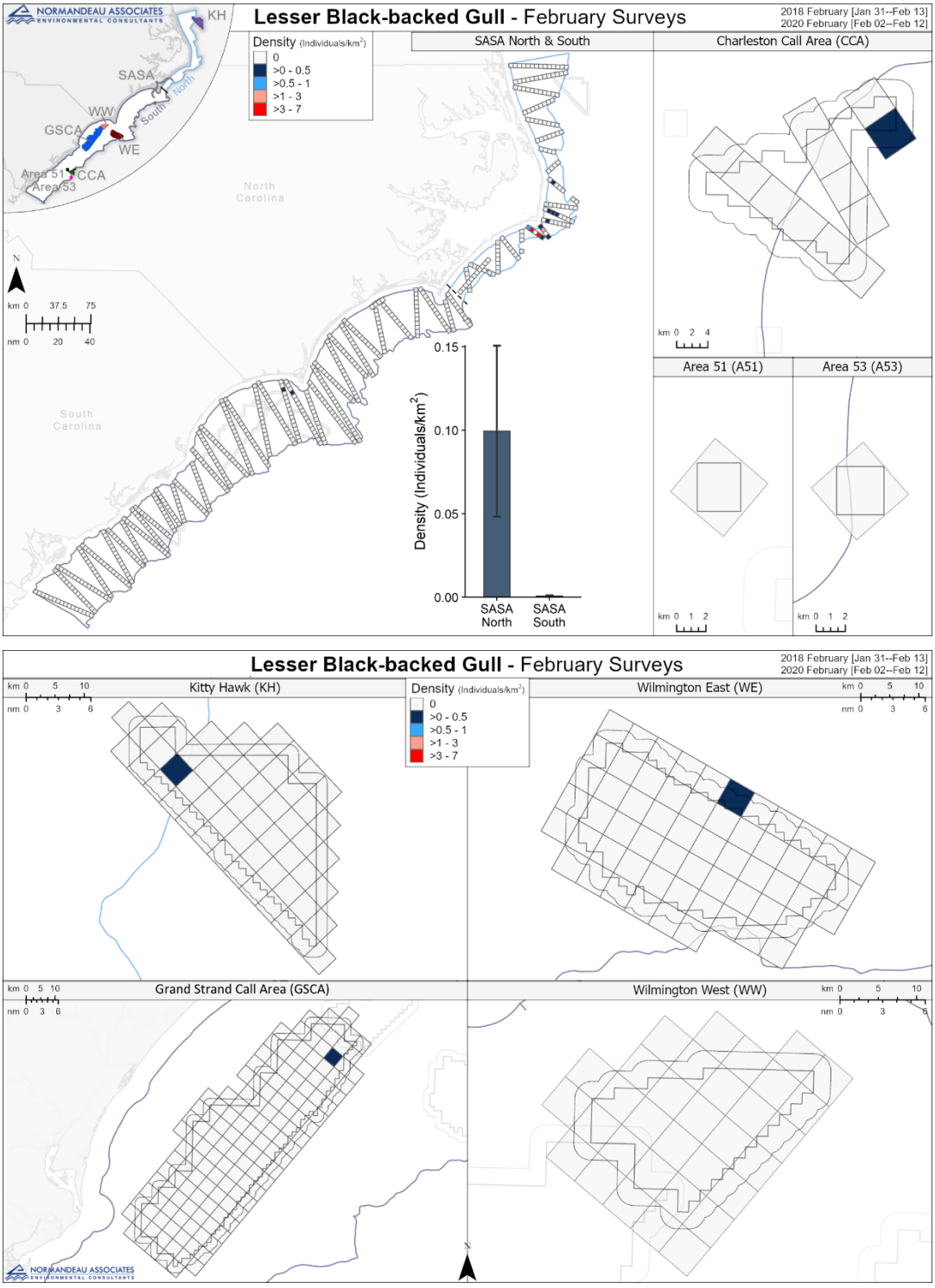


Figure C–193. Spatial distribution of lesser black-backed gulls during the February surveys for all areas

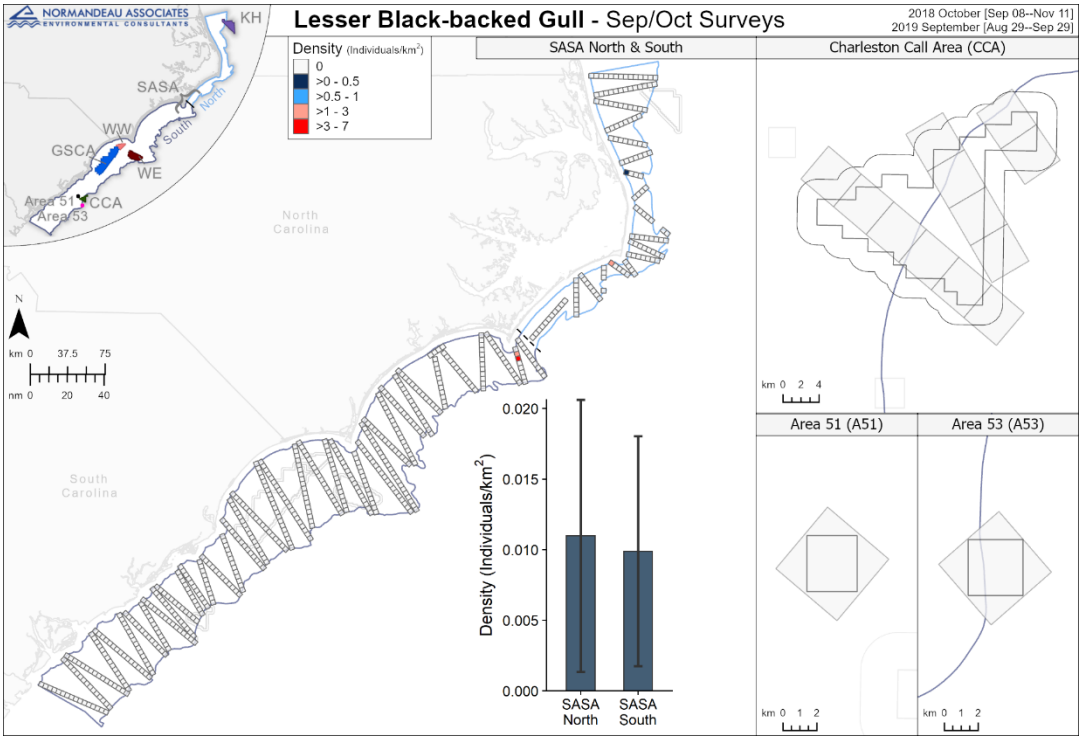


Figure C–194. Spatial distribution of lesser black-backed gulls during the September/October surveys for all areas

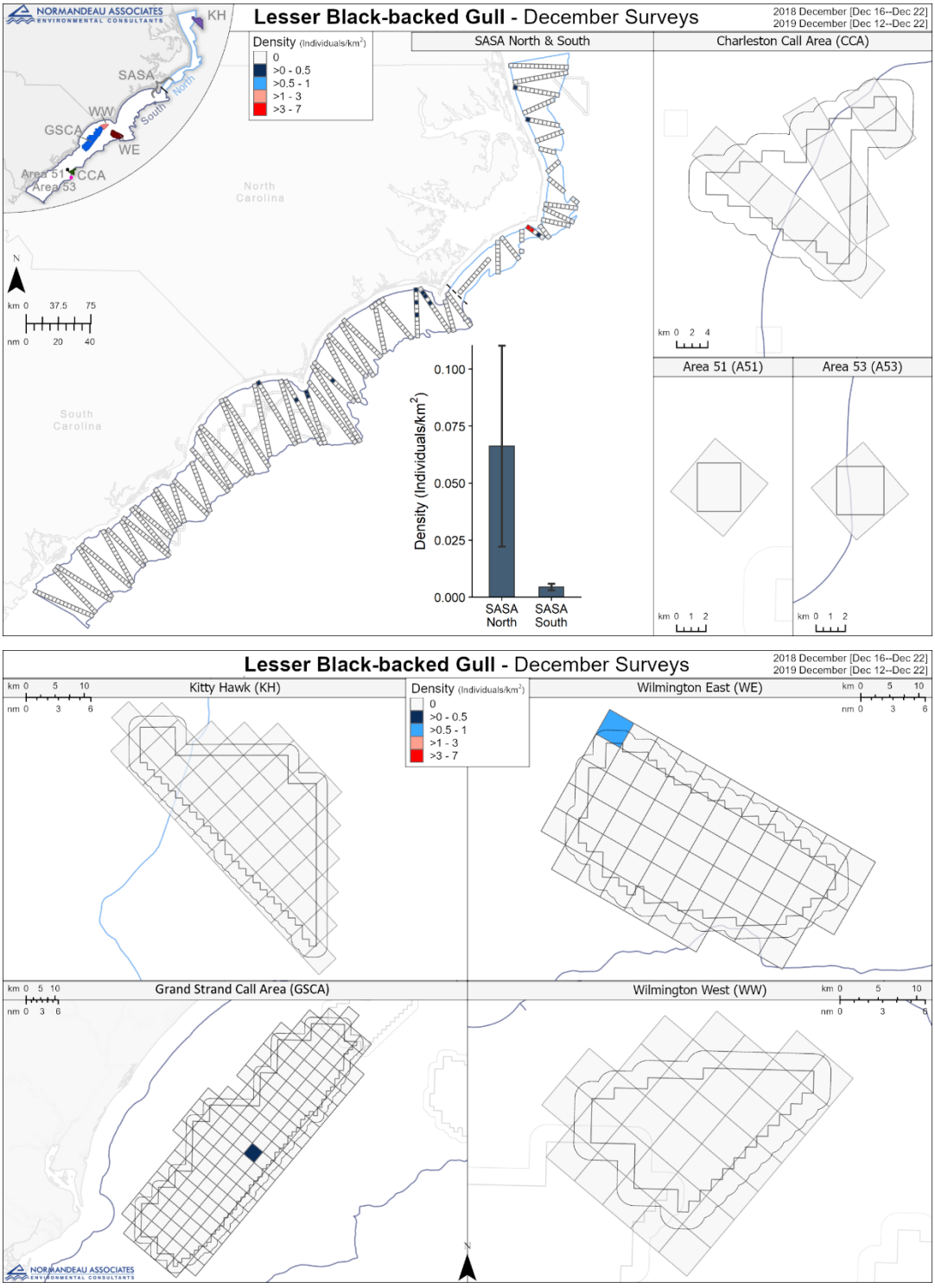


Figure C–195. Spatial distribution of lesser black-backed gulls during the December surveys for all areas

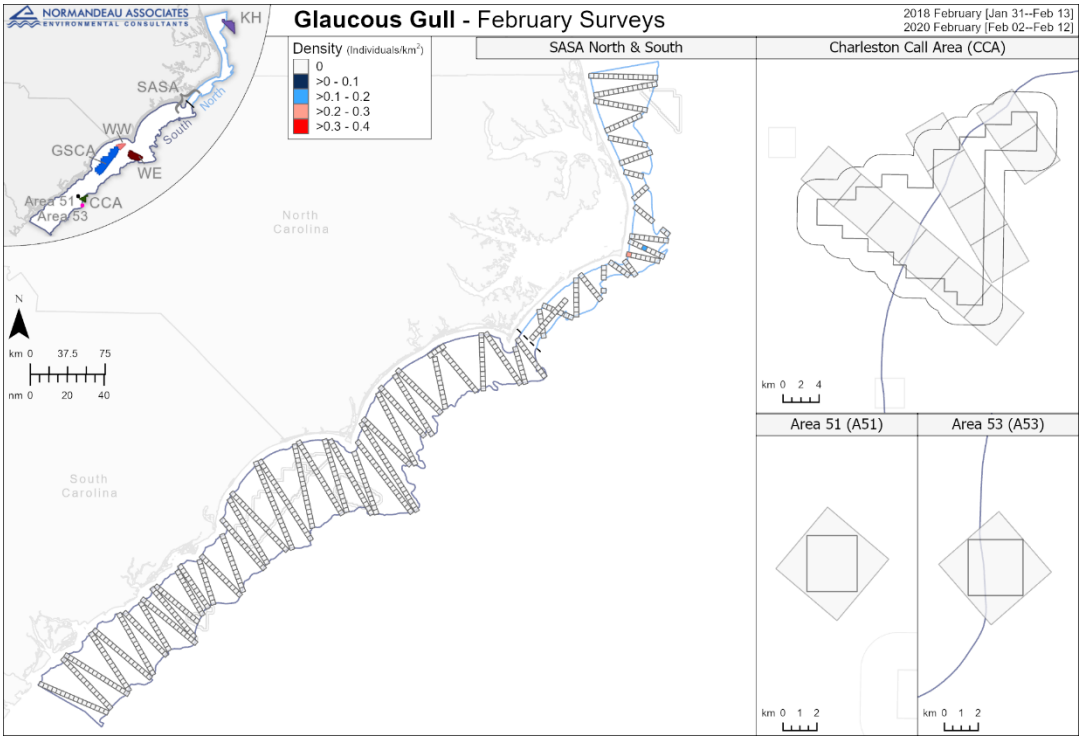


Figure C–196. Spatial distribution of glaucous gulls during the February surveys for all areas

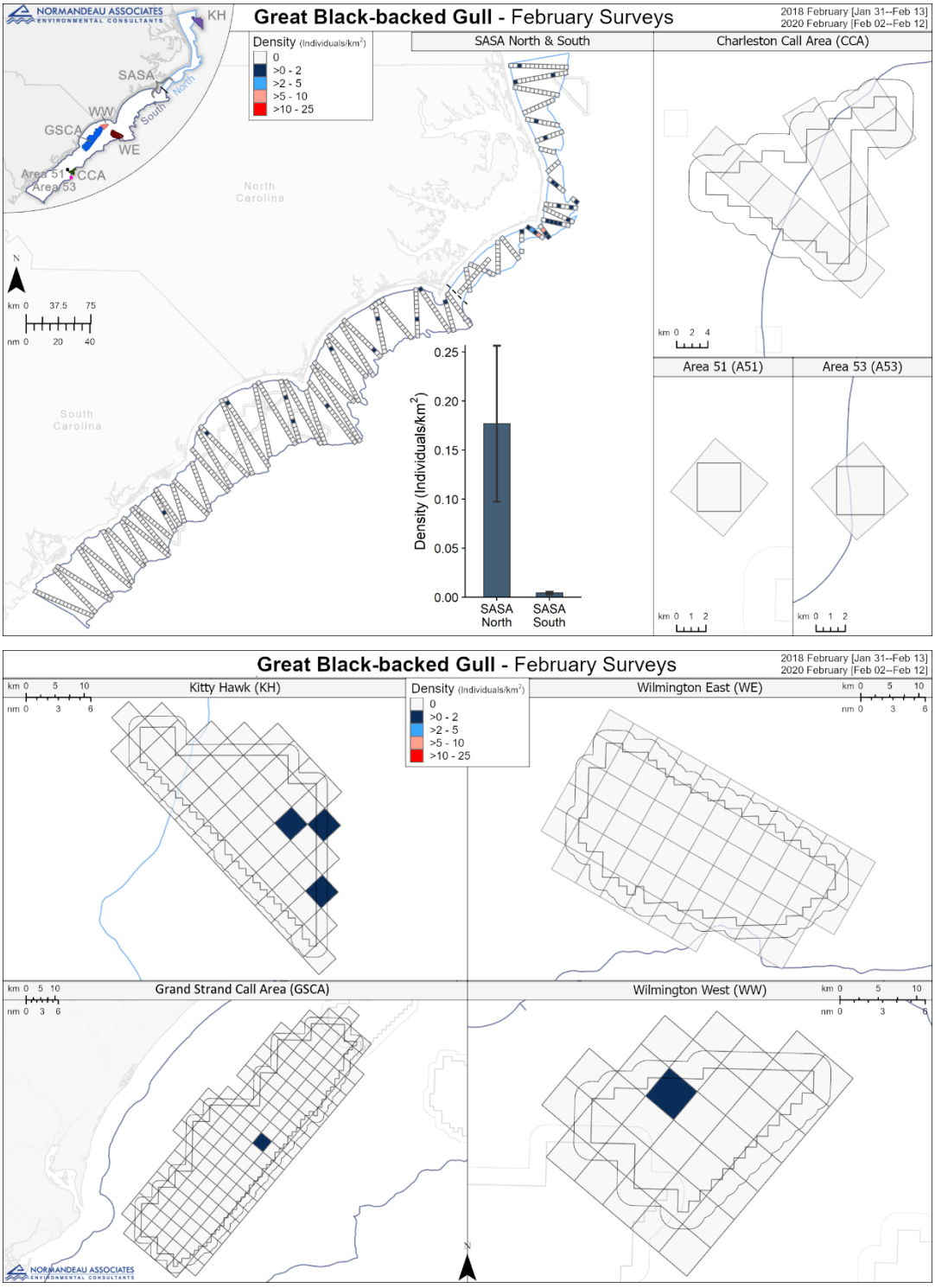


Figure C–197. Spatial distribution of great black-backed gulls during the February surveys for all areas

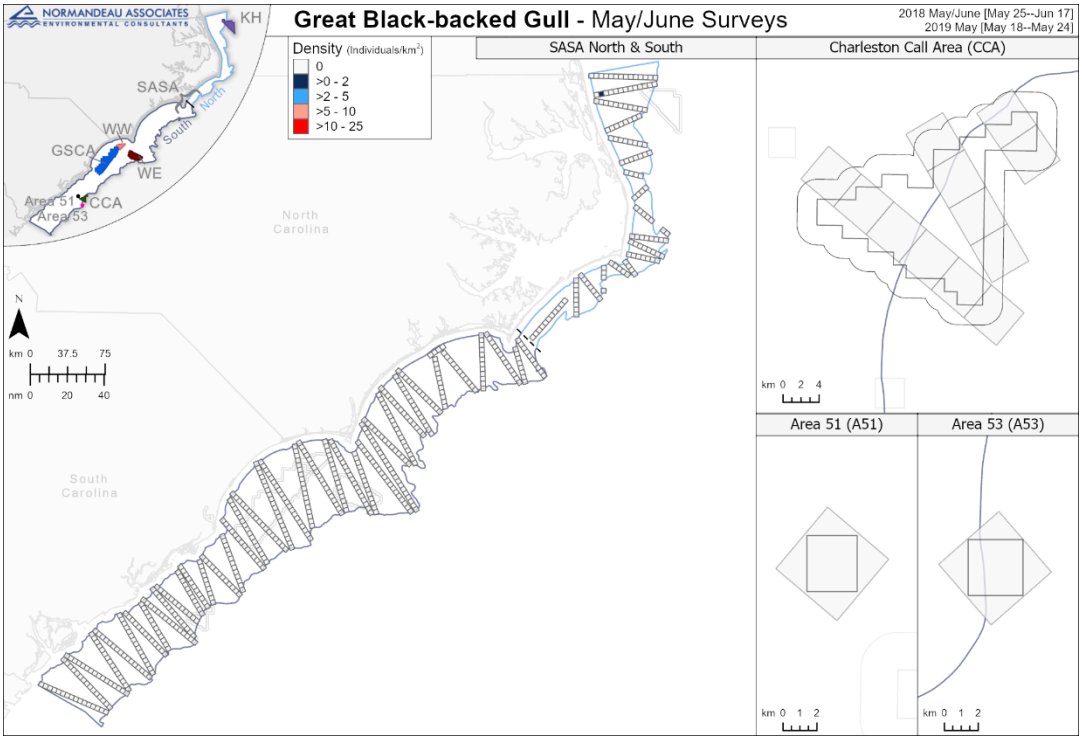


Figure C–198. Spatial distribution of great black-backed gulls during the May/June surveys for all areas

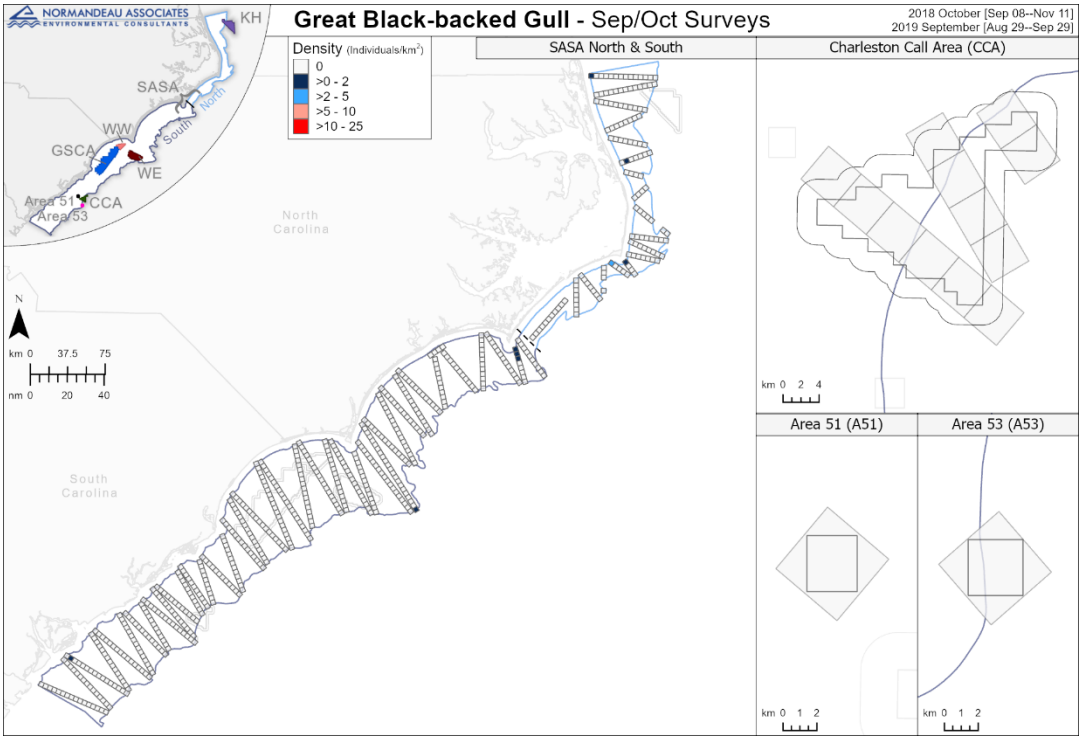


Figure C–199. Spatial distribution of great black-backed gulls during the September/October surveys for all areas

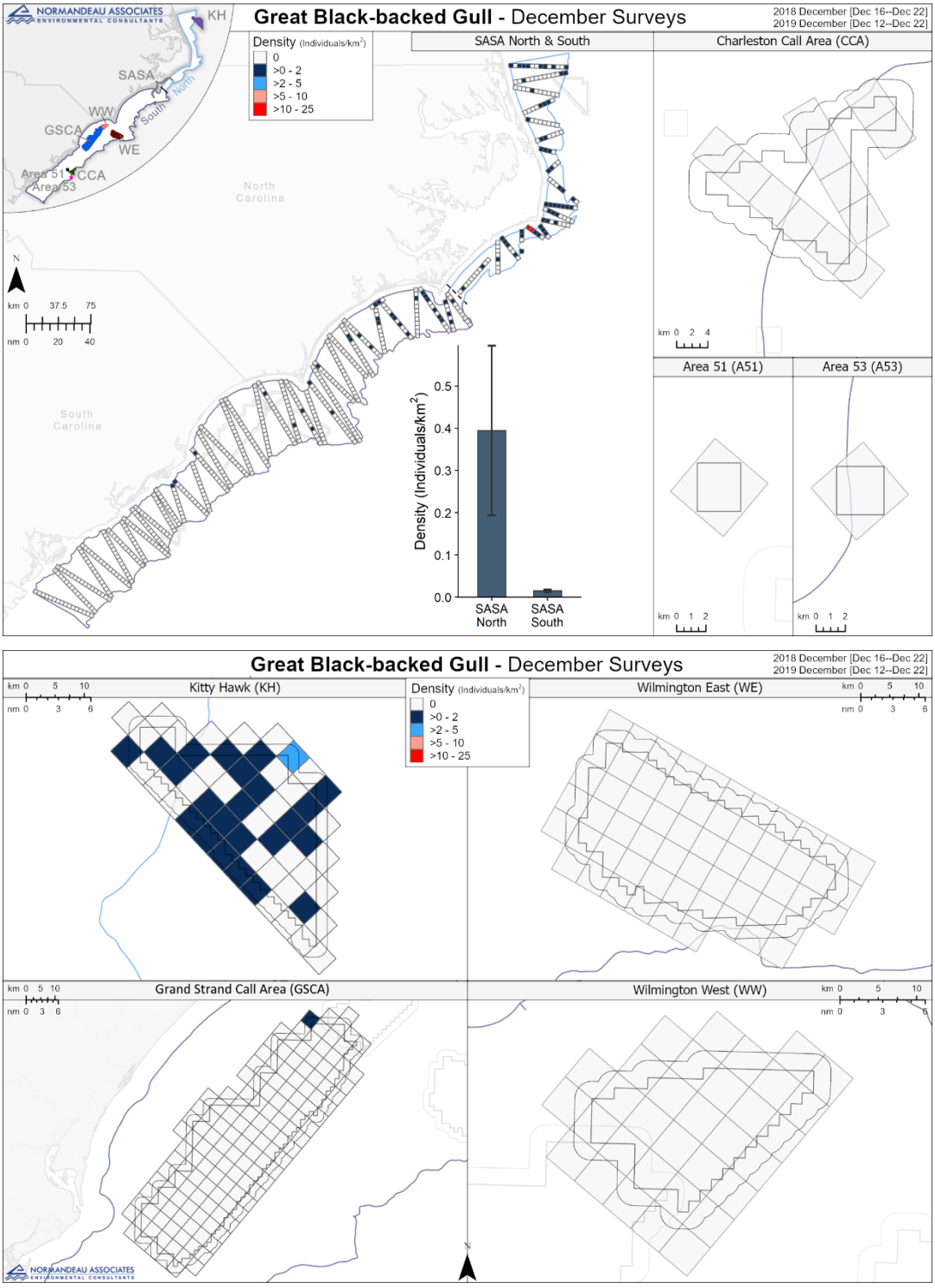


Figure C–200. Spatial distribution of great black-backed gulls during the December surveys for all areas

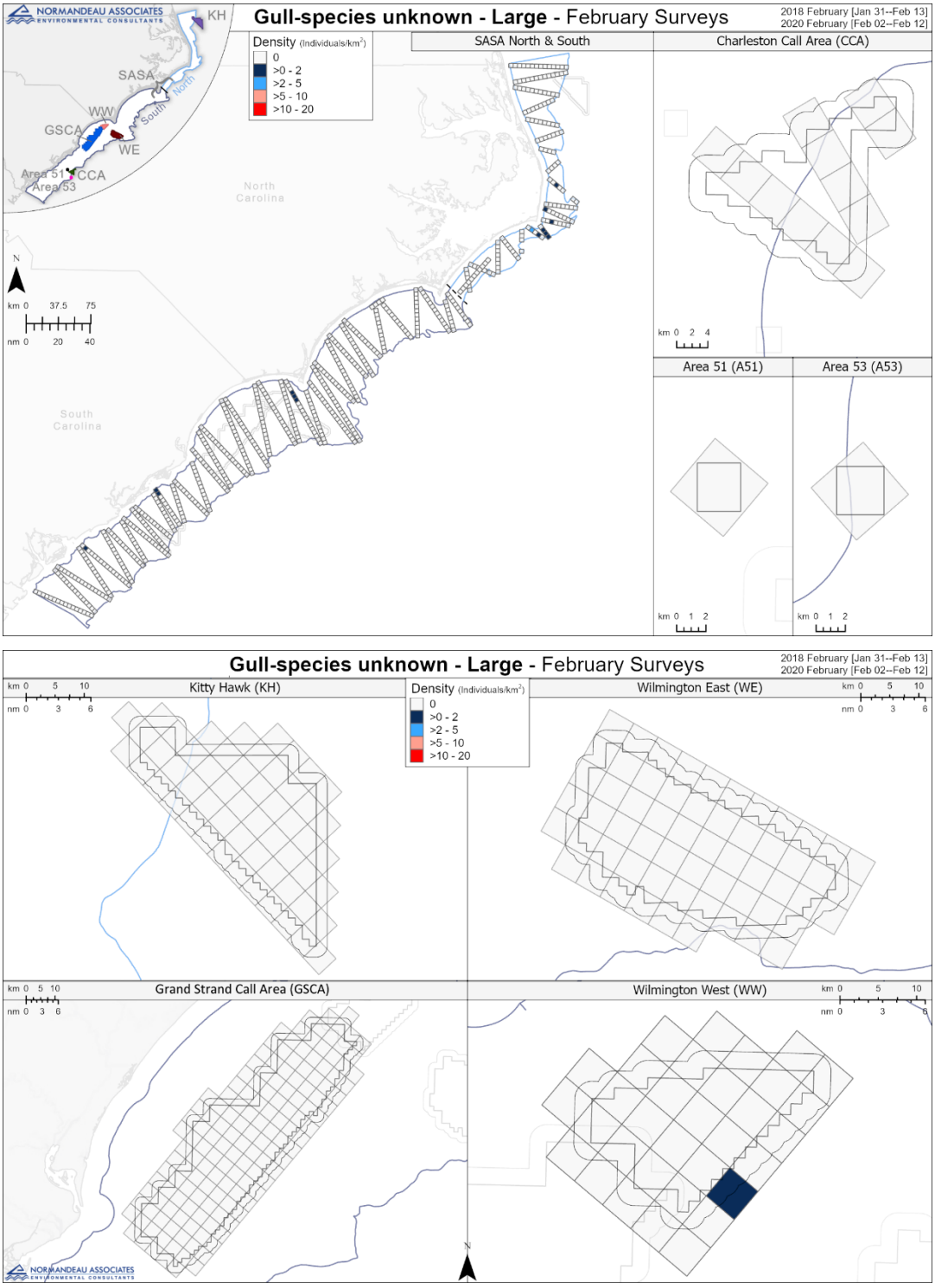


Figure C–201. Spatial distribution of gull-species unknown-large during the February surveys for all areas

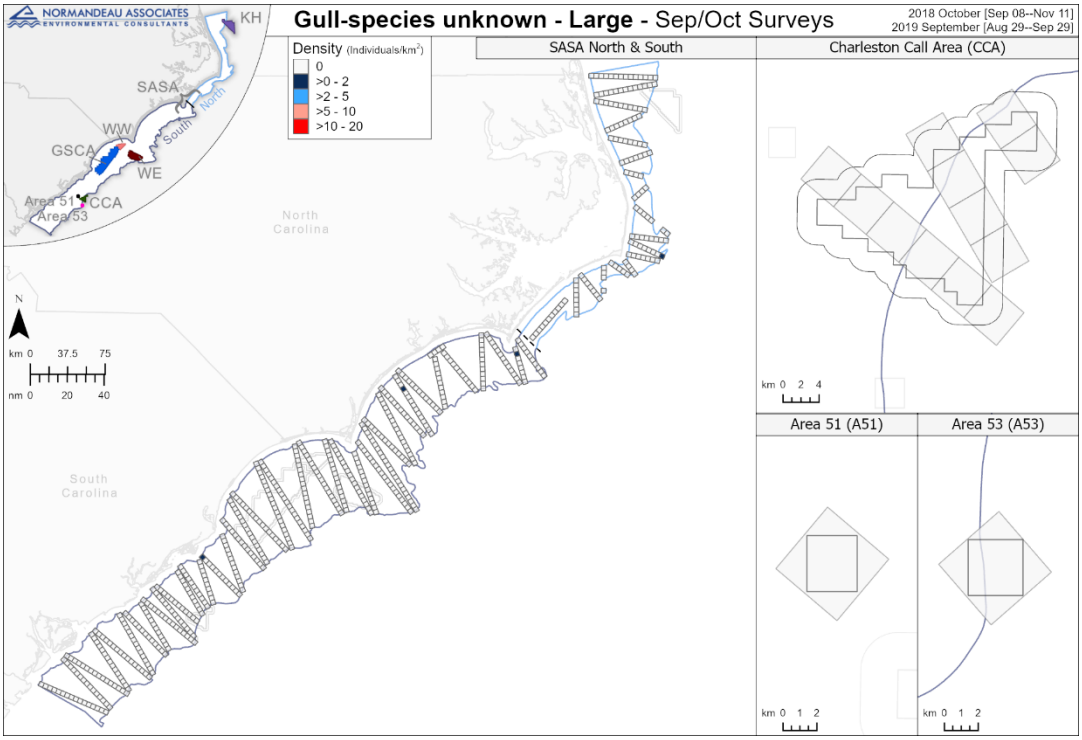


Figure C–202. Spatial distribution of gull-species unknown-large during the September/October surveys for all areas

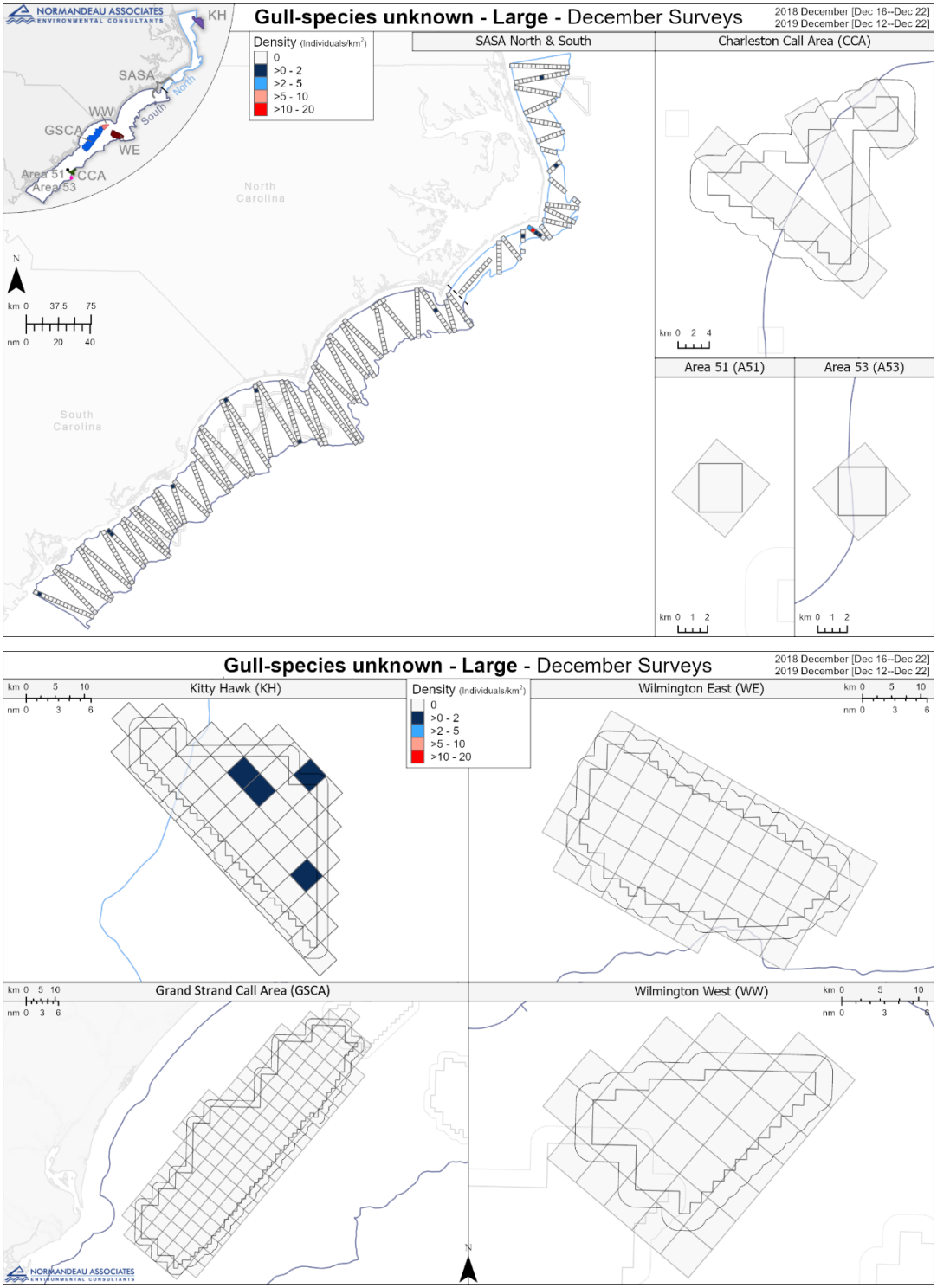


Figure C–203. Spatial distribution of gull-species unknown-large during the December surveys for all areas

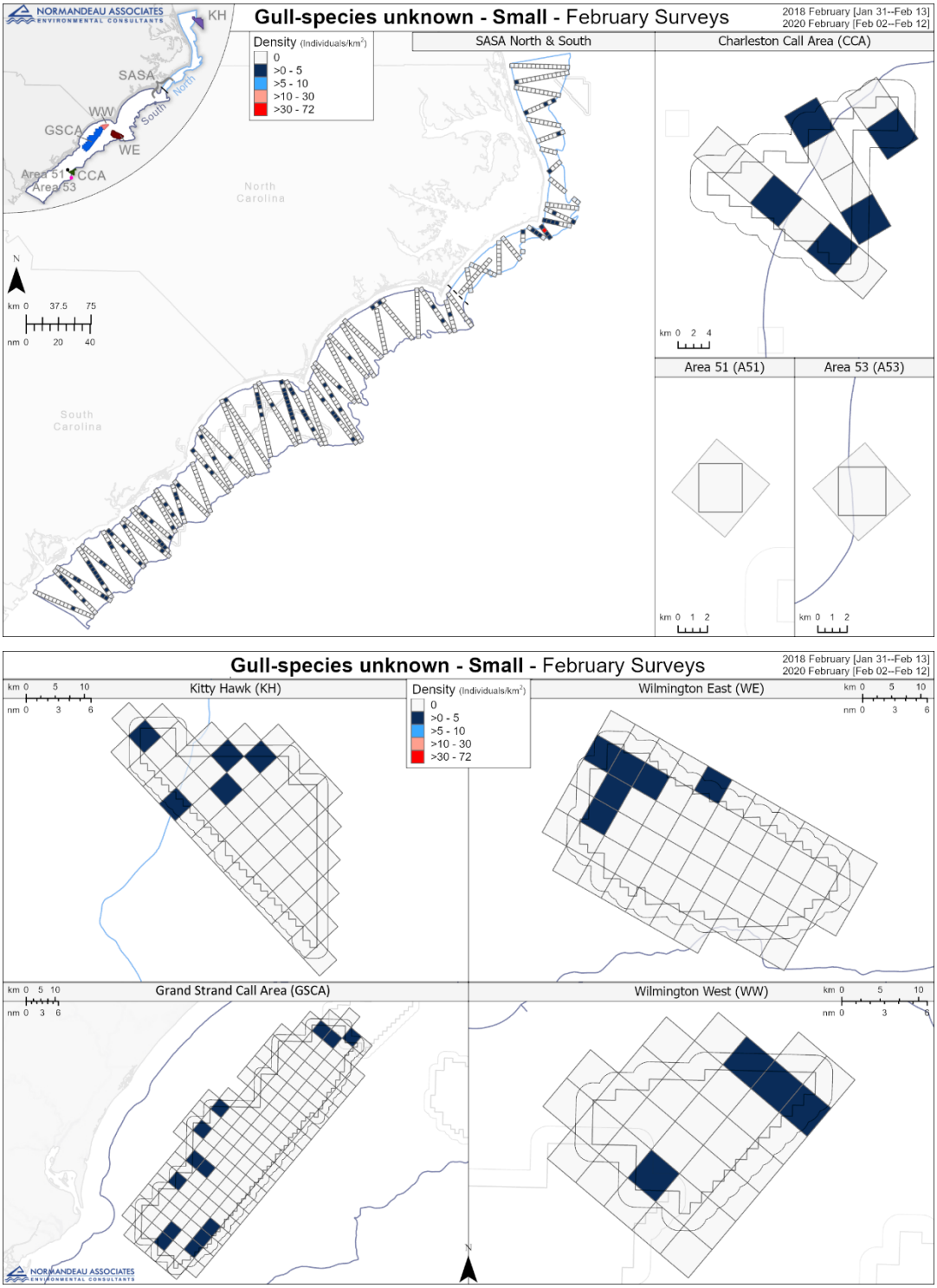


Figure C–204. Spatial distribution of gull-species unknown-small during the February surveys for all areas

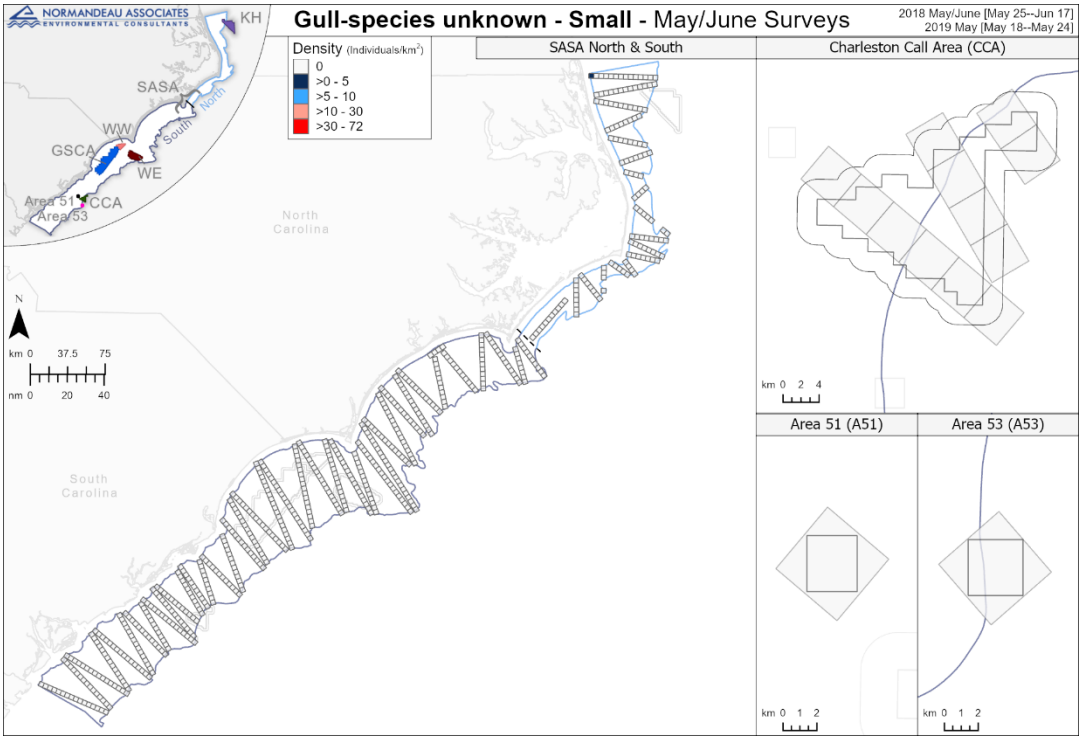


Figure C–205. Spatial distribution of gull-species unknown-small during the May/June surveys for all areas

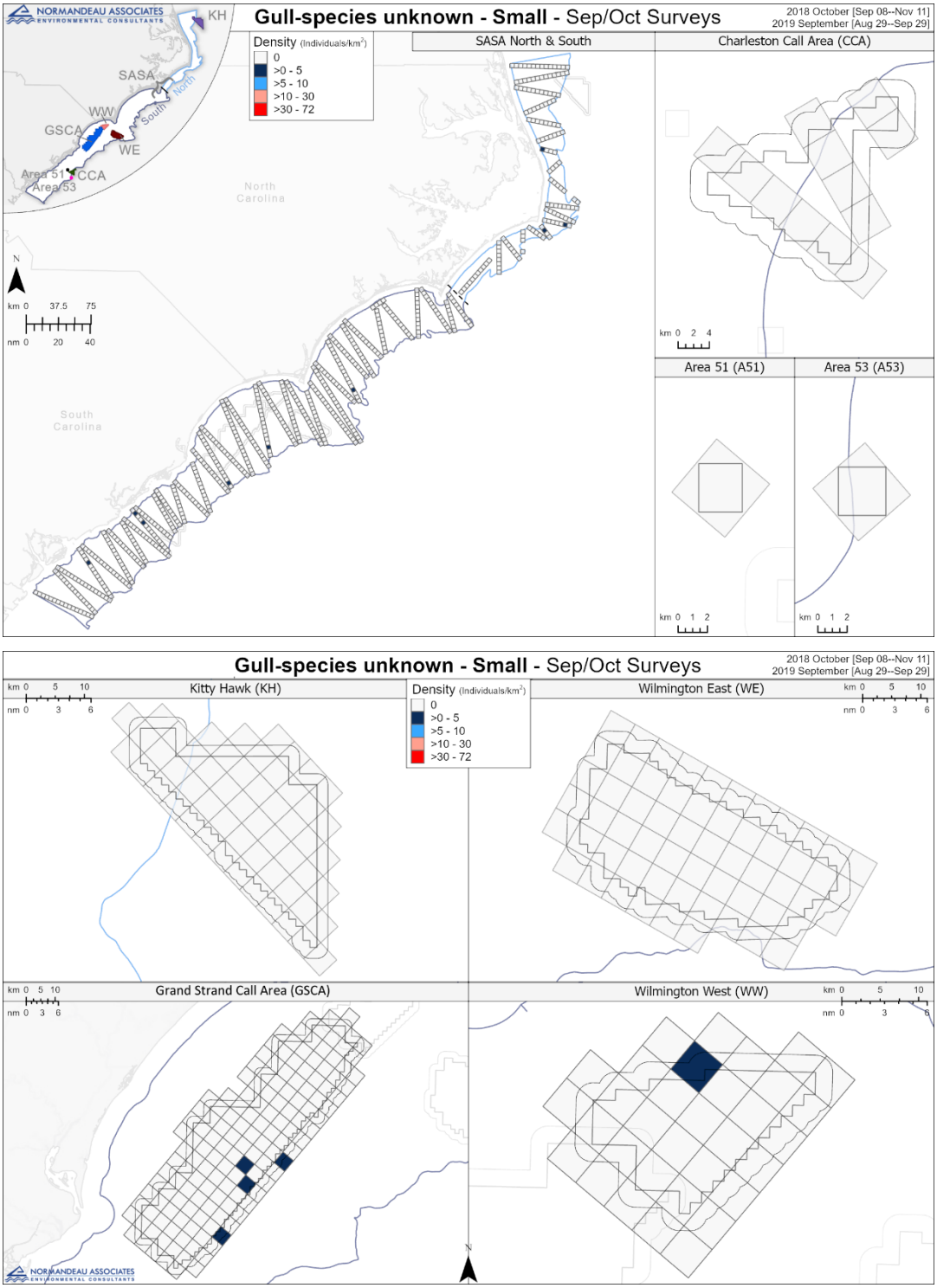


Figure C–206. Spatial distribution of gull-species unknown-small during the September/October surveys for all areas

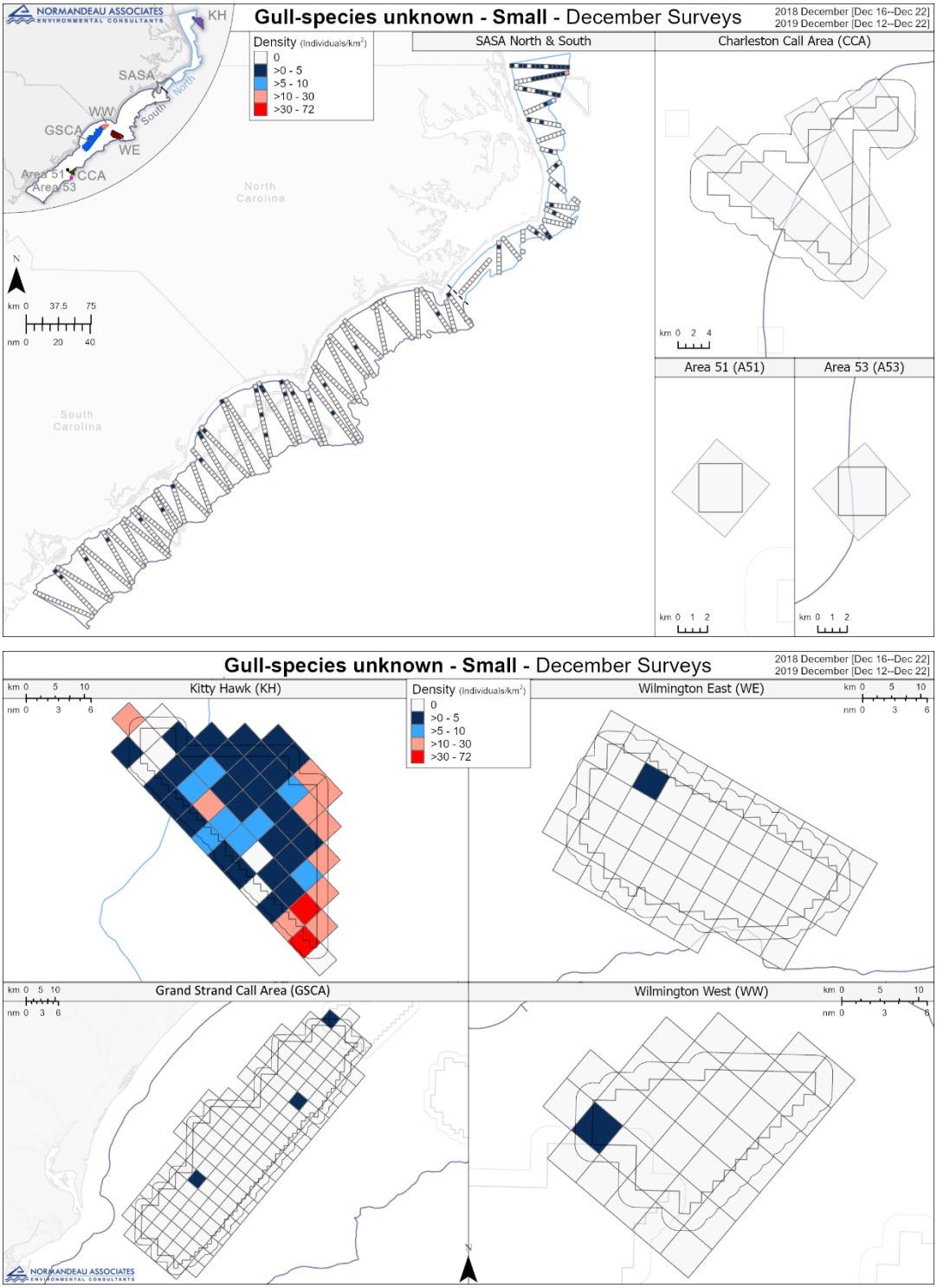


Figure C–207. Spatial distribution of gull-species unknown-small during the December surveys for all areas

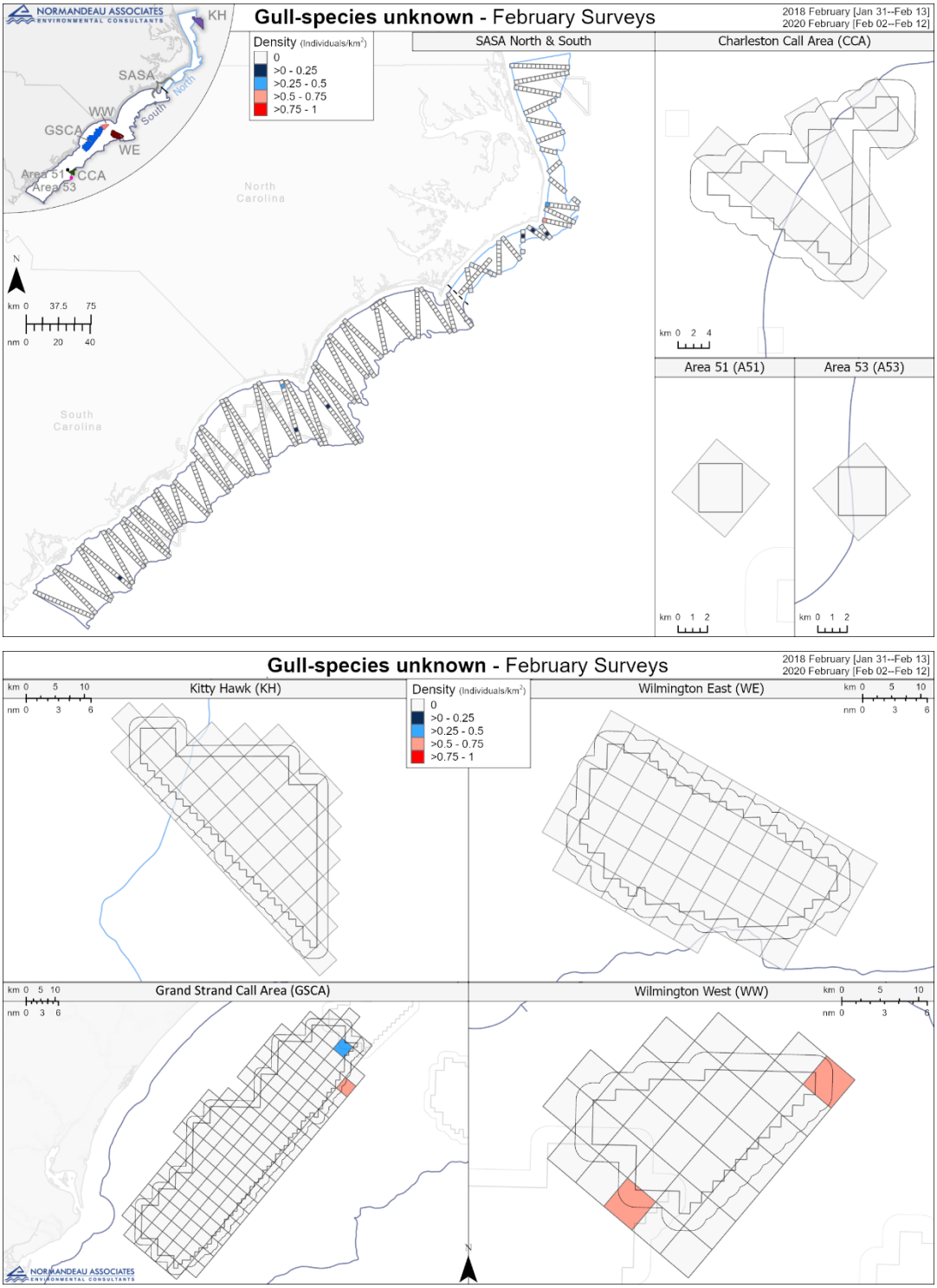


Figure C–208. Spatial distribution of gull-species unknown during the February surveys for all areas

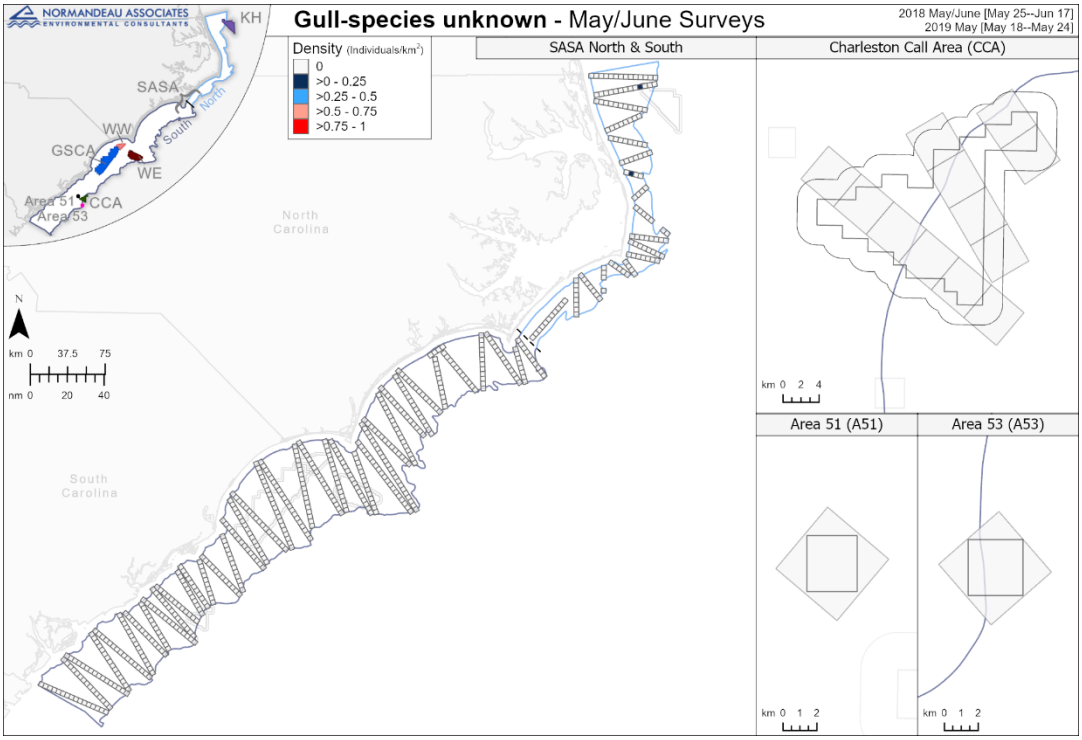


Figure C–209. Spatial distribution of gull-species unknown during the May/June surveys for all areas

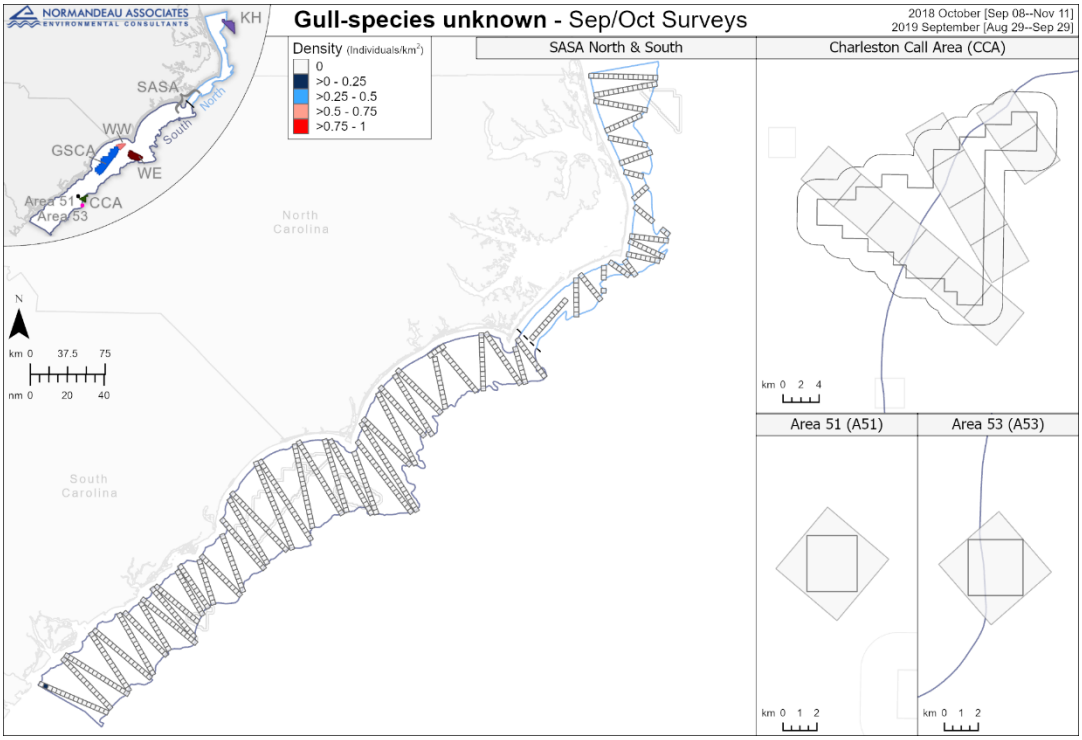


Figure C–210. Spatial distribution of gull-species unknown during the September/ October surveys for all areas

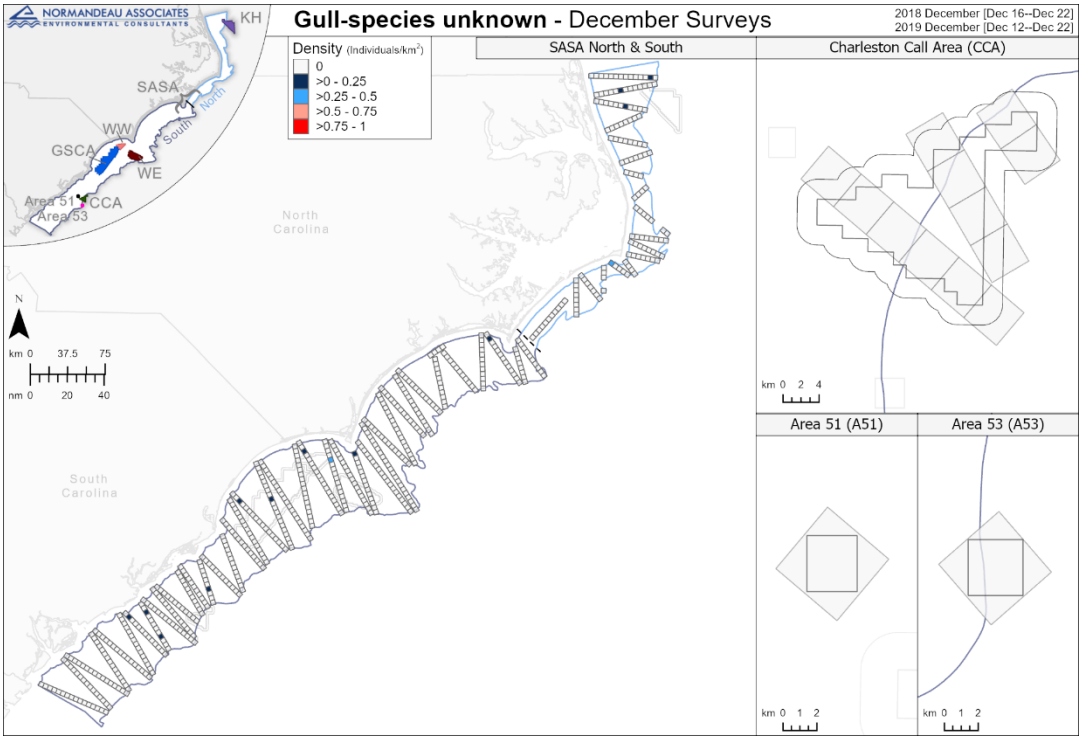


Figure C–211. Spatial distribution of gull-species unknown during the December surveys for all areas

C.4.18 Tern

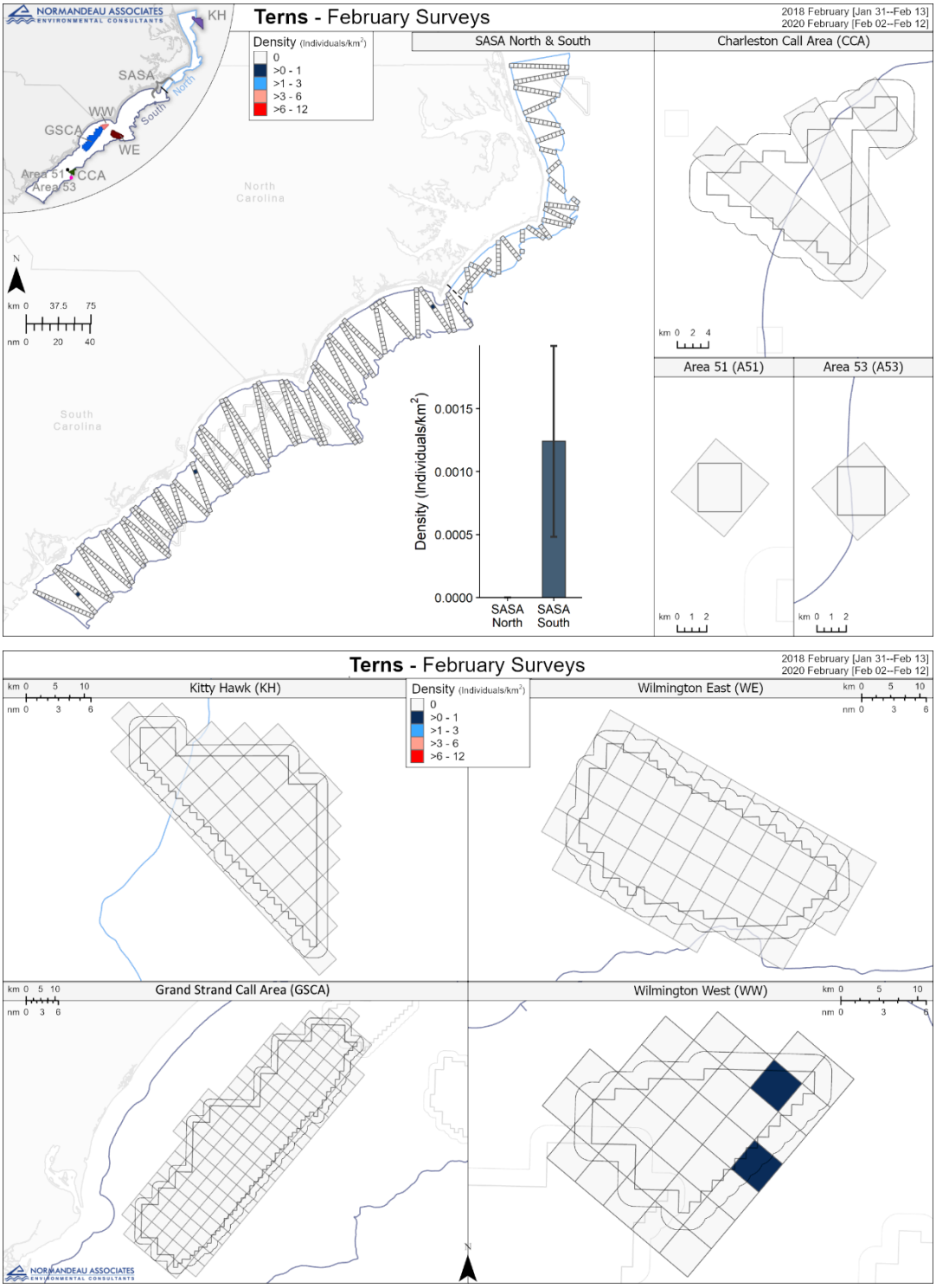


Figure C–212. Spatial distribution of all tern species during the February surveys for all areas

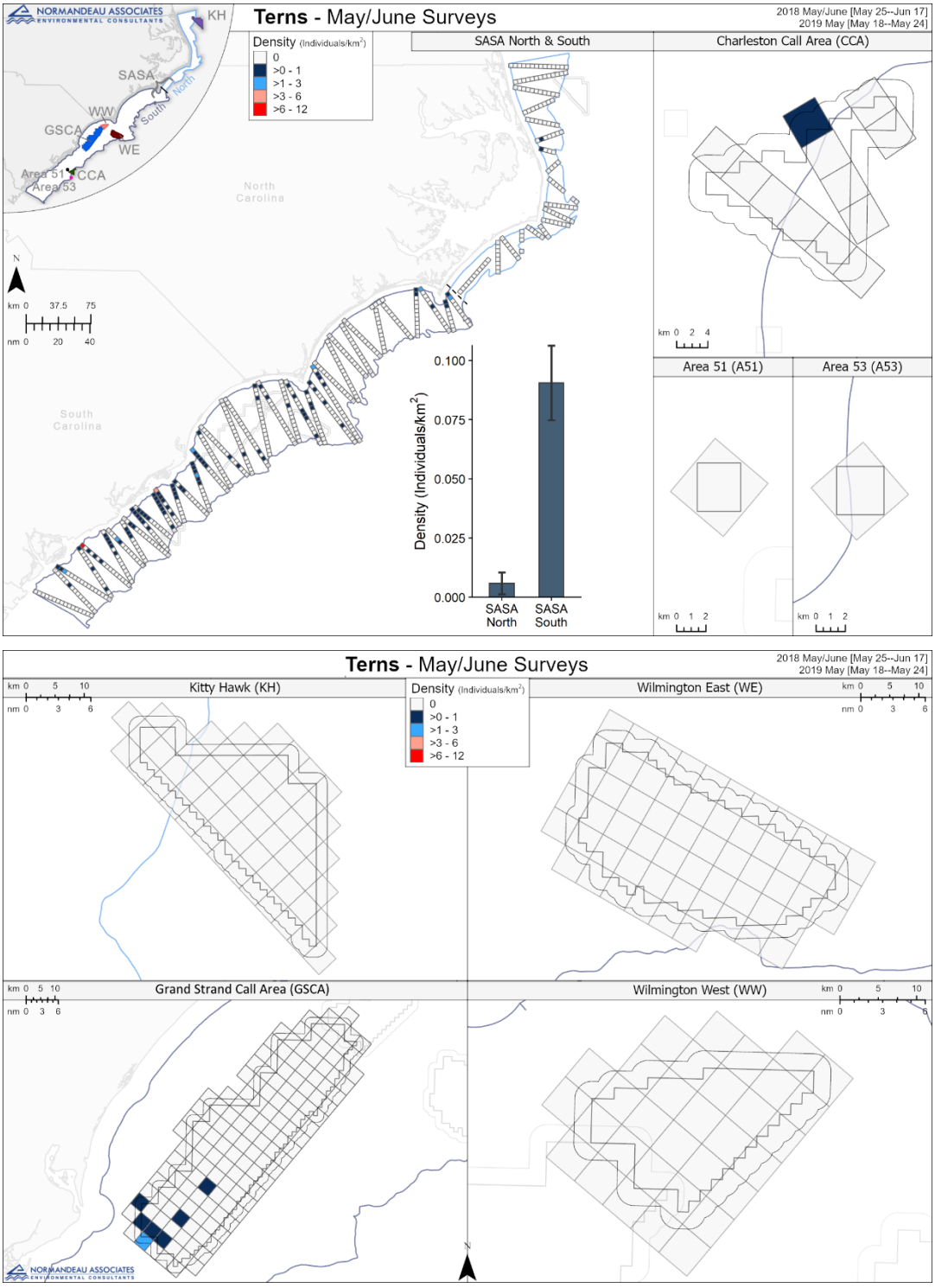


Figure C–213. Spatial distribution of all tern species during the May/June surveys for all areas

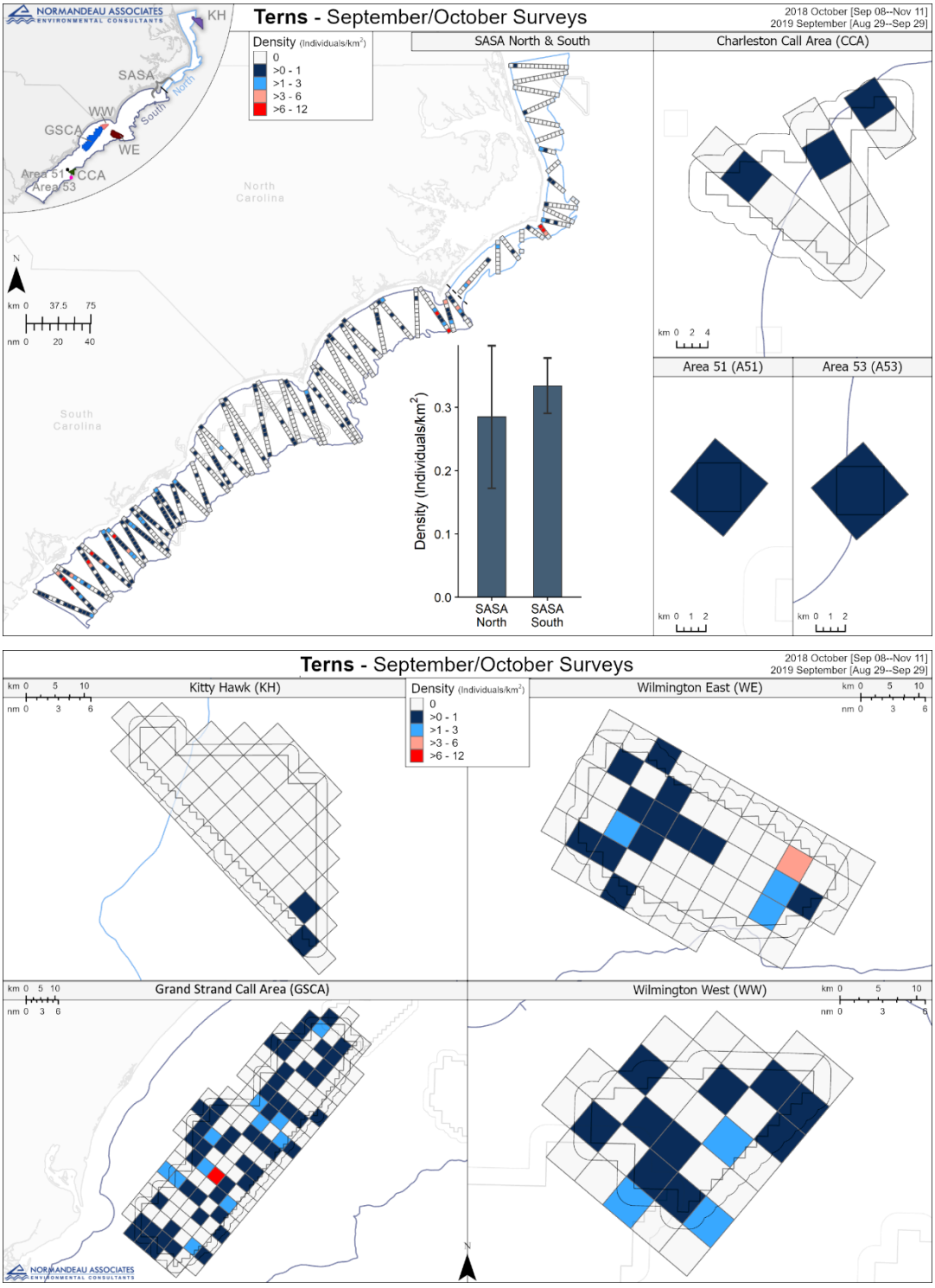


Figure C–214. Spatial distribution of all tern species during the September/October surveys for all areas

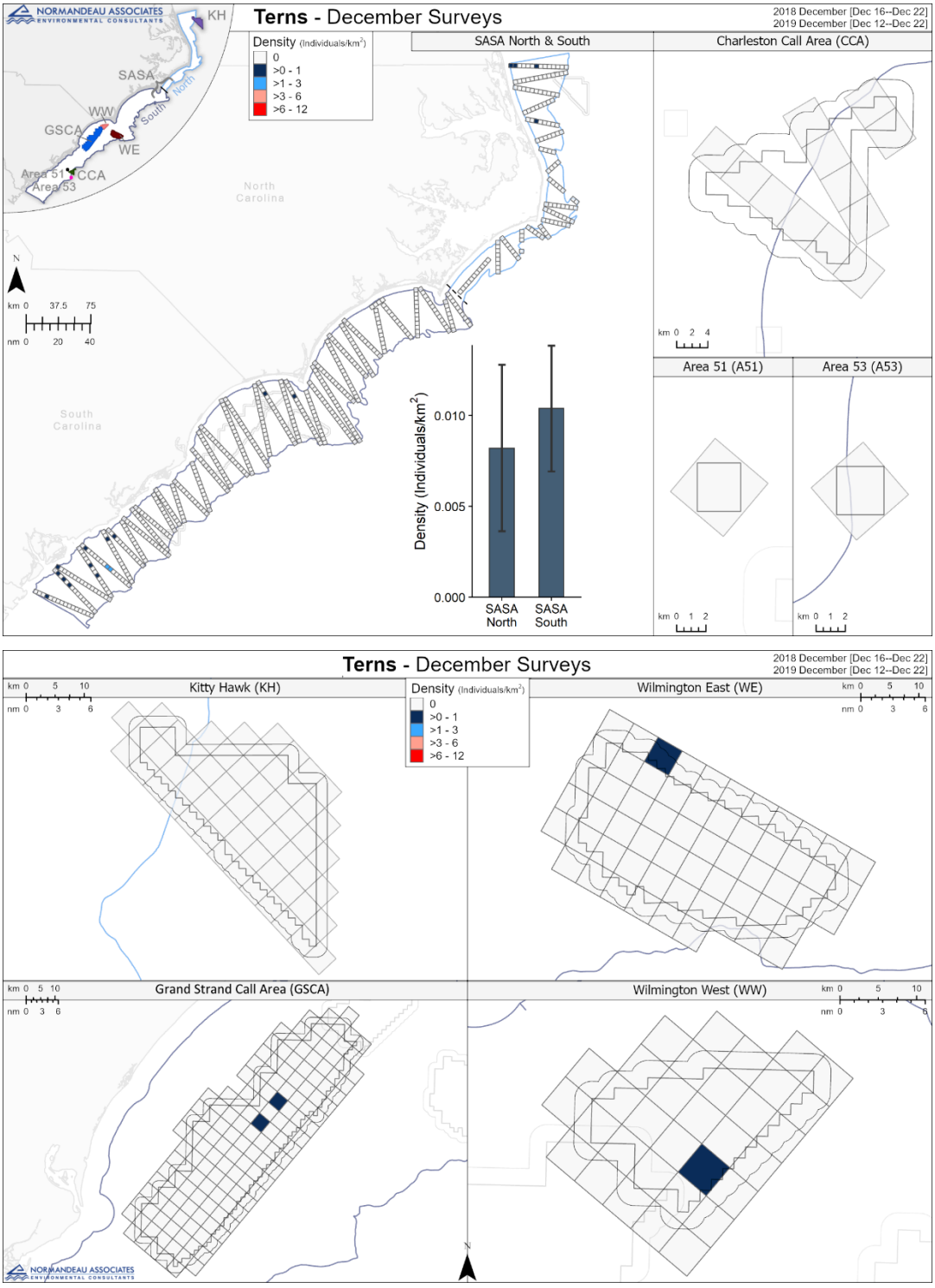


Figure C–215. Spatial distribution of all tern species during the December surveys for all areas

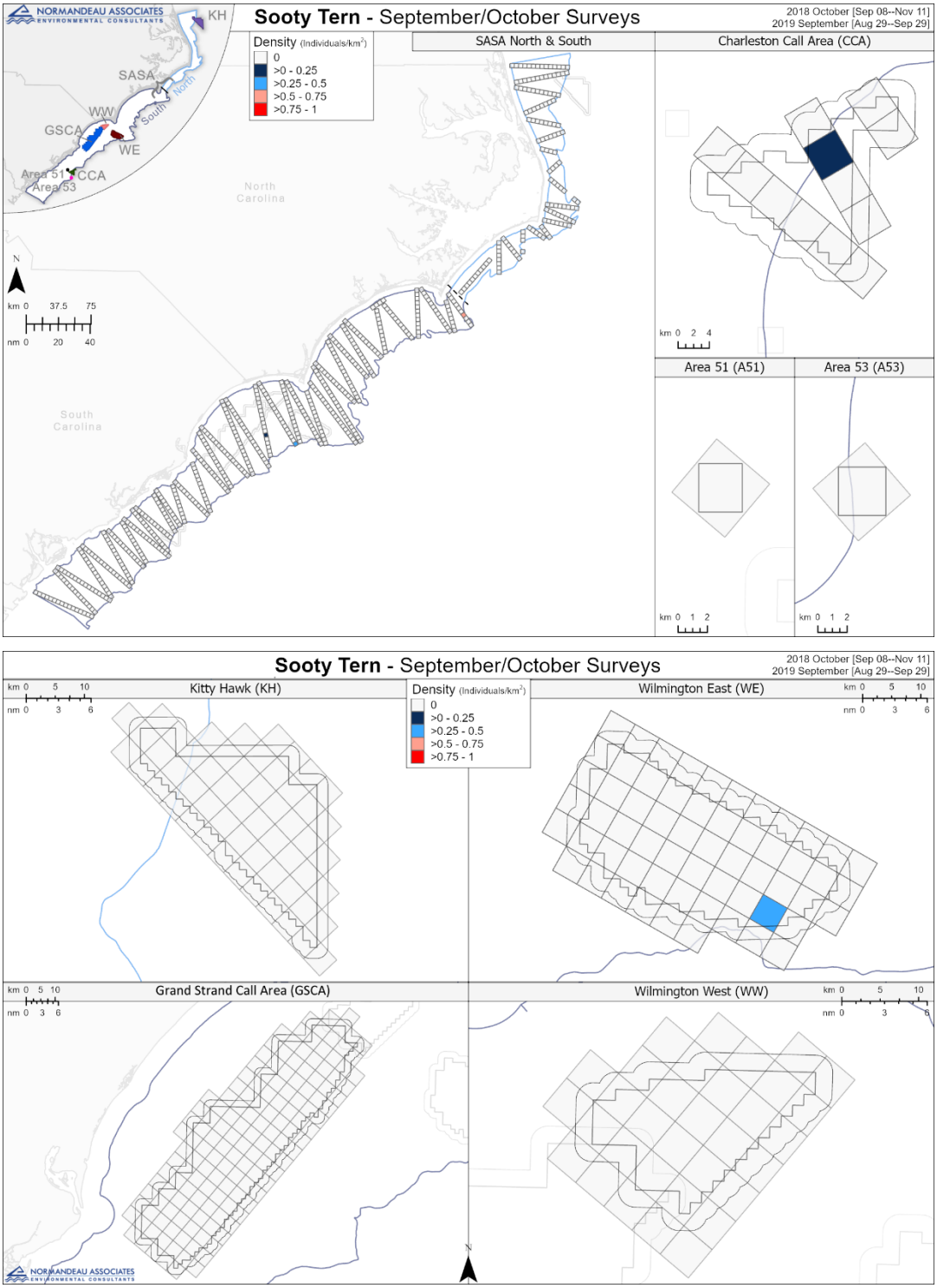


Figure C–216. Spatial distribution of sooty terns during the September/October surveys for all areas

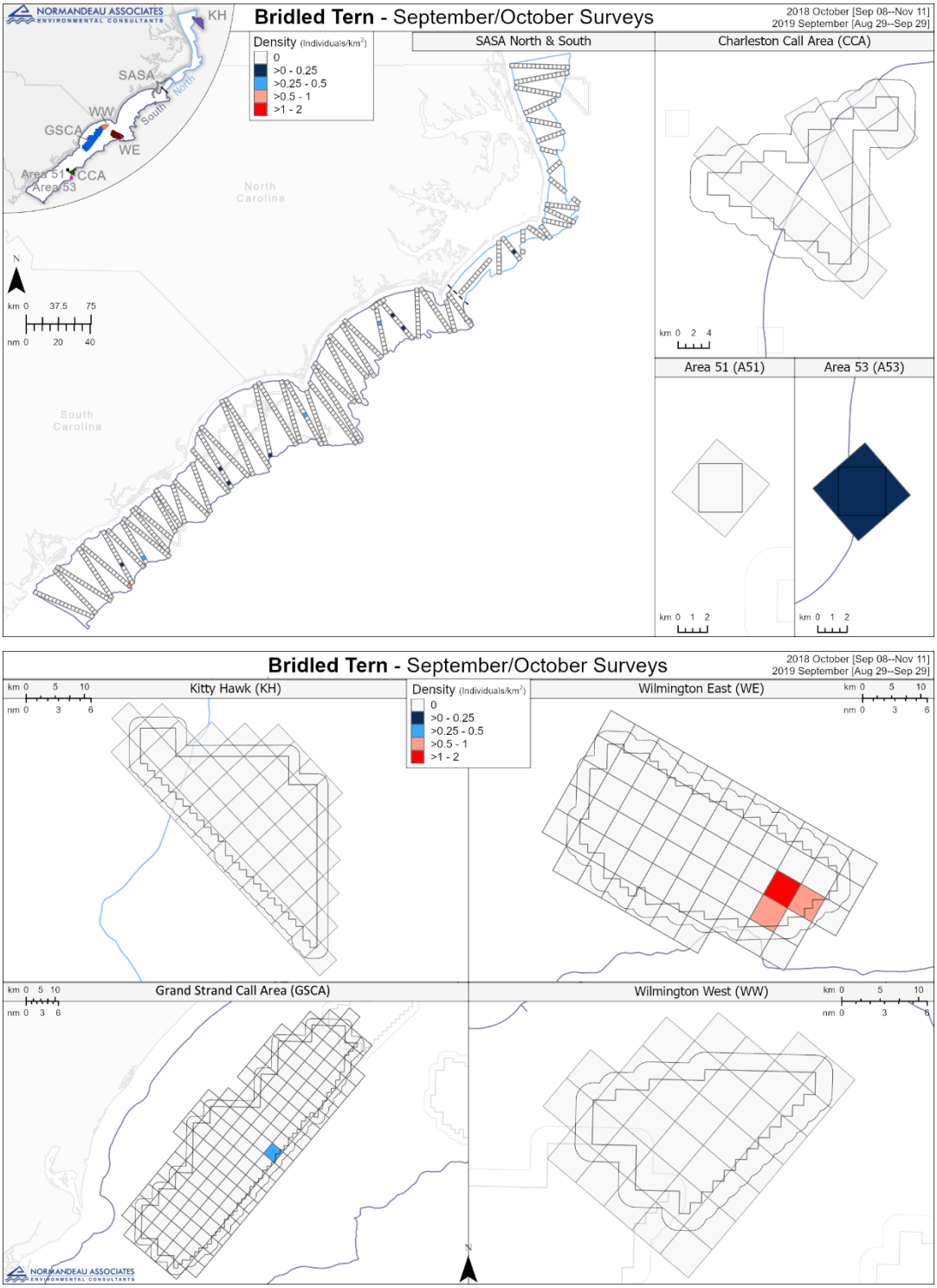


Figure C–217. Spatial distribution of bridled terns during the September/October surveys for all areas

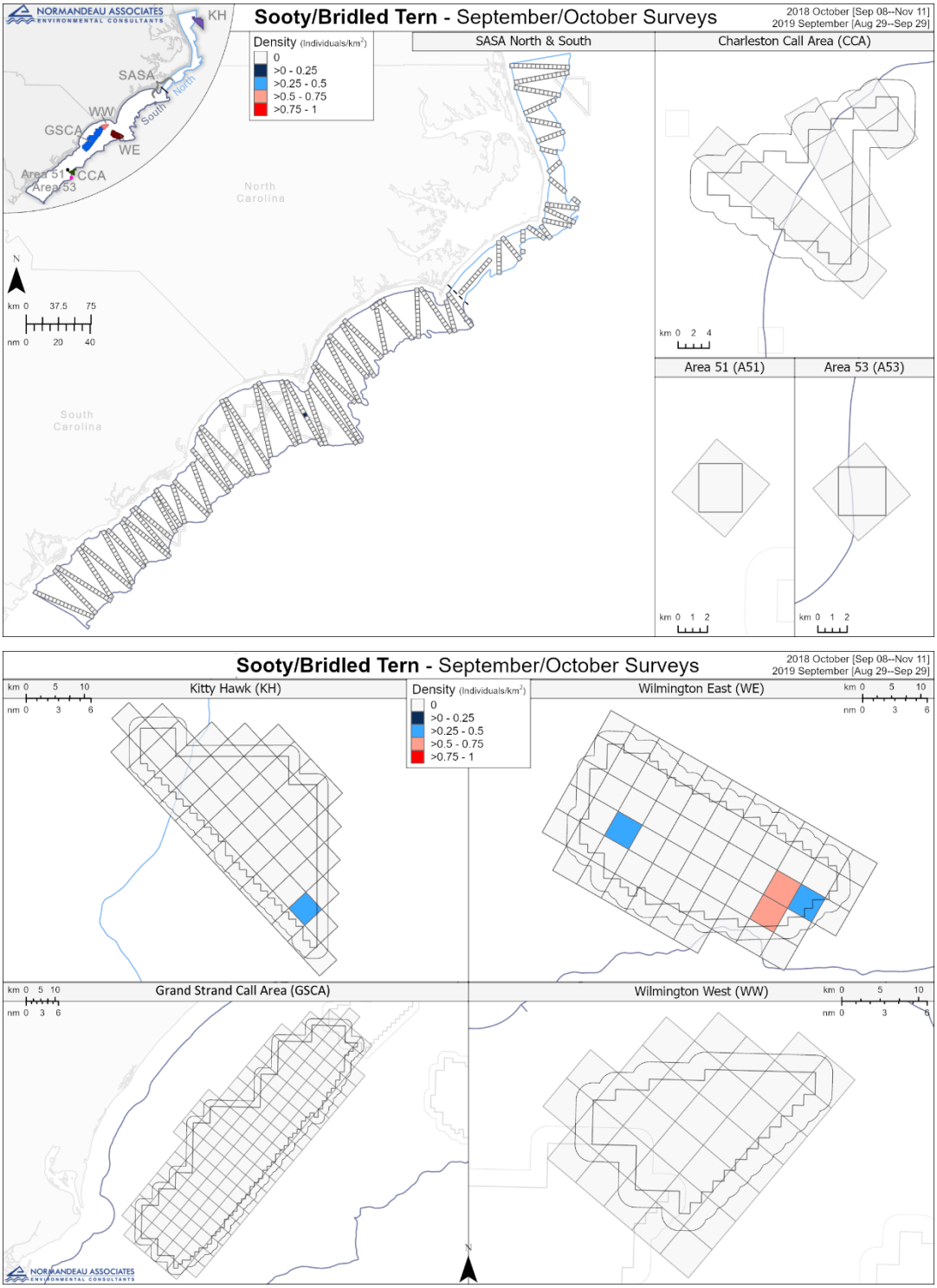


Figure C–218. Spatial distribution of sooty/bridled terns during the September/October surveys for all areas

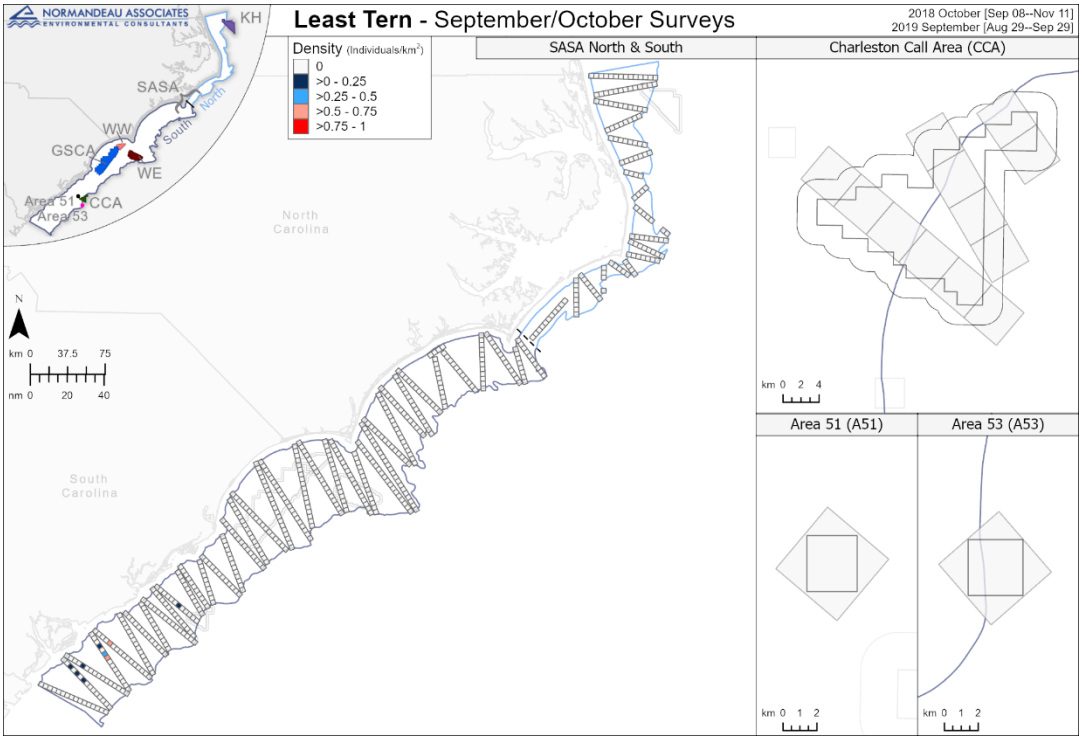


Figure C–219. Spatial distribution of least terns during the September/October surveys for all areas

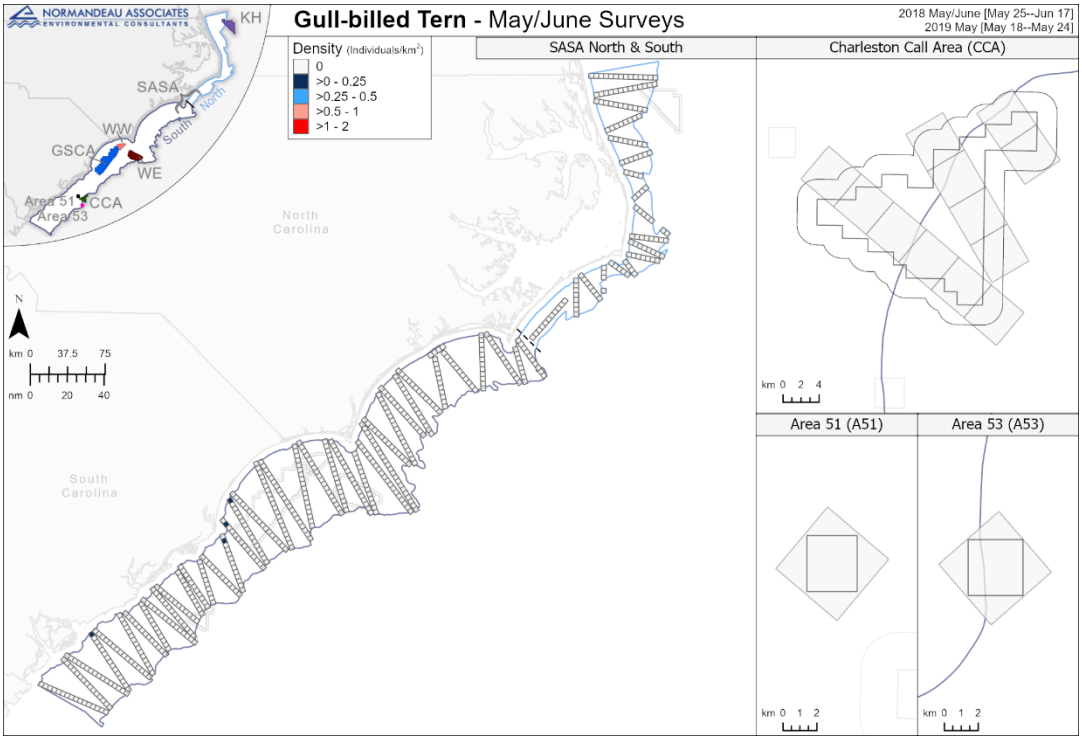


Figure C–220. Spatial distribution of gull-billed terns during the May/June surveys for all areas

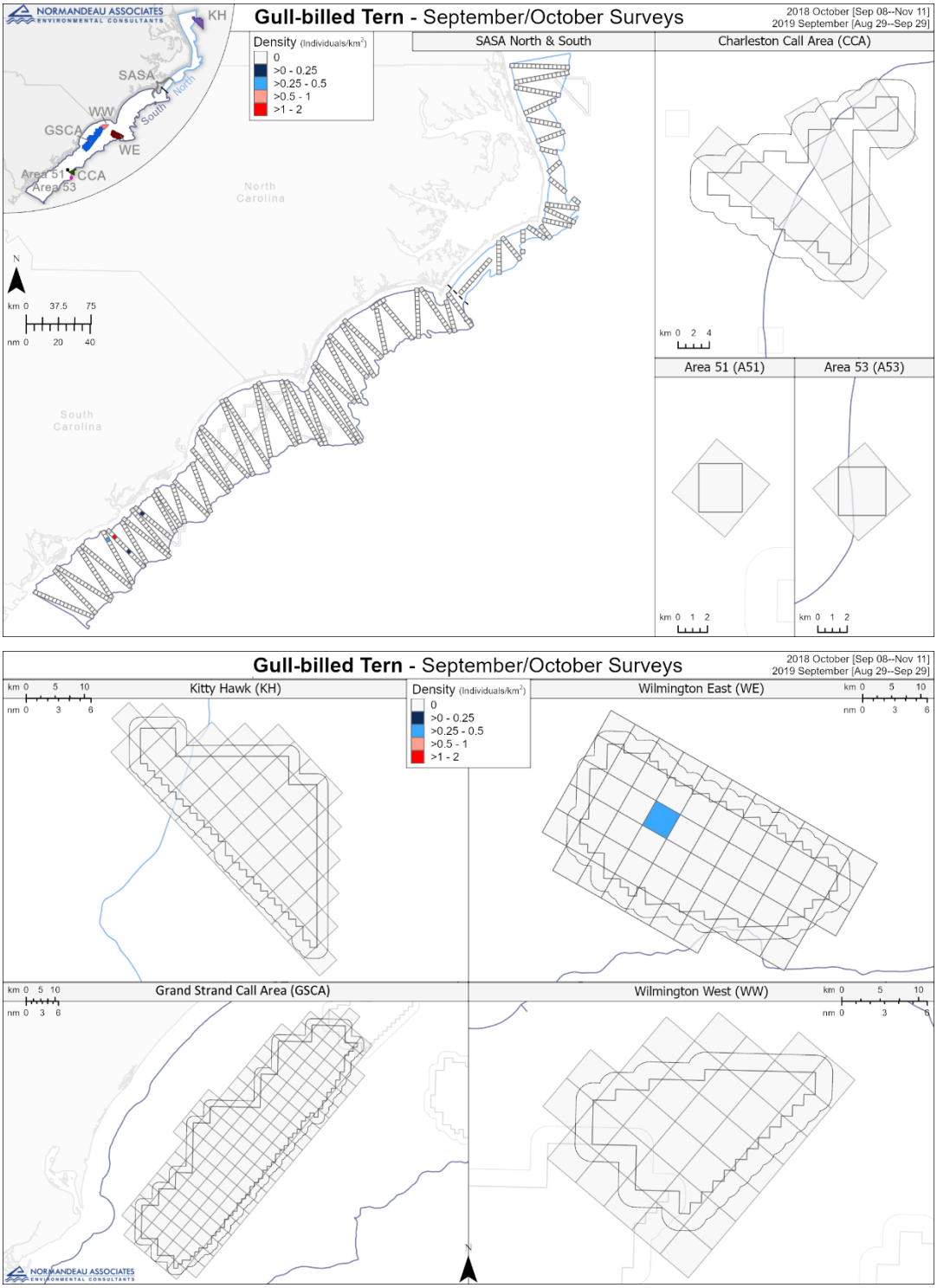


Figure C–221. Spatial distribution of gull-billed terns during the September/October surveys for all areas

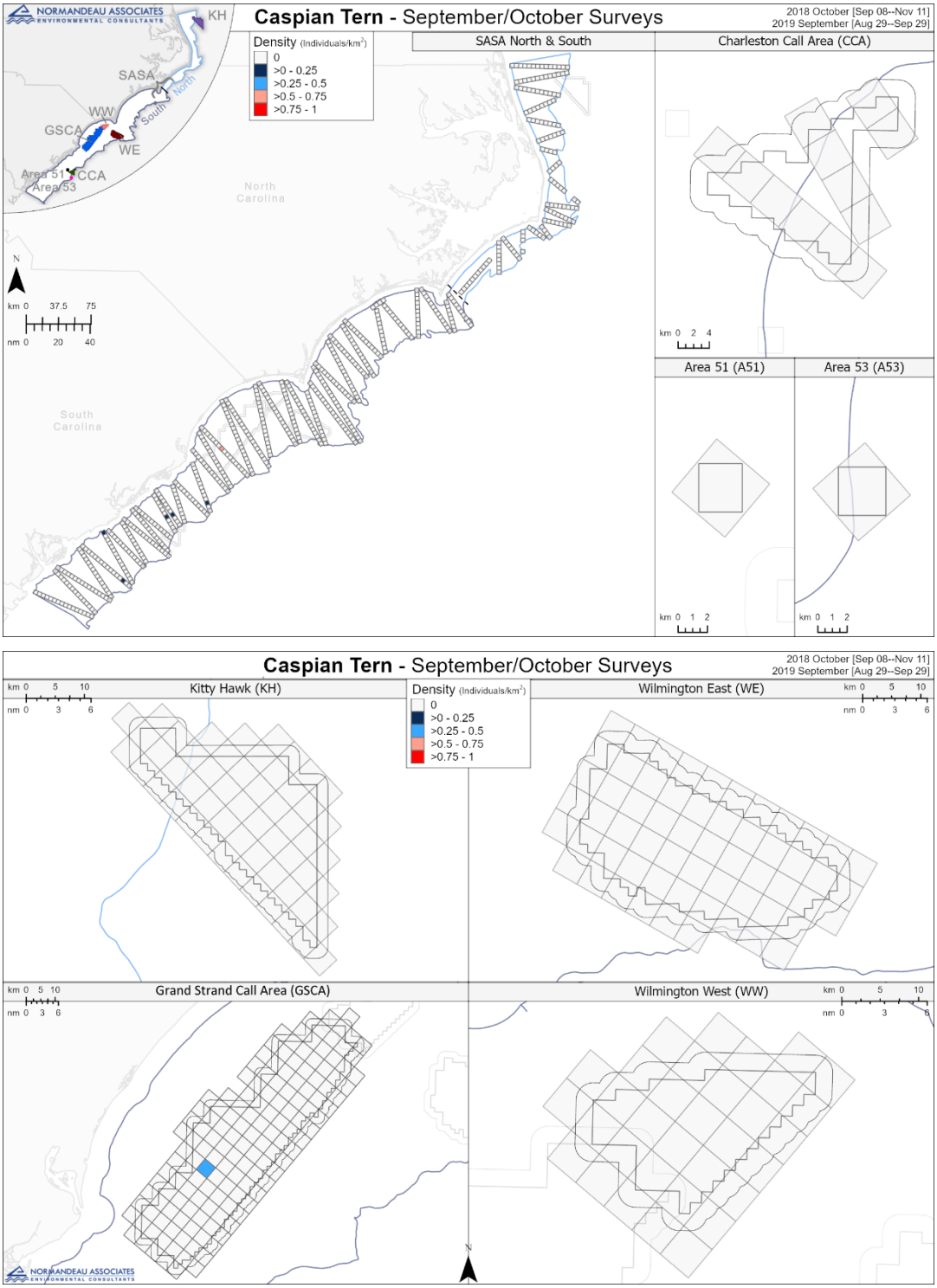


Figure C–222. Spatial distribution of Caspian terns during the September/October surveys for all areas

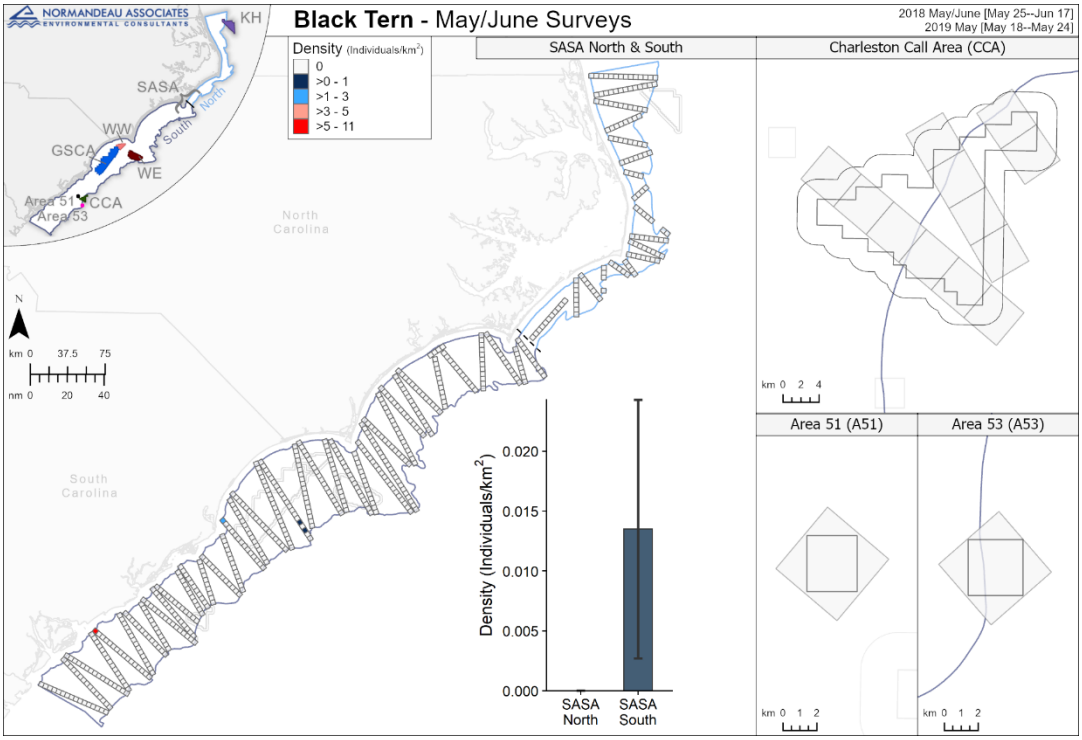


Figure C–223. Spatial distribution of black terns during the May/June surveys for all areas

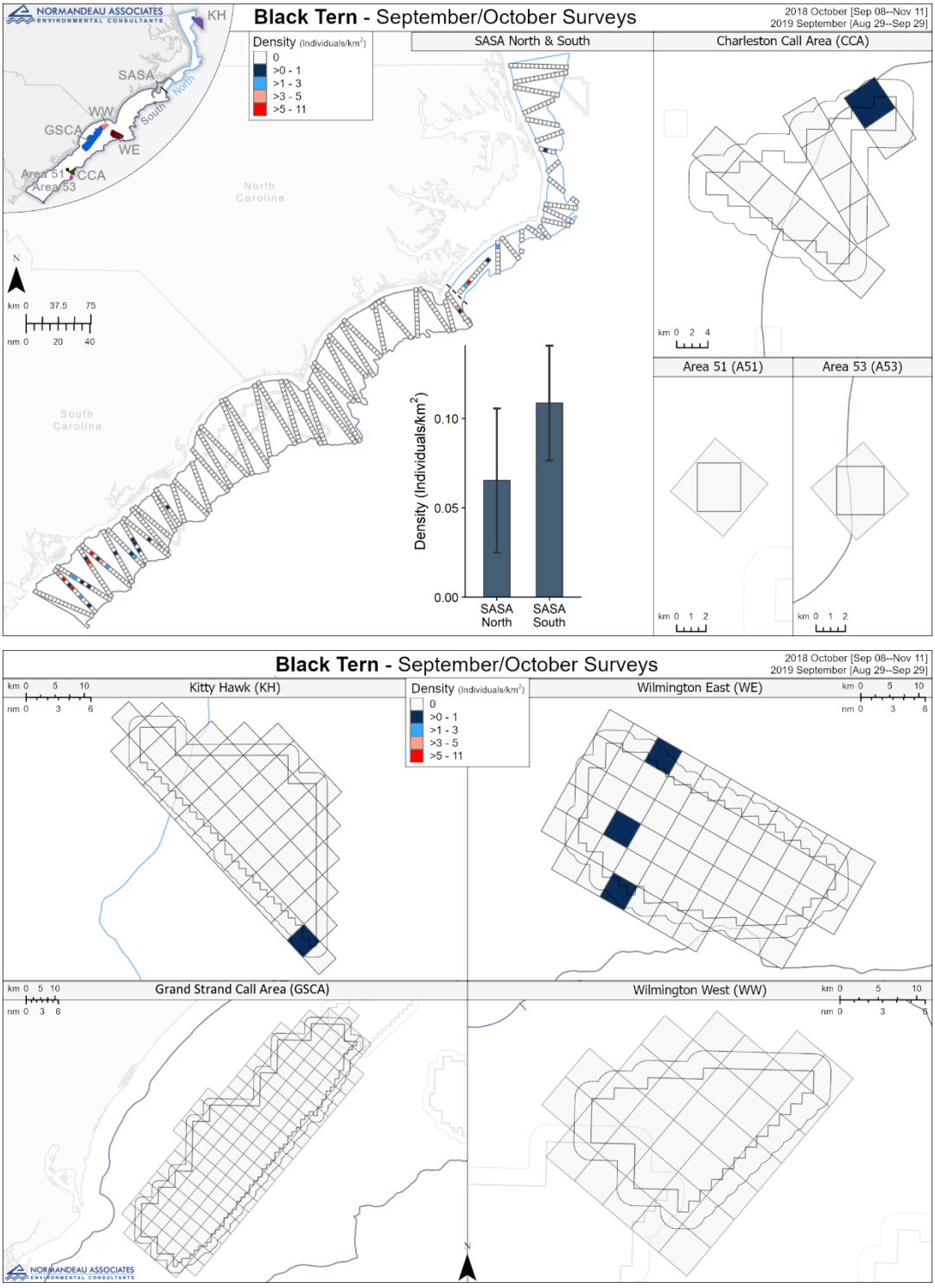


Figure C–224. Spatial distribution of black terns during the September/October surveys for all areas

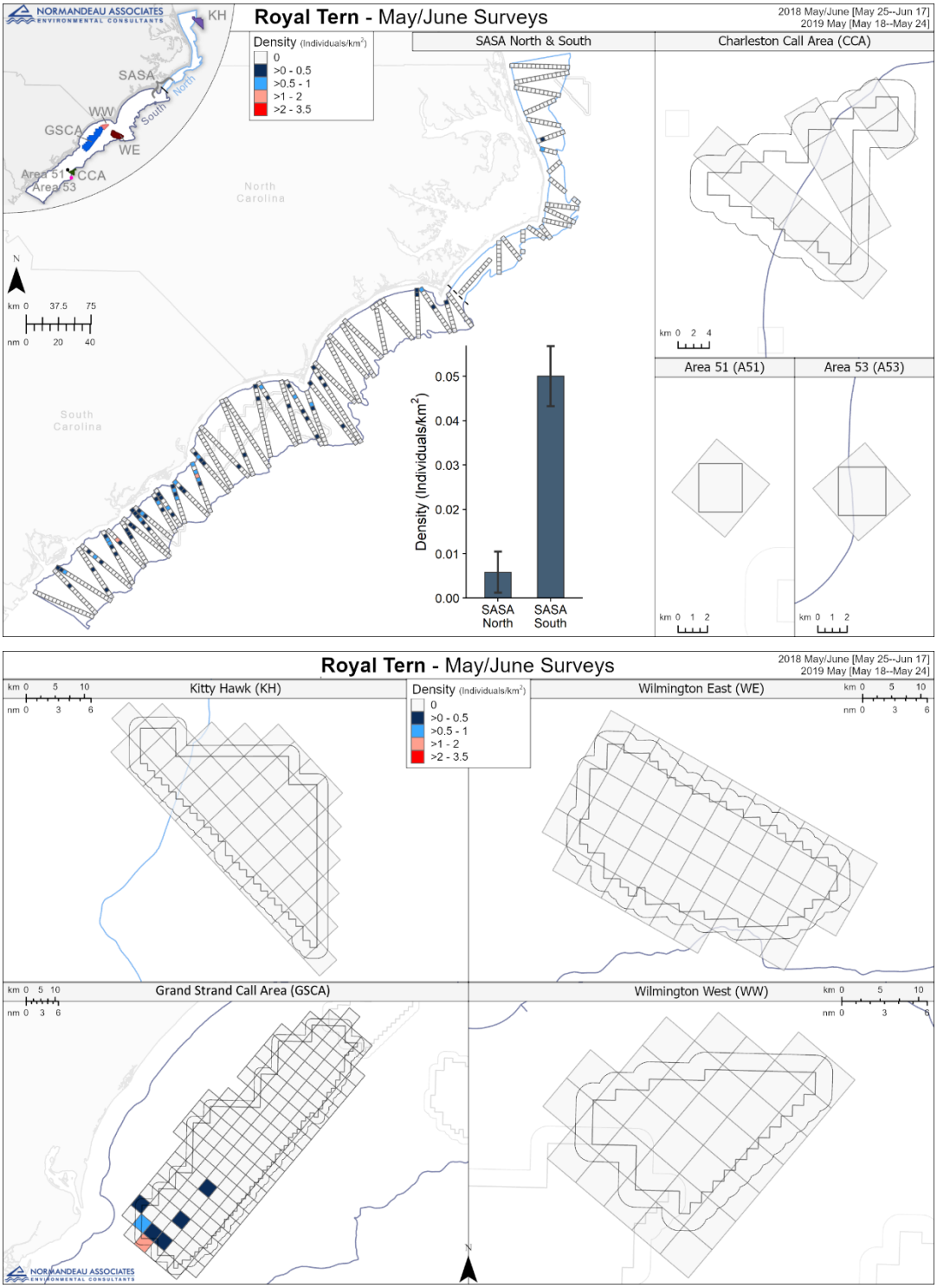


Figure C–225. Spatial distribution of royal terns during the May/June surveys for all areas

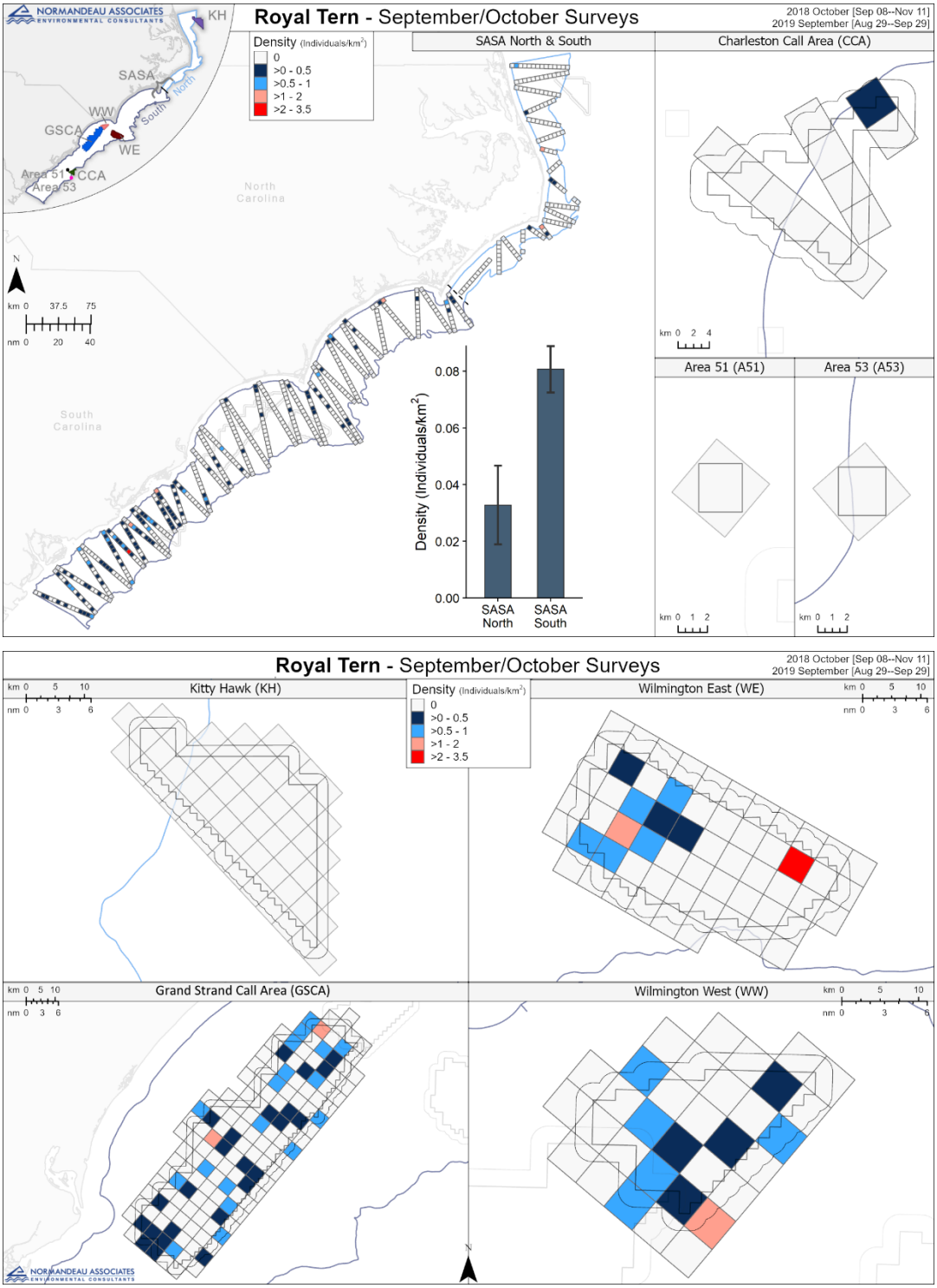


Figure C–226. Spatial distribution of royal terns during the September/October surveys for all areas

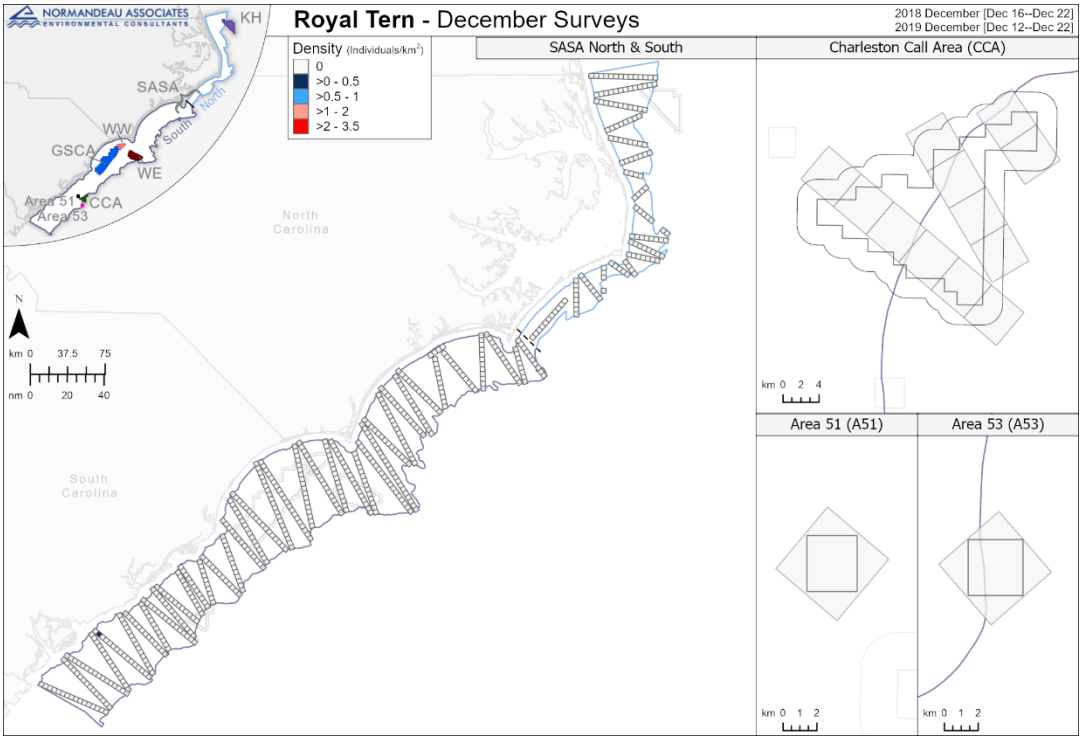


Figure C–227. Spatial distribution of royal terns during the December surveys for all areas

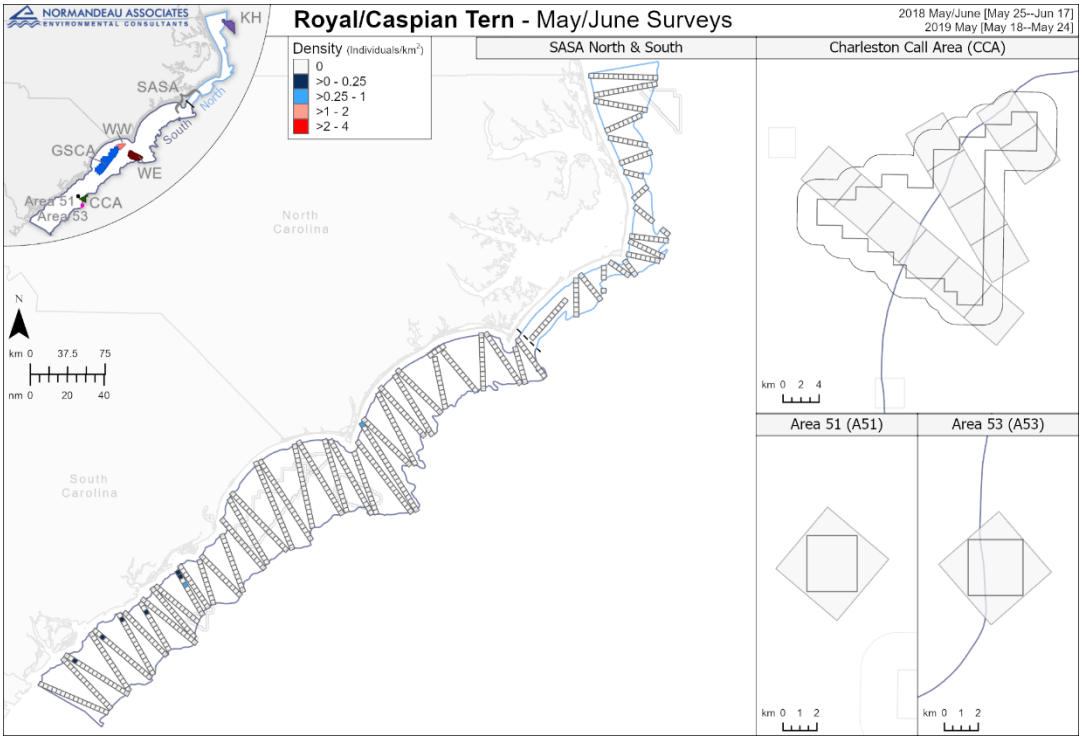


Figure C–228. Spatial distribution of royal/Caspian terns during the May/June surveys for all areas

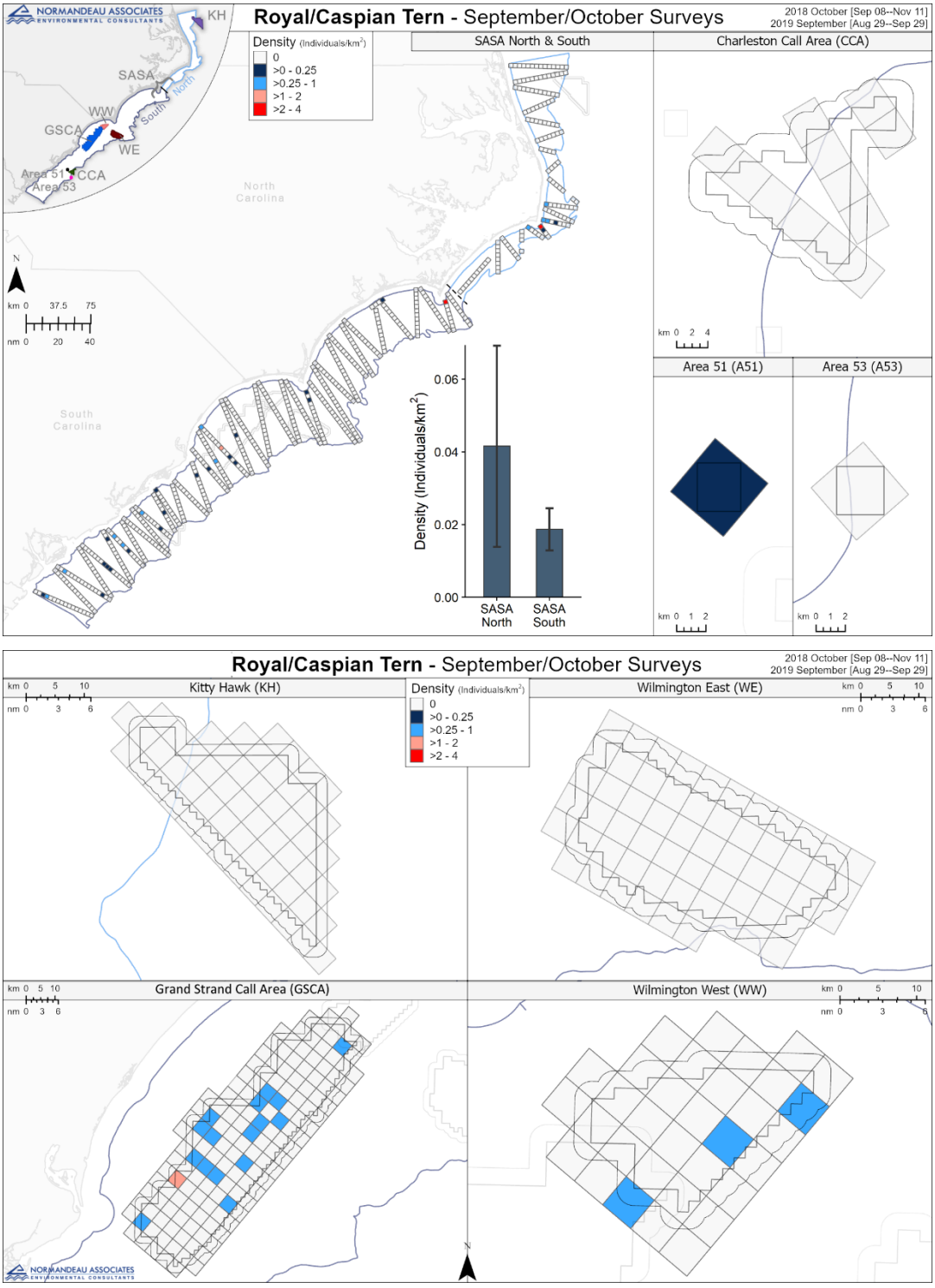


Figure C–229. Spatial distribution of royal/Caspian terns during the September/ October surveys for all areas

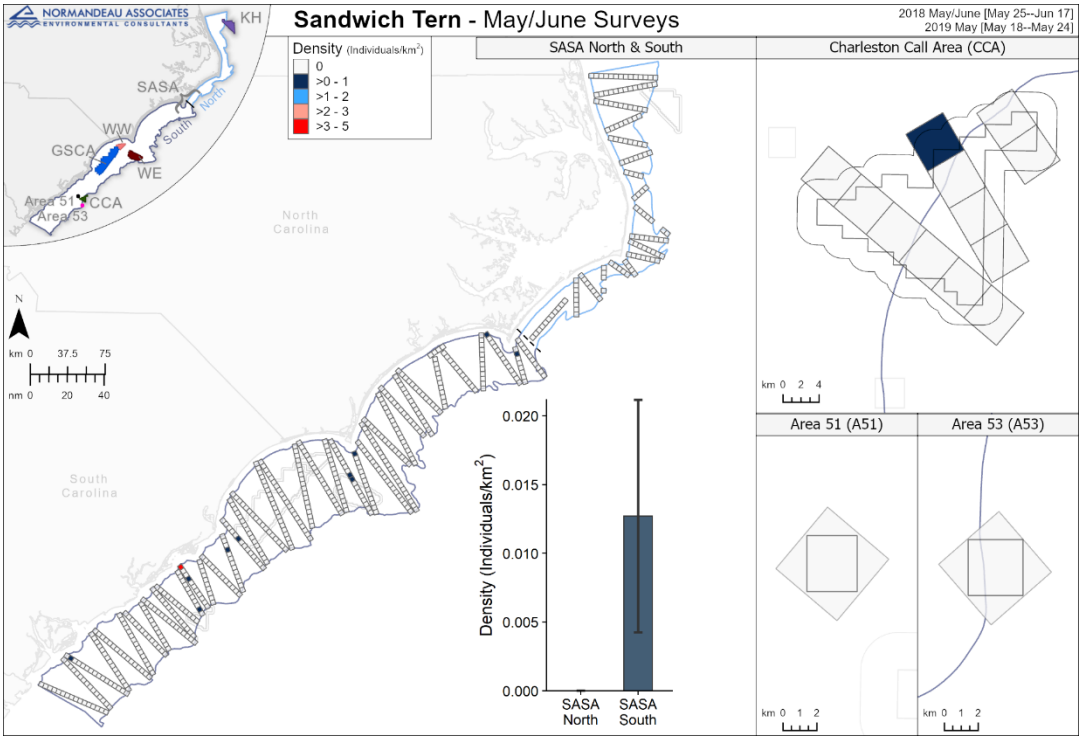


Figure C–230. Spatial distribution of sandwich terns during the May/June surveys for all areas

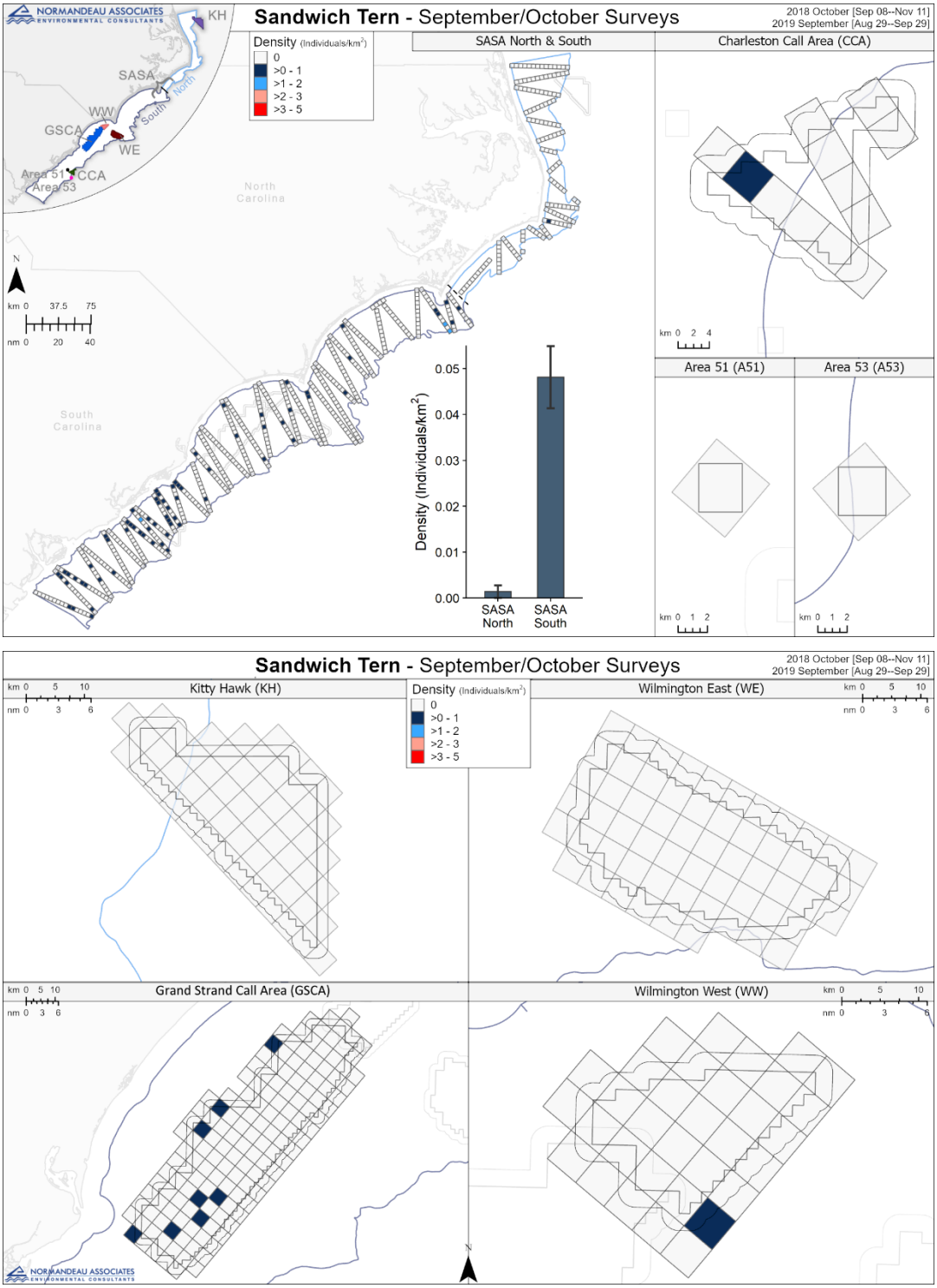


Figure C–231. Spatial distribution of sandwich terns during the September/October surveys for all areas

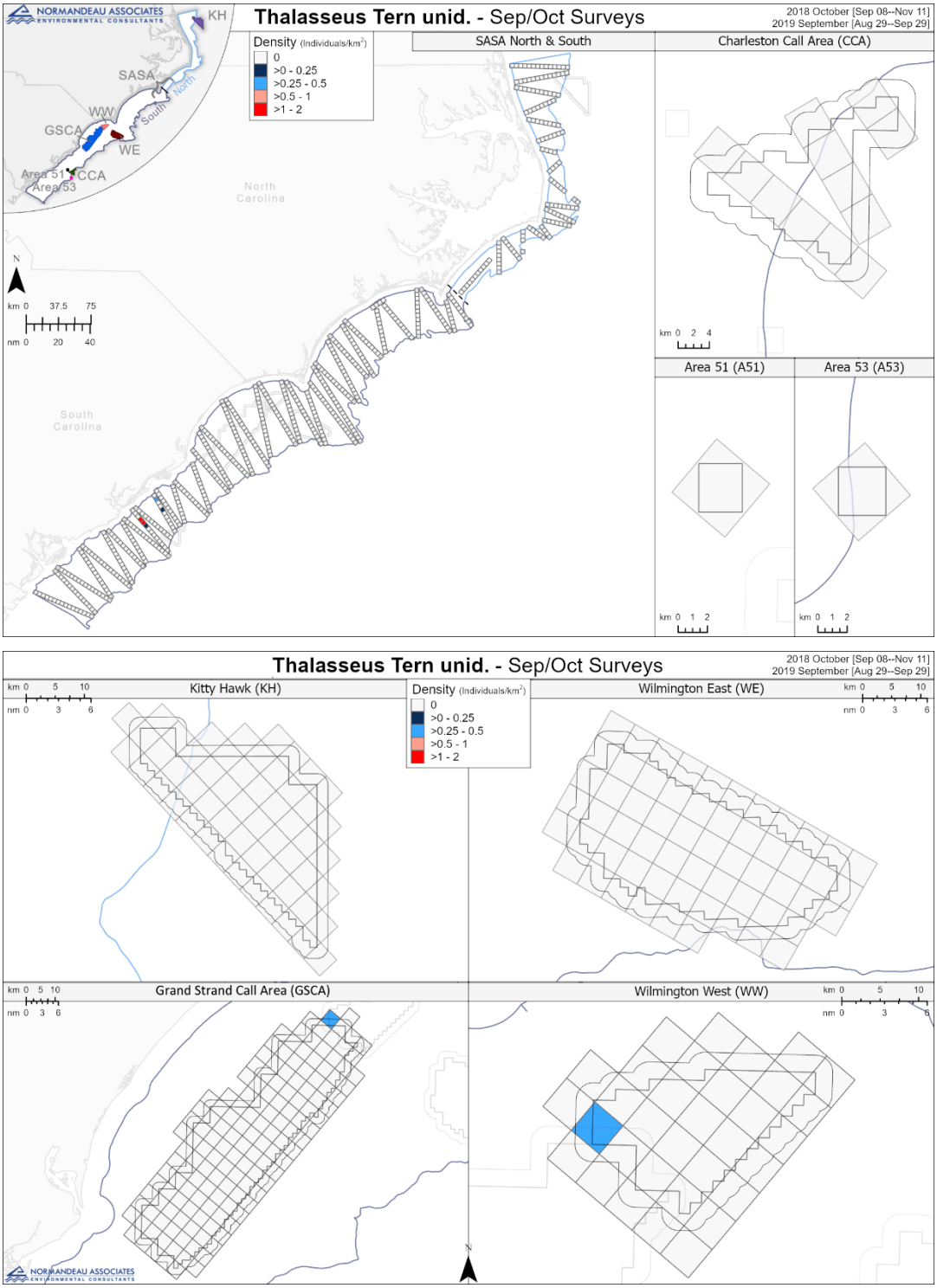


Figure C–232. Spatial distribution of Thalasseus tern (unid.) during the September/October surveys for all areas

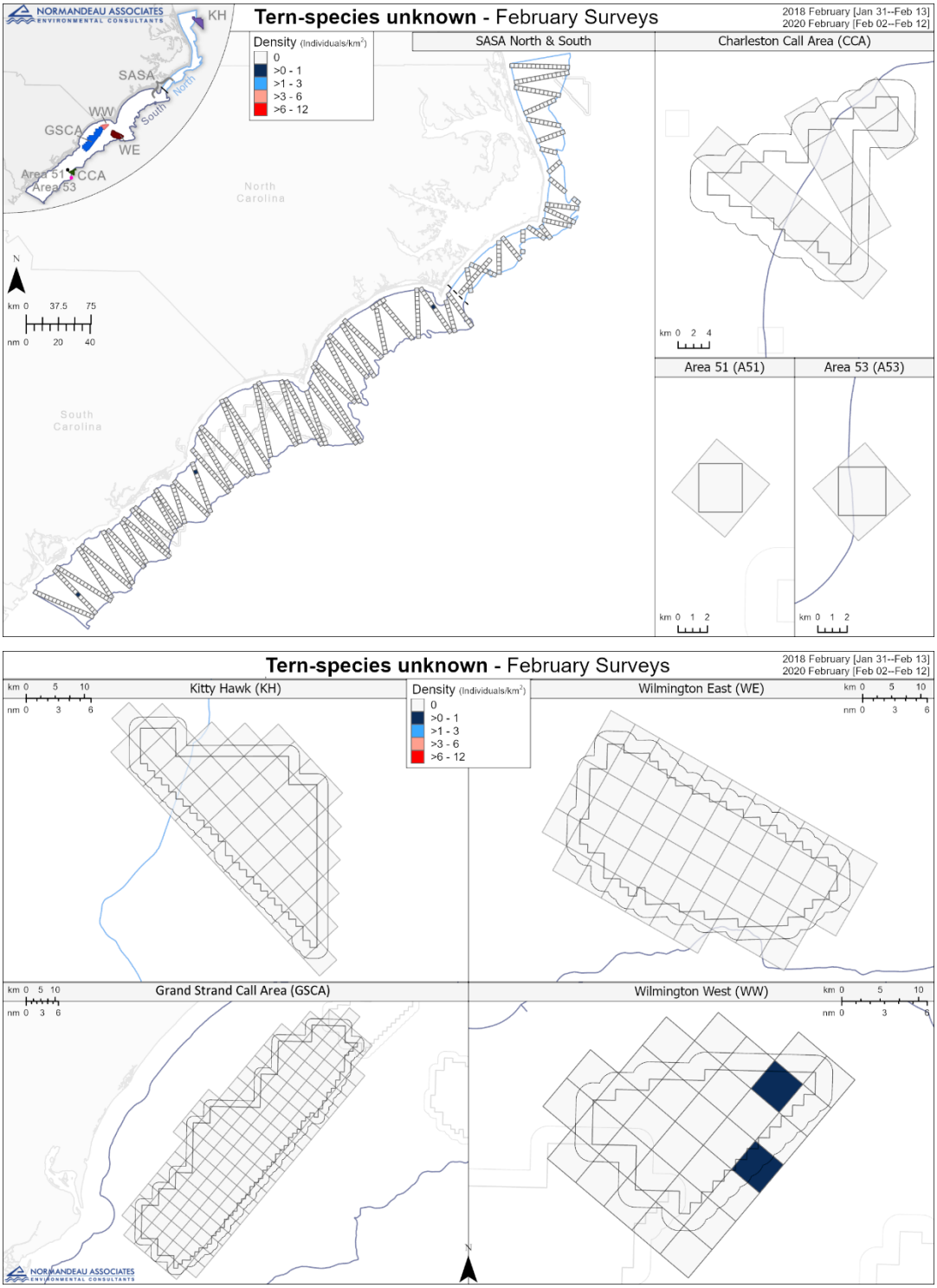


Figure C–233. Spatial distribution of tern-species unknown during the February surveys for all areas

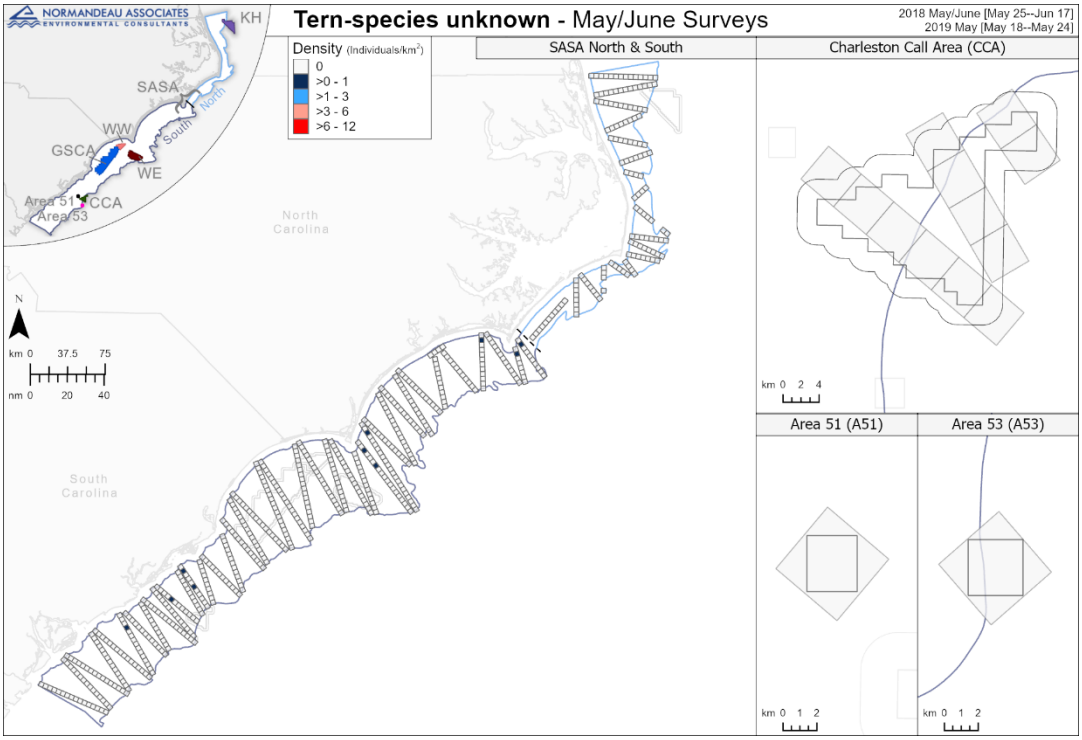


Figure C–234. Spatial distribution of tern-species unknown during the May/June surveys for all areas

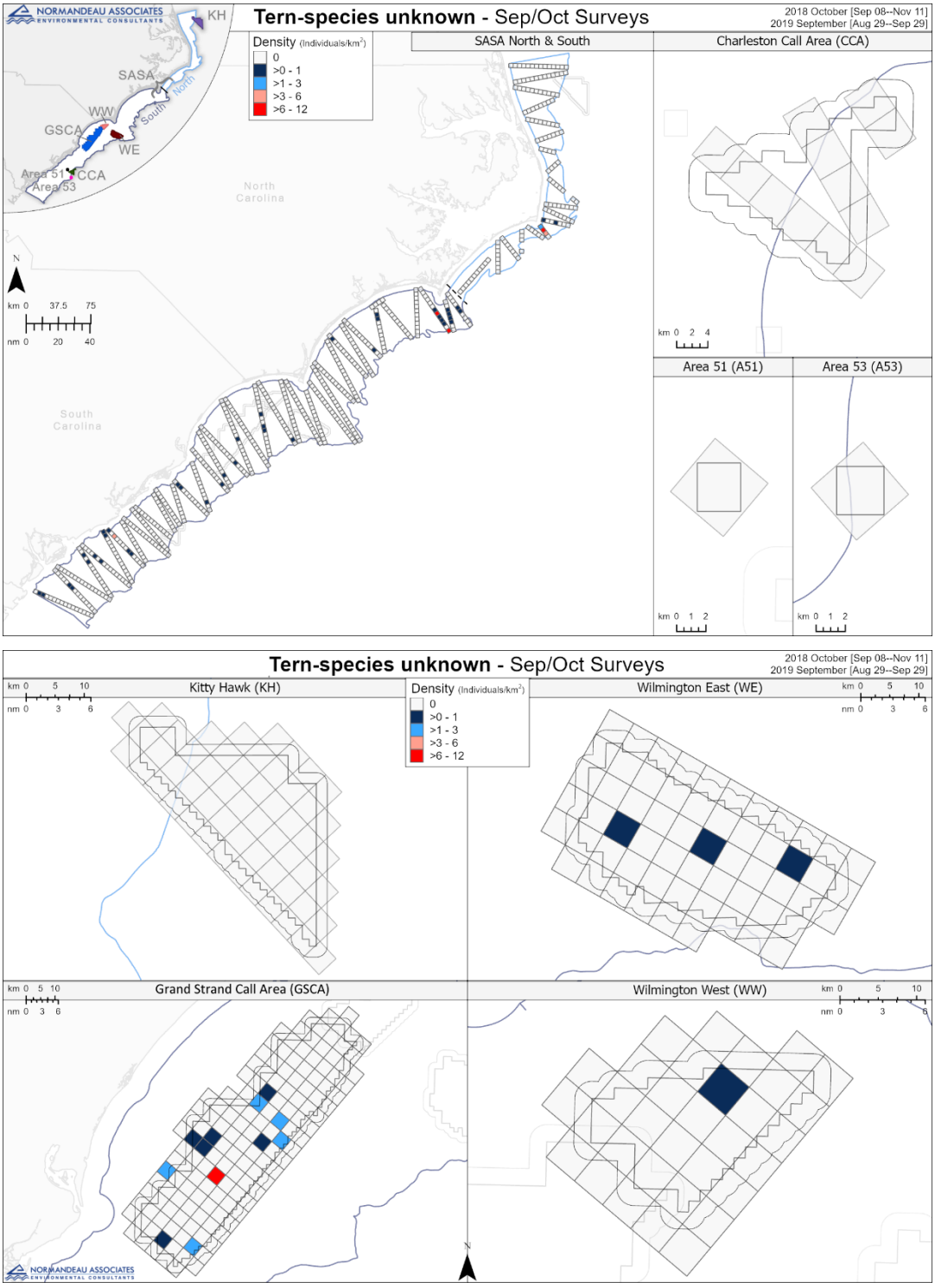


Figure C–235. Spatial distribution of tern-species unknown during the September/ October surveys for all areas

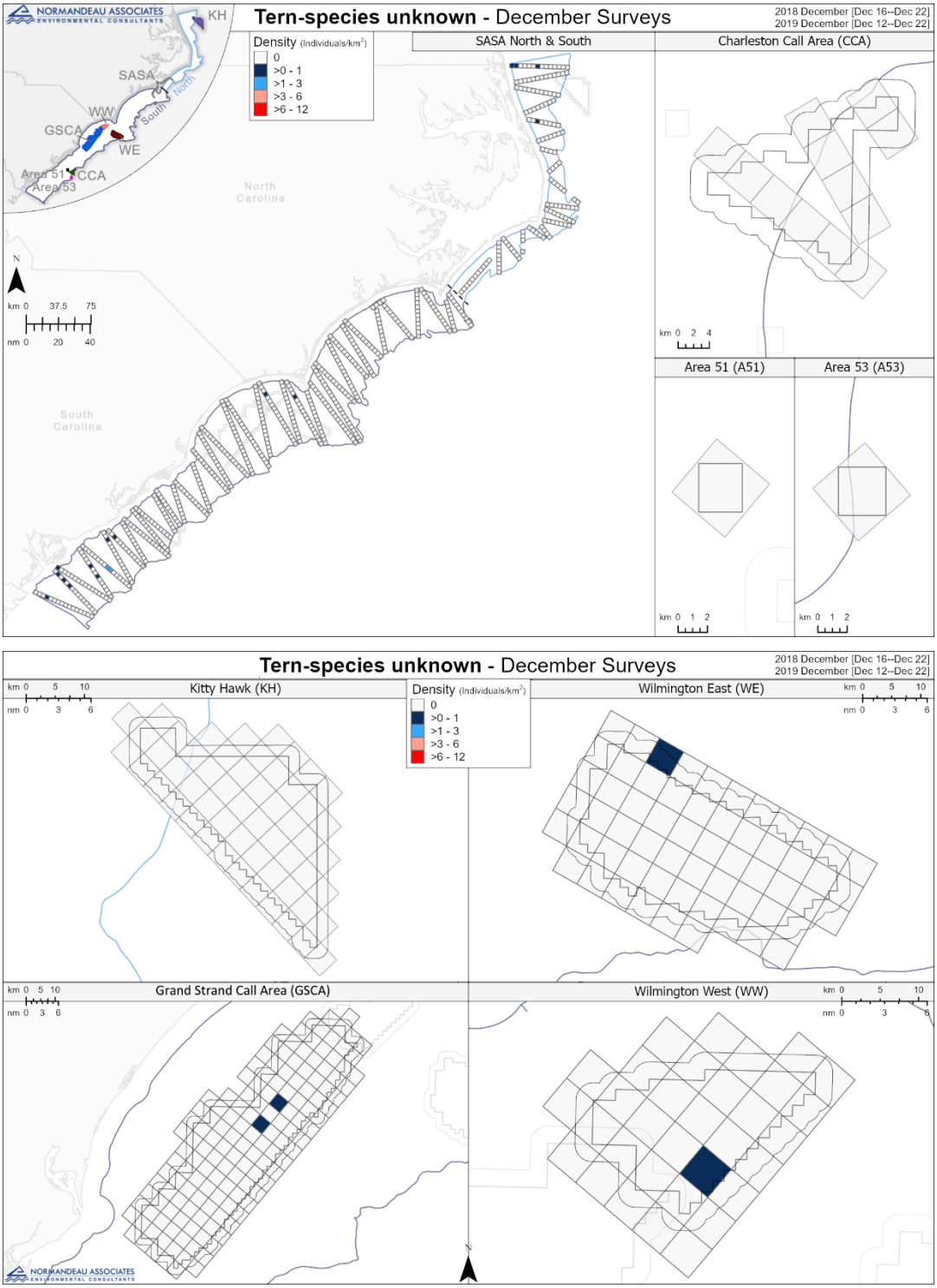


Figure C–236. Spatial distribution of tern-species unknown during the December surveys for all areas

C.4.19 *Sterna* Tern

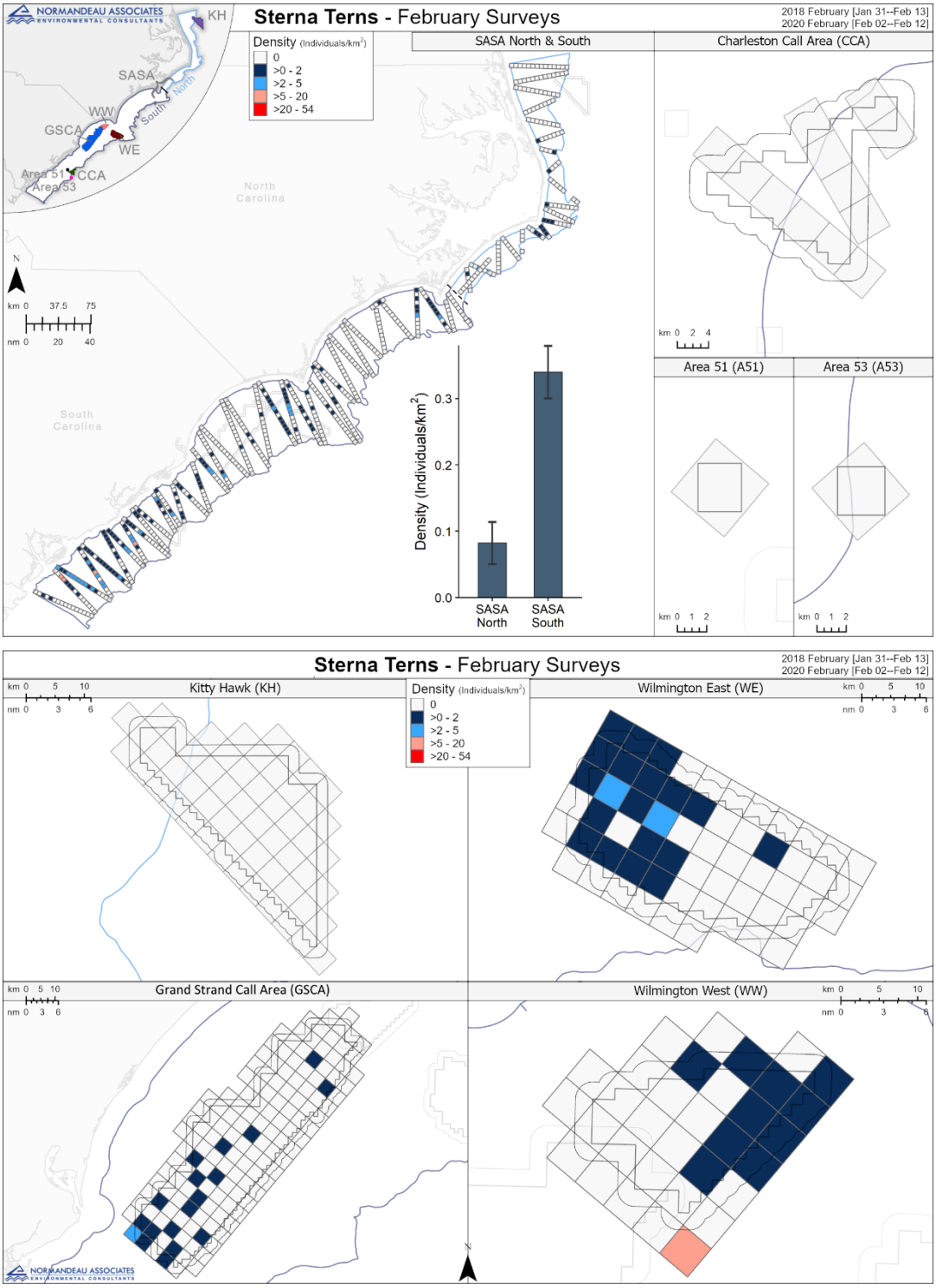


Figure C–237. Spatial distribution of all *Sterna* tern species during the February surveys for all areas

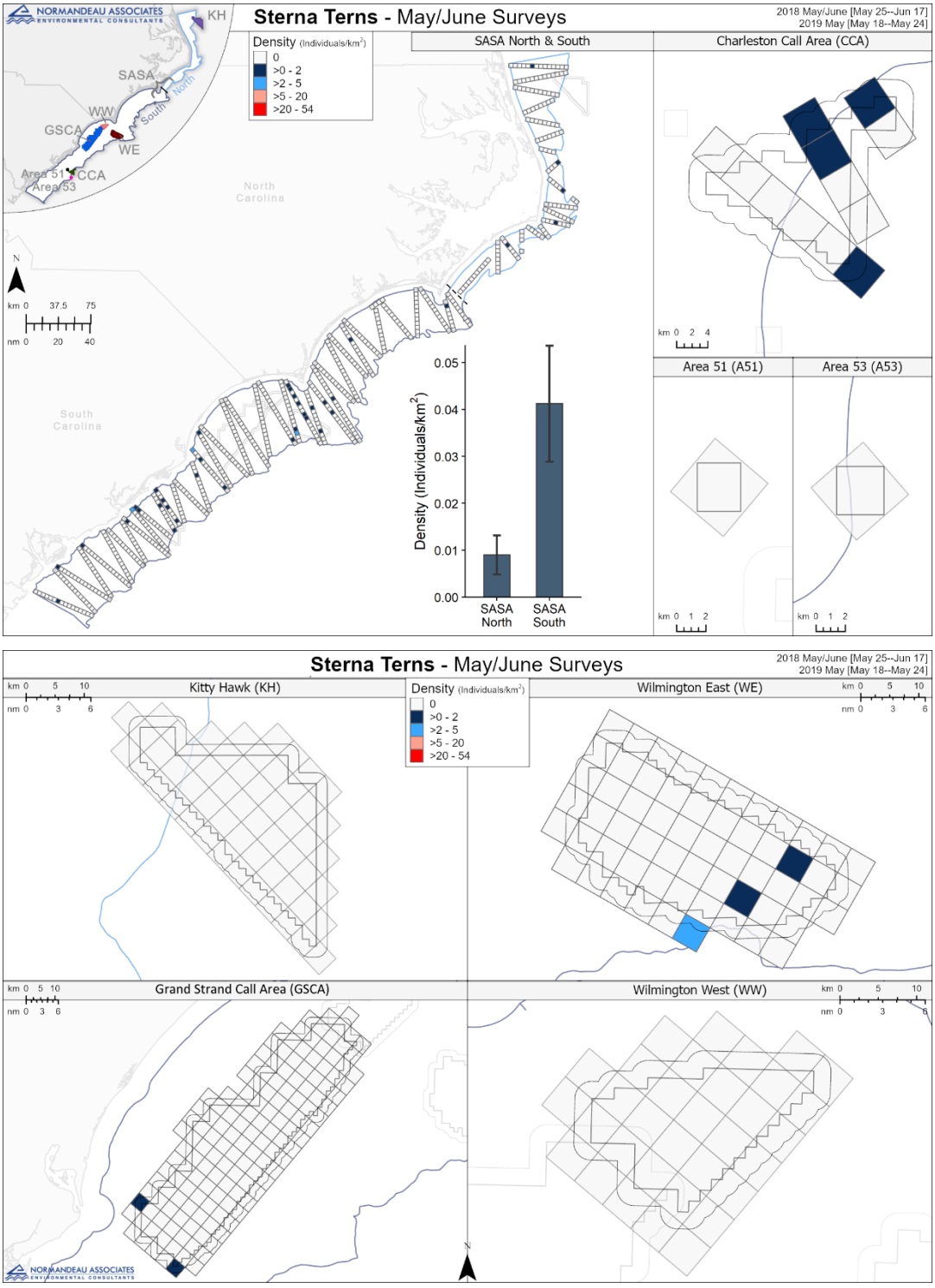


Figure C–238. Spatial distribution of all *Sterna* tern species during the May/June surveys for all areas

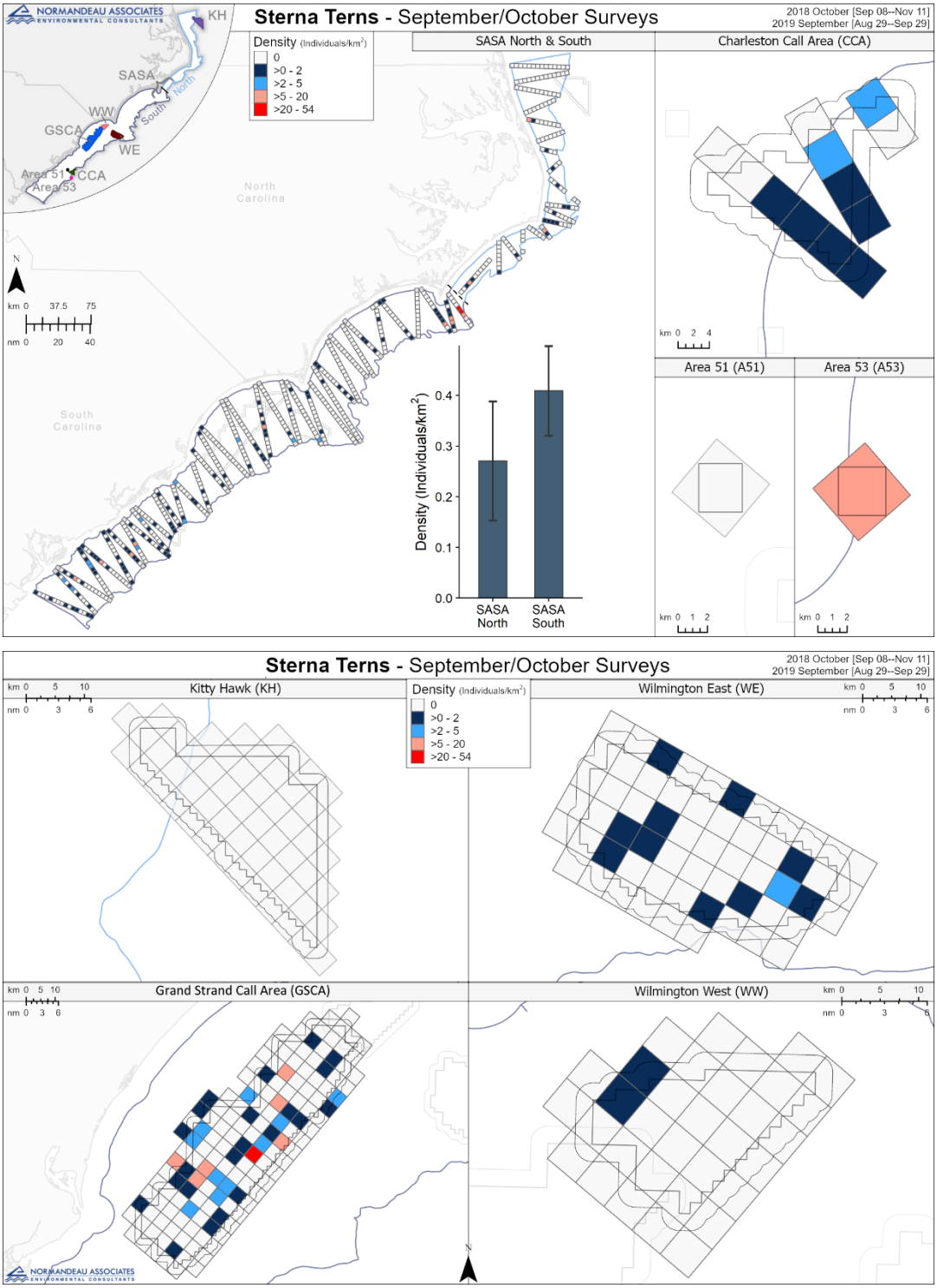


Figure C–239. Spatial distribution of all *Sterna* tern species during the September/October surveys for all areas

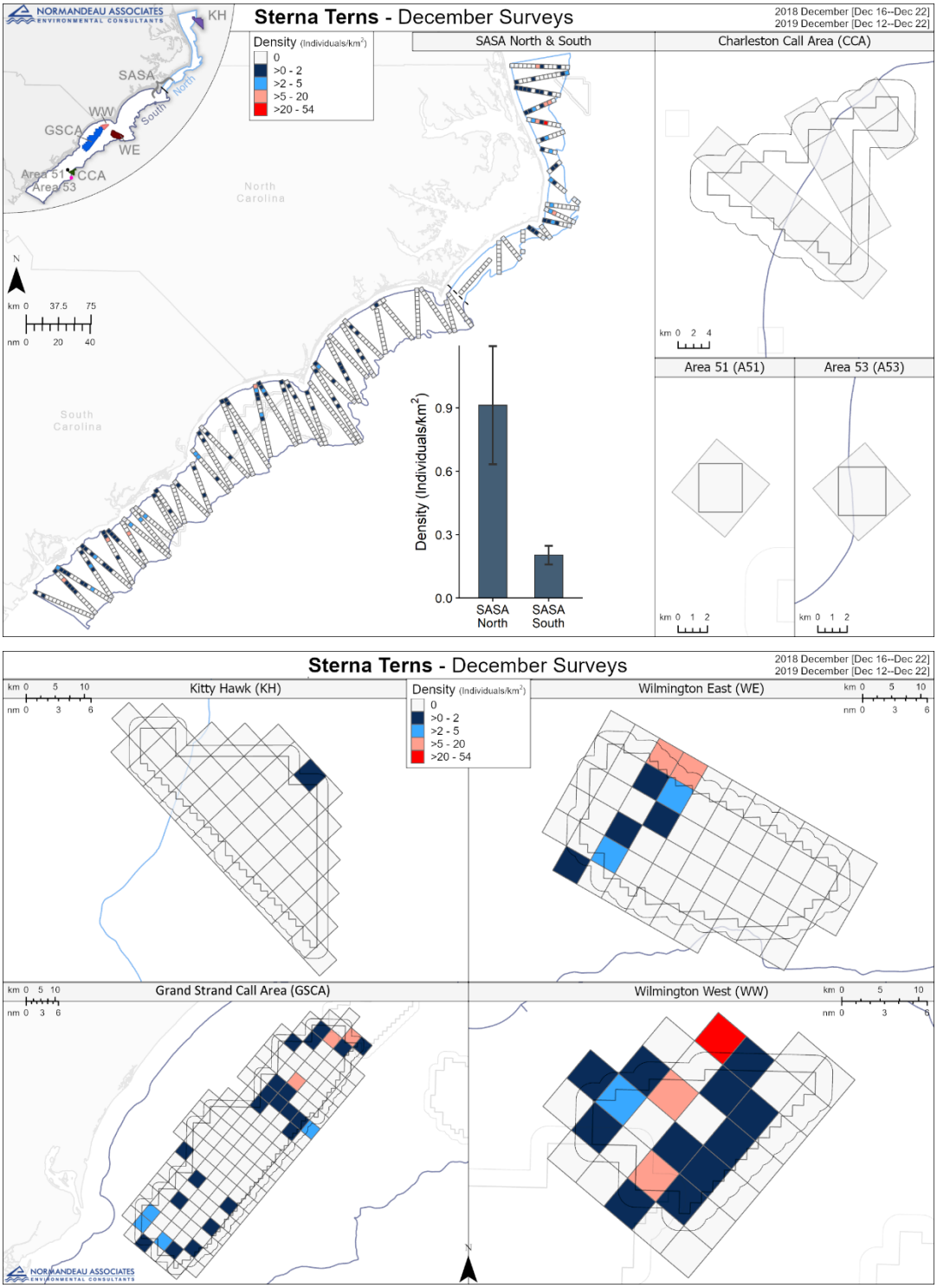


Figure C–240. Spatial distribution of all *Sterna* tern species during the December surveys for all areas

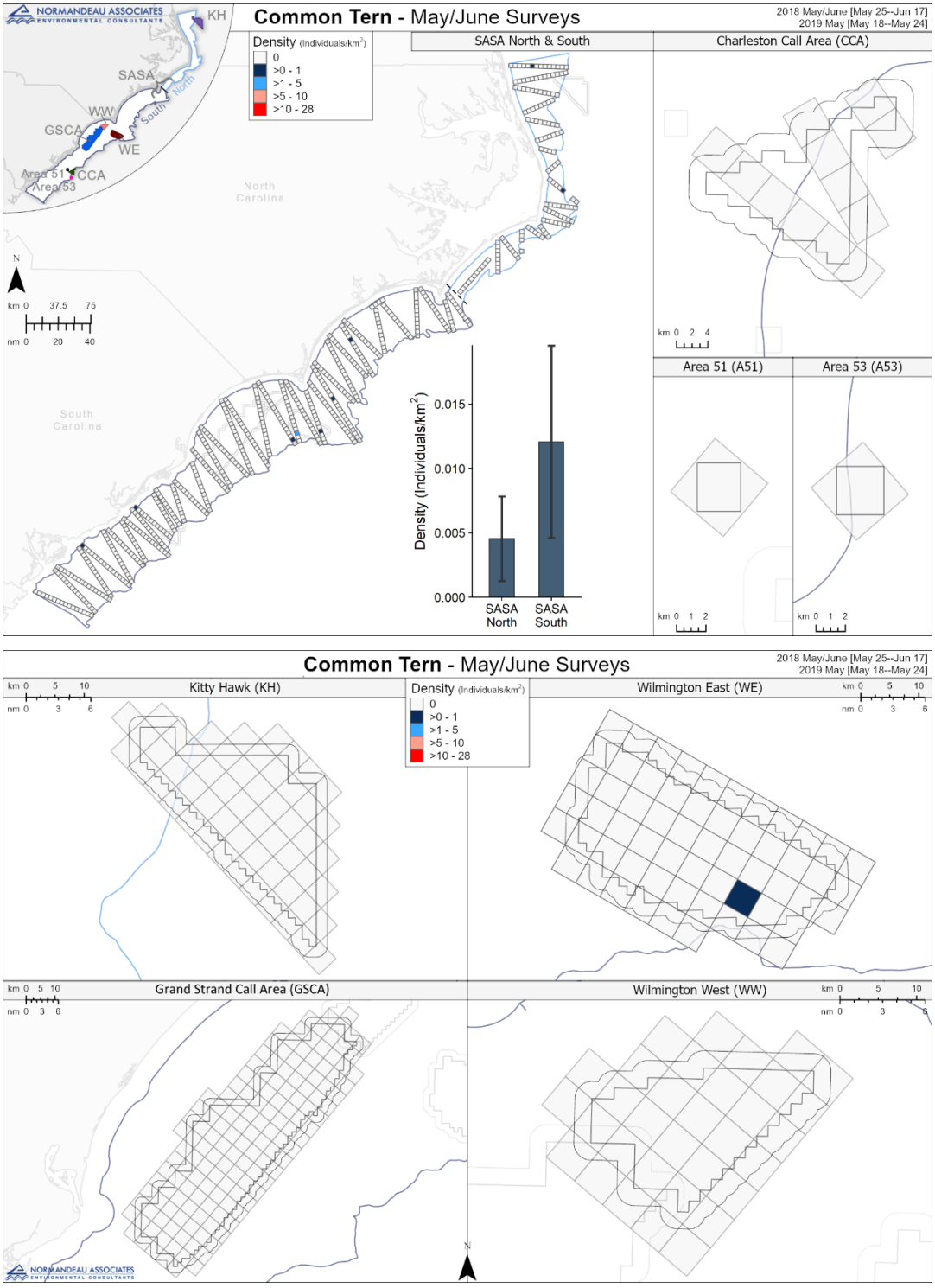


Figure C–241. Spatial distribution of common terns during the May/June surveys for all areas

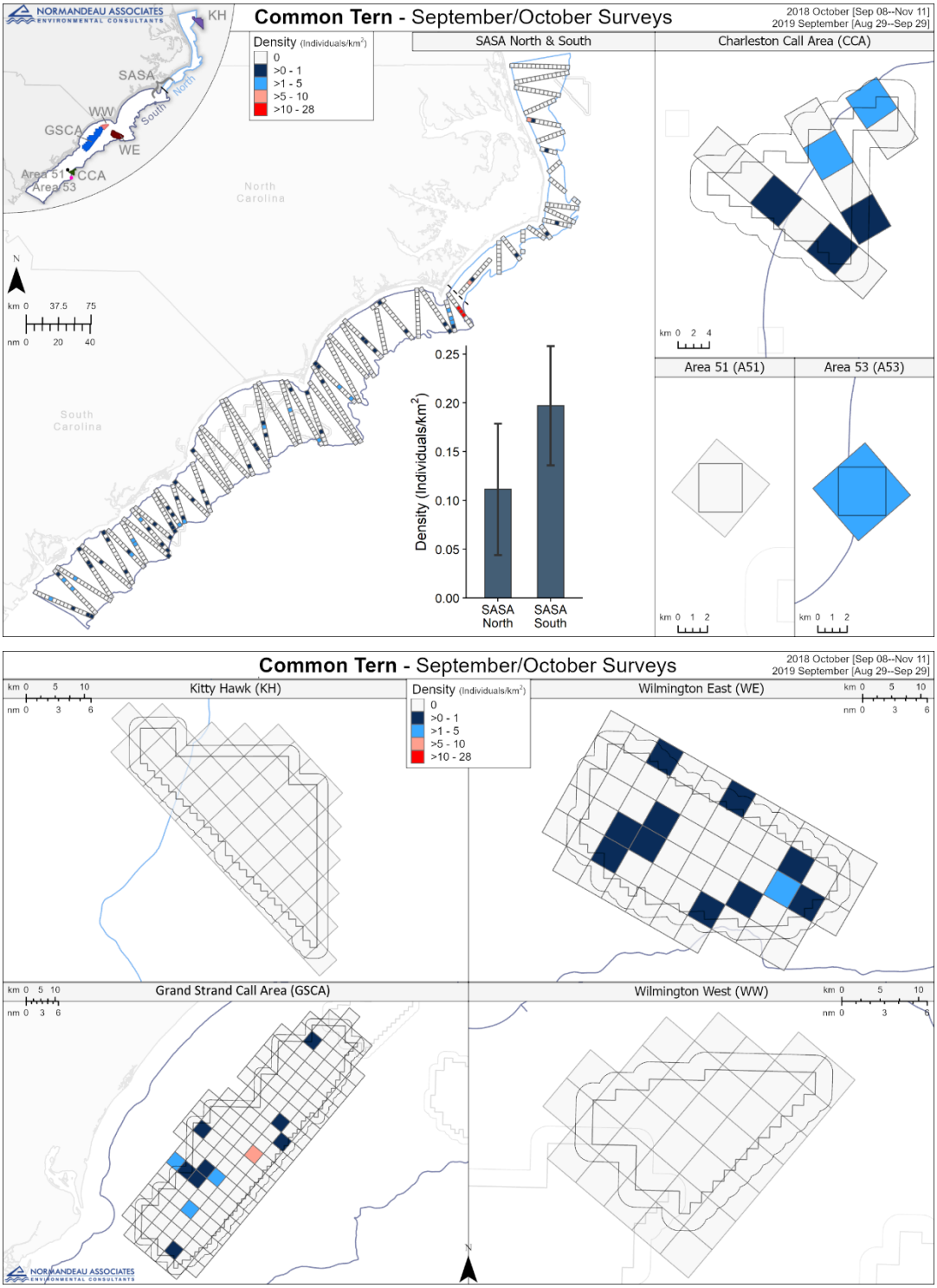


Figure C–242. Spatial distribution of common terns during the September/October surveys for all areas

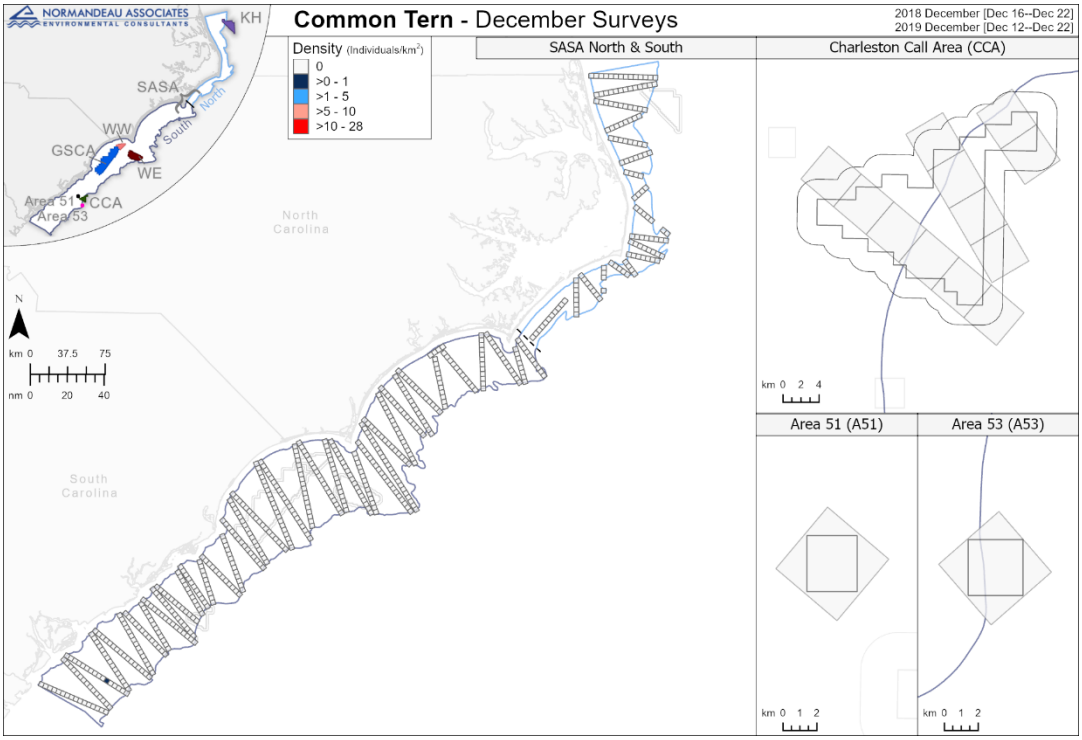


Figure C–243. Spatial distribution of common terns during the December surveys for all areas

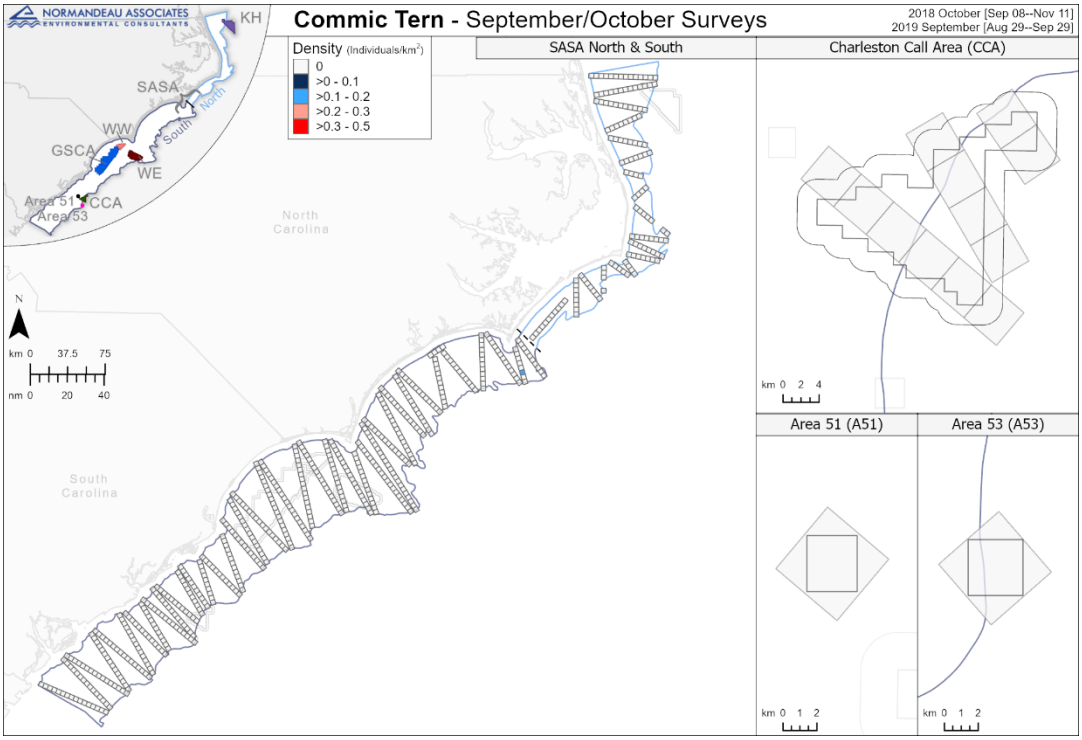


Figure C–244. Spatial distribution of commic terns during the September/October surveys for all areas

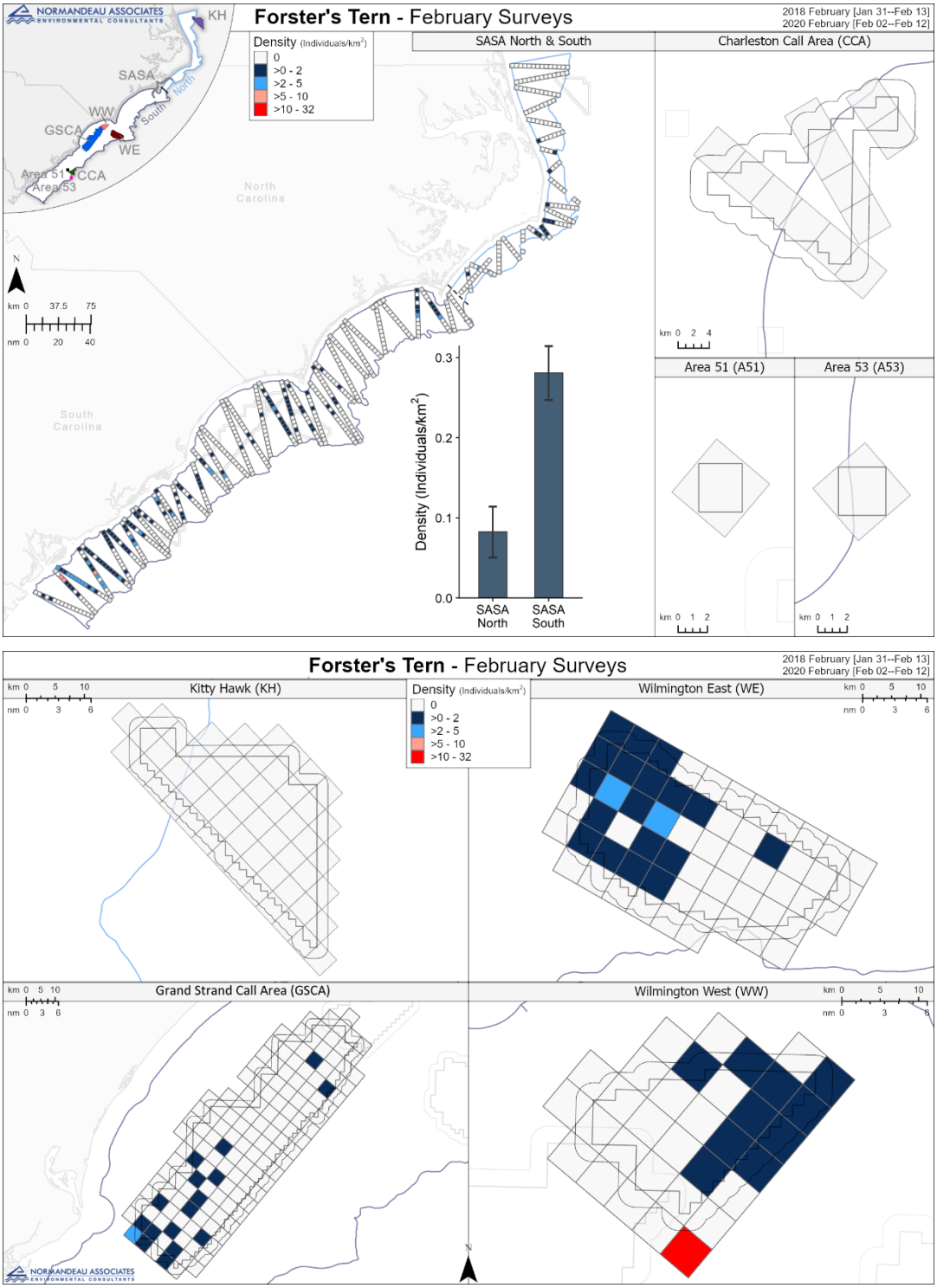


Figure C–245. Spatial distribution of Forster's terns during the February surveys for all areas

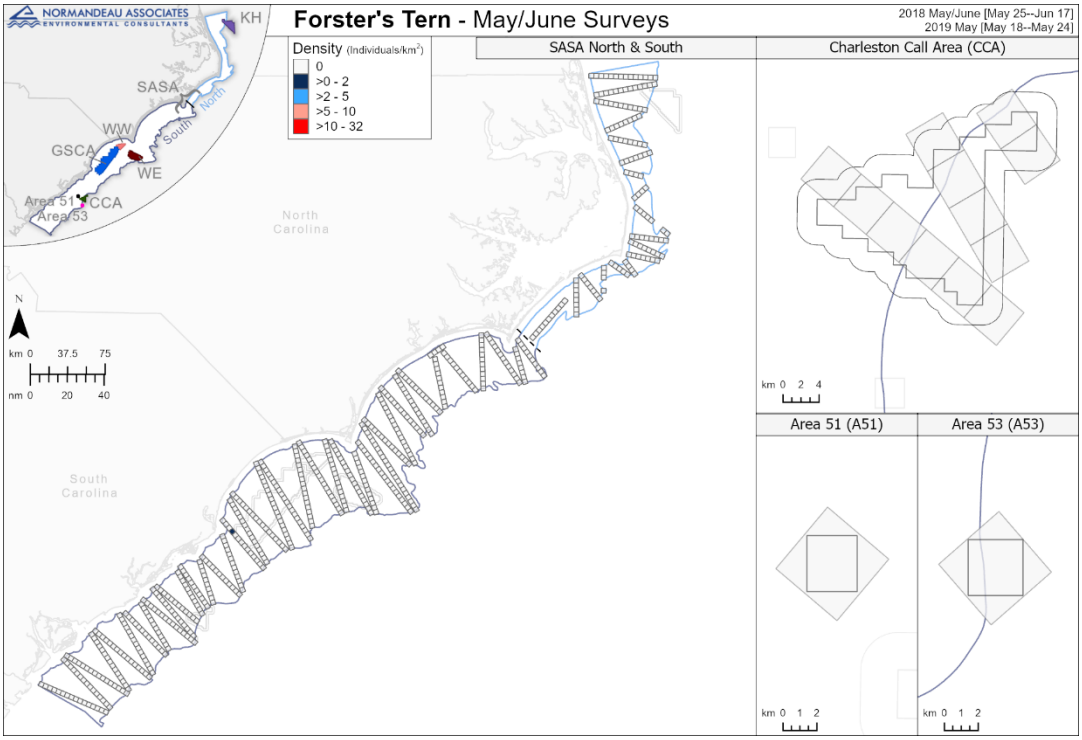


Figure C–246. Spatial distribution of Forster's terns during the May/June surveys for all areas

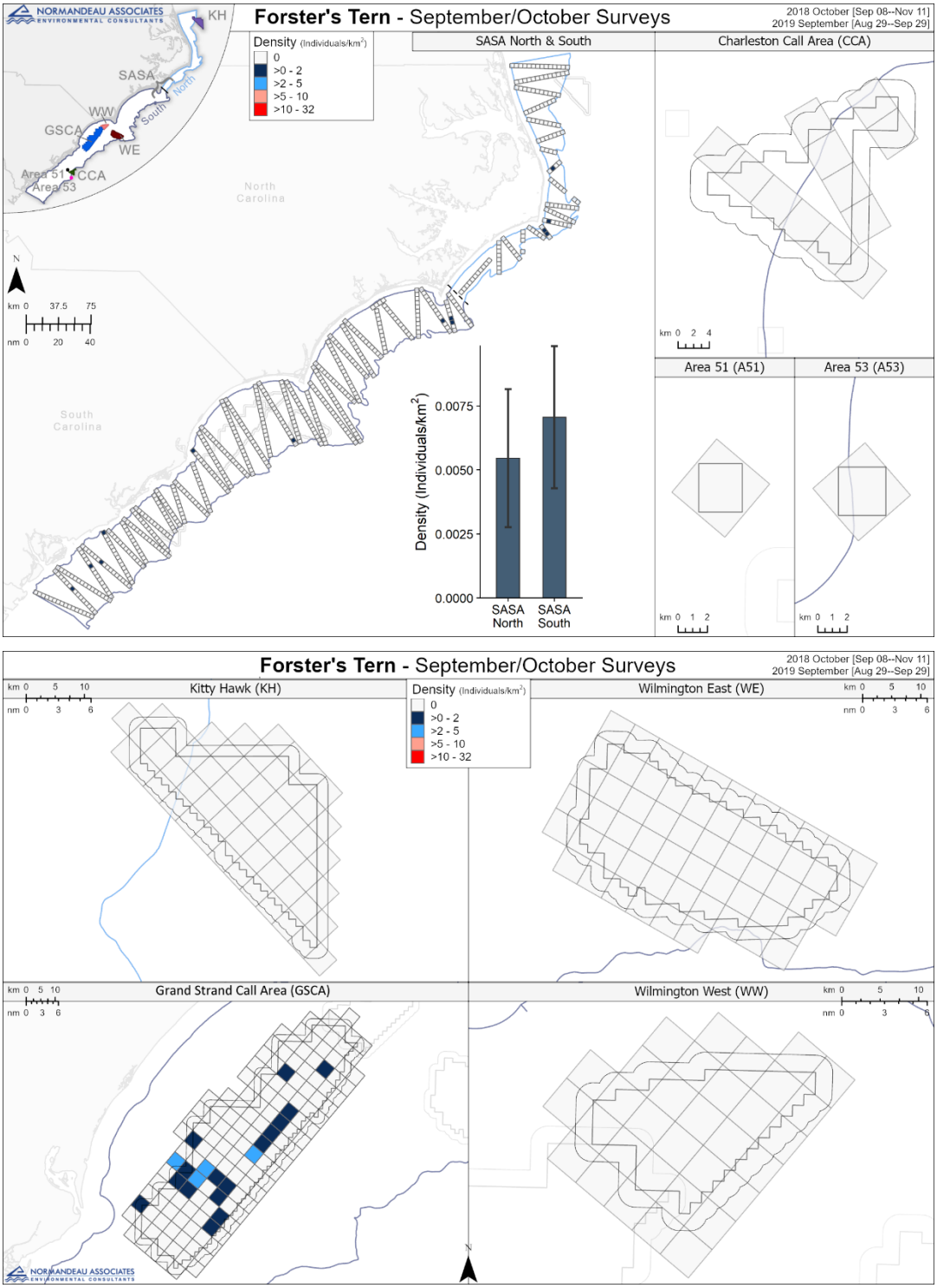


Figure C–247. Spatial distribution of Forster's terns during the September/October surveys for all areas

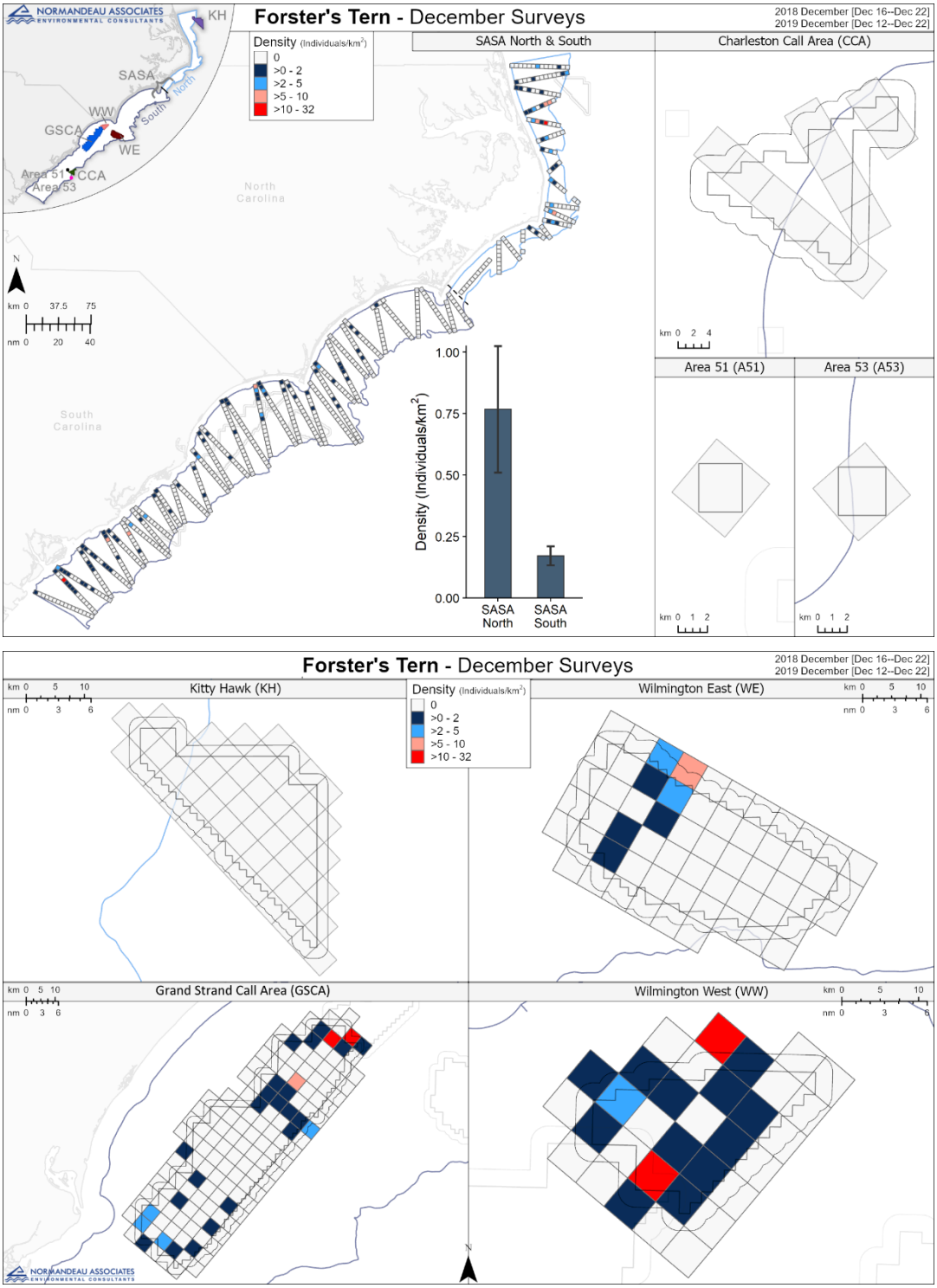


Figure C–248. Spatial distribution of Forster's terns during the December surveys for all areas

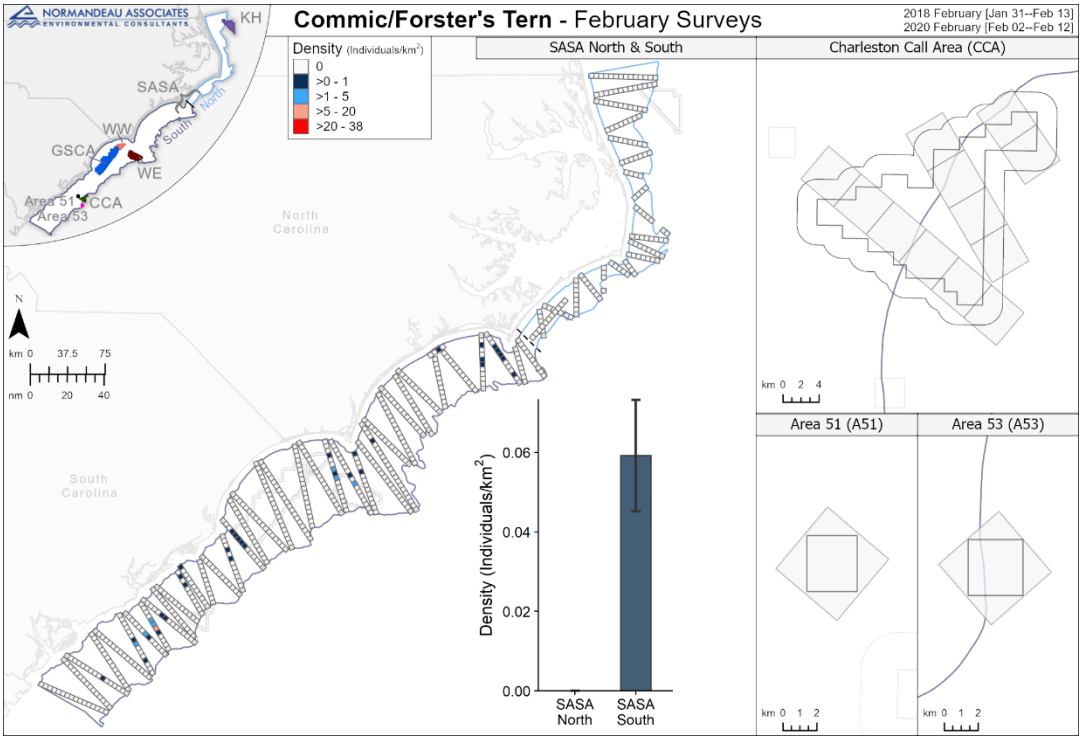


Figure C–249. Spatial distribution of commic/Forster's terns during the February surveys for all areas

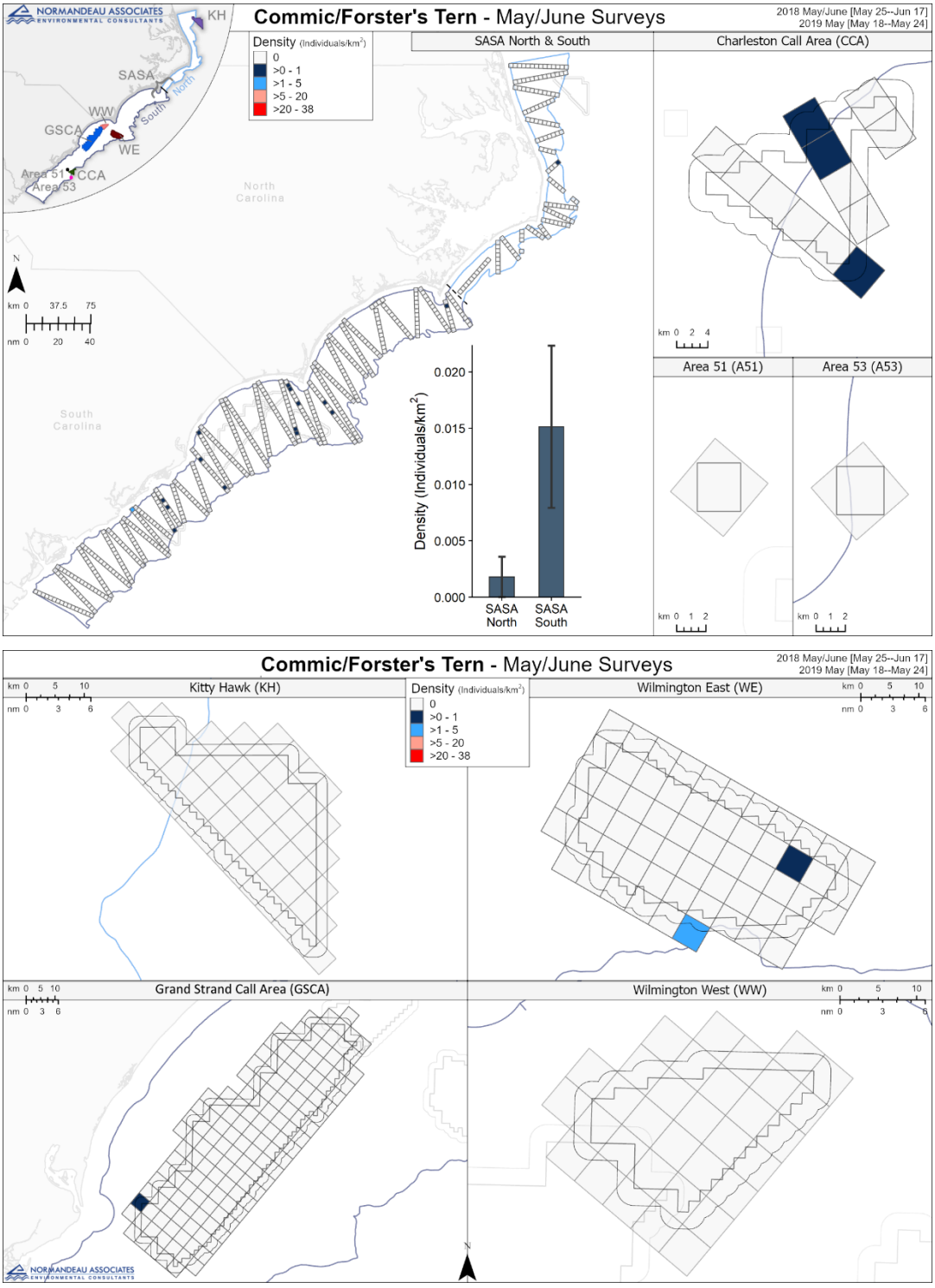


Figure C–250. Spatial distribution of commic/Forster's terns during the May/June surveys for all areas

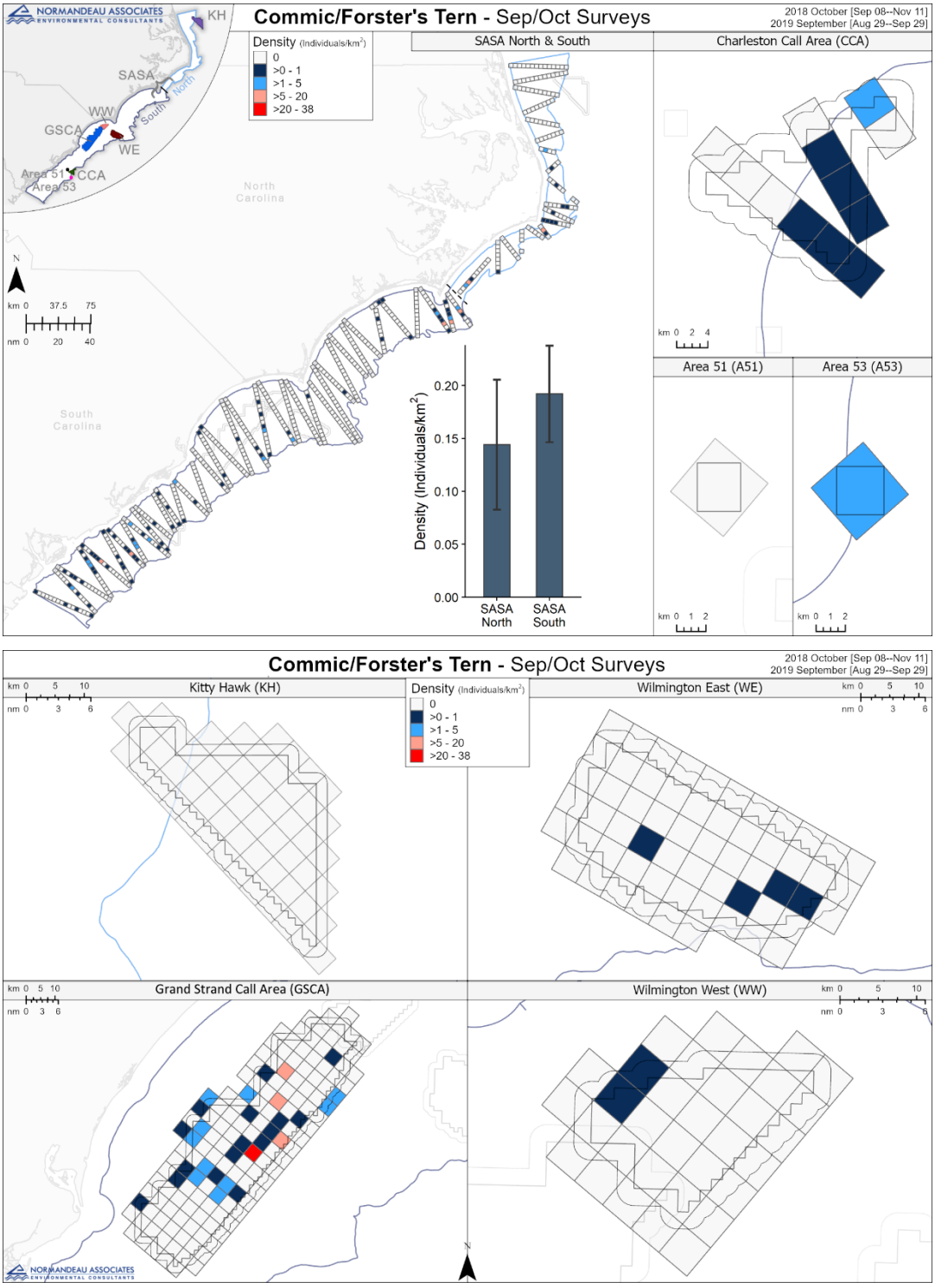


Figure C–251. Spatial distribution of commic/Forster's terns during the September/ October surveys for all areas

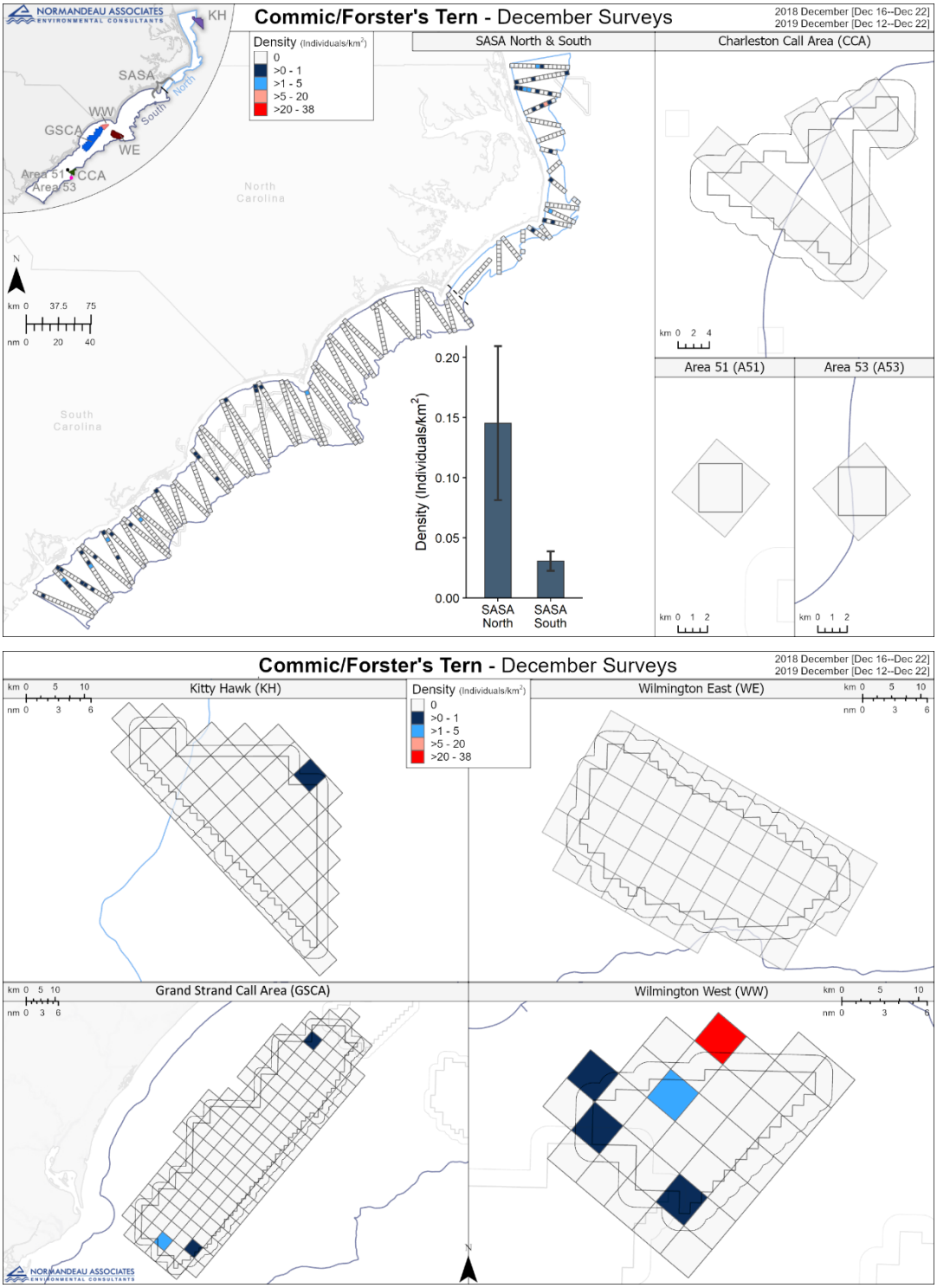


Figure C–252. Spatial distribution of commic/Forster's terns during the December surveys for all areas

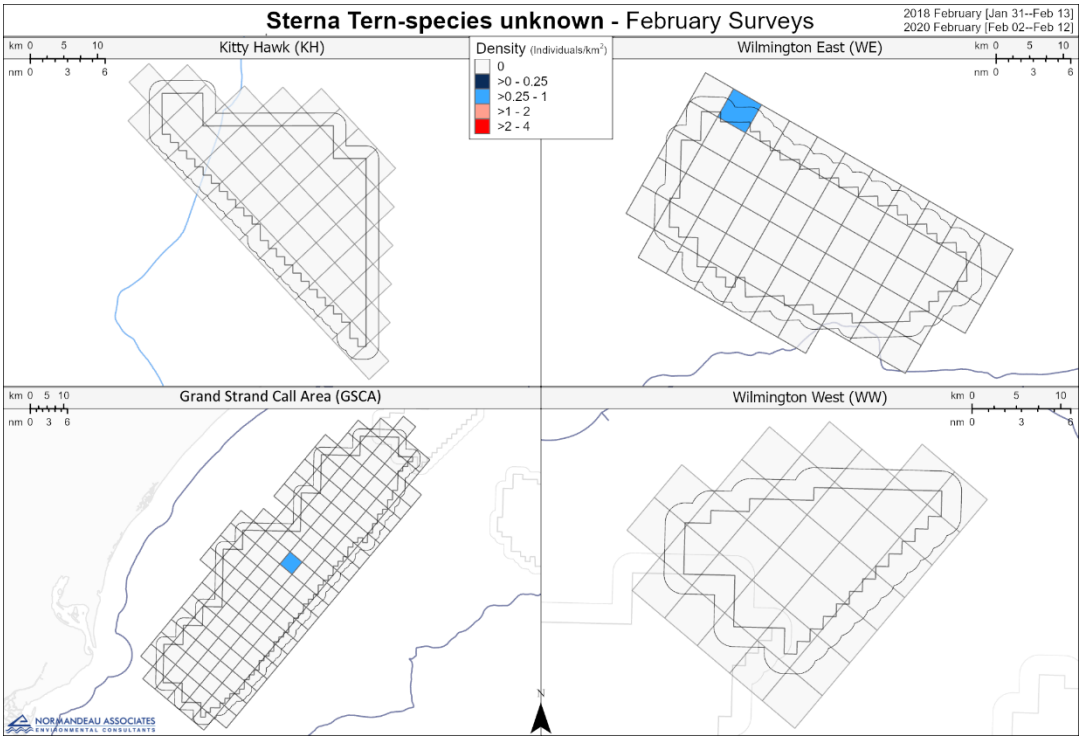


Figure C–253. Spatial distribution of *Sterna* tern-species unknown during the February surveys for all areas

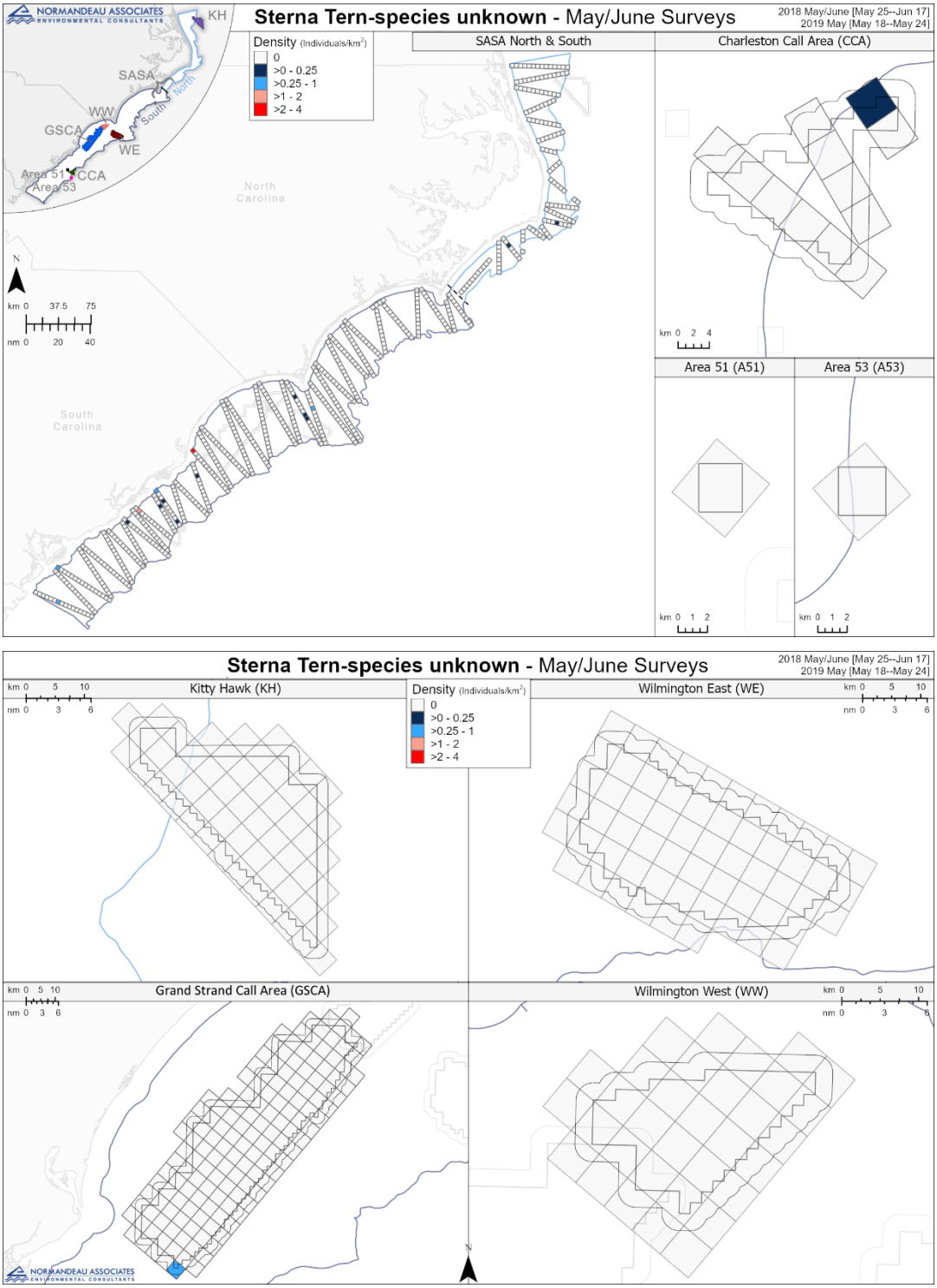


Figure C–254. Spatial distribution of *Sterna* tern-species unknown during the May/June surveys for all areas

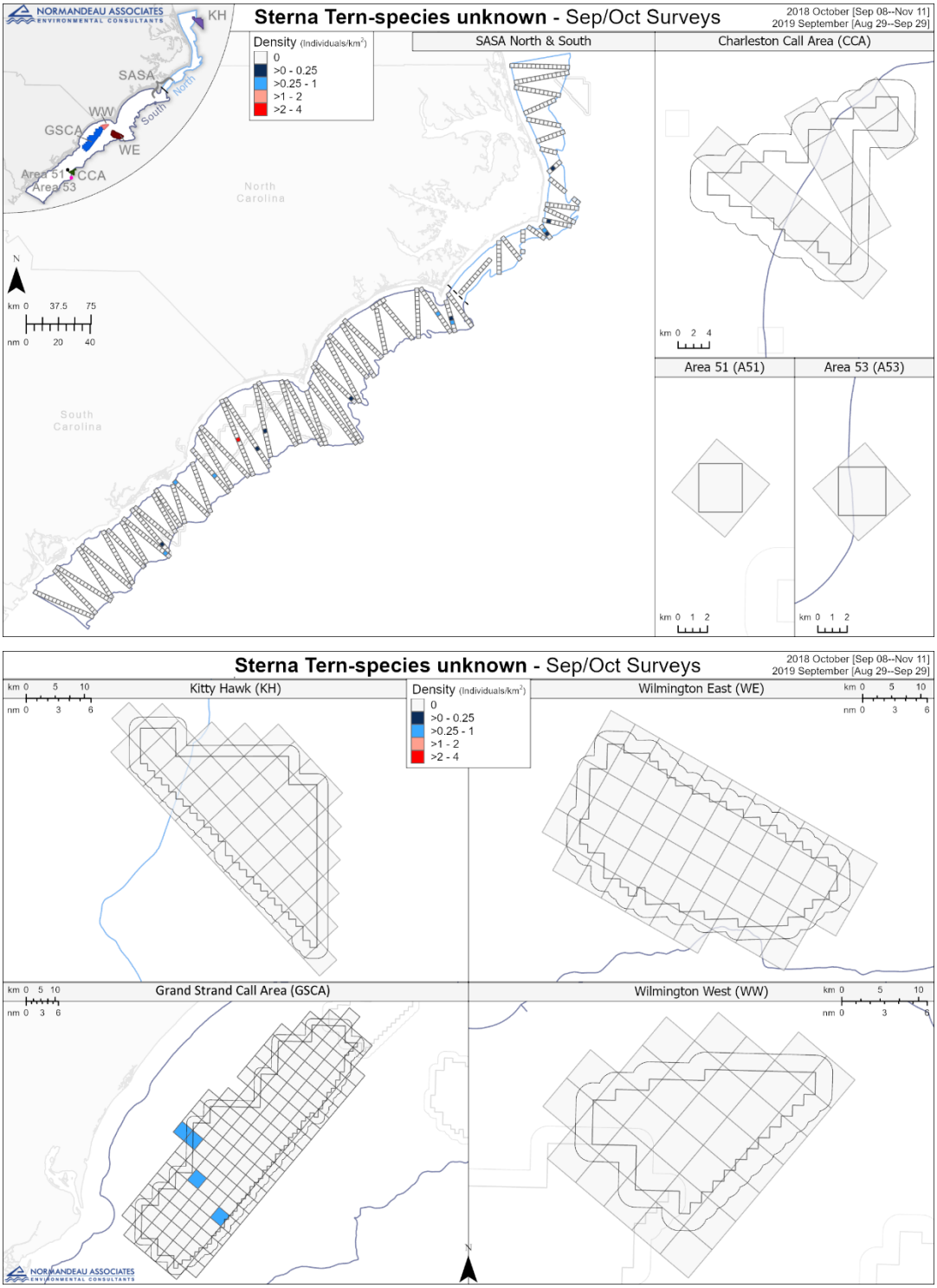


Figure C–255. Spatial distribution of *Sterna* tern-species unknown during the September/October surveys for all areas

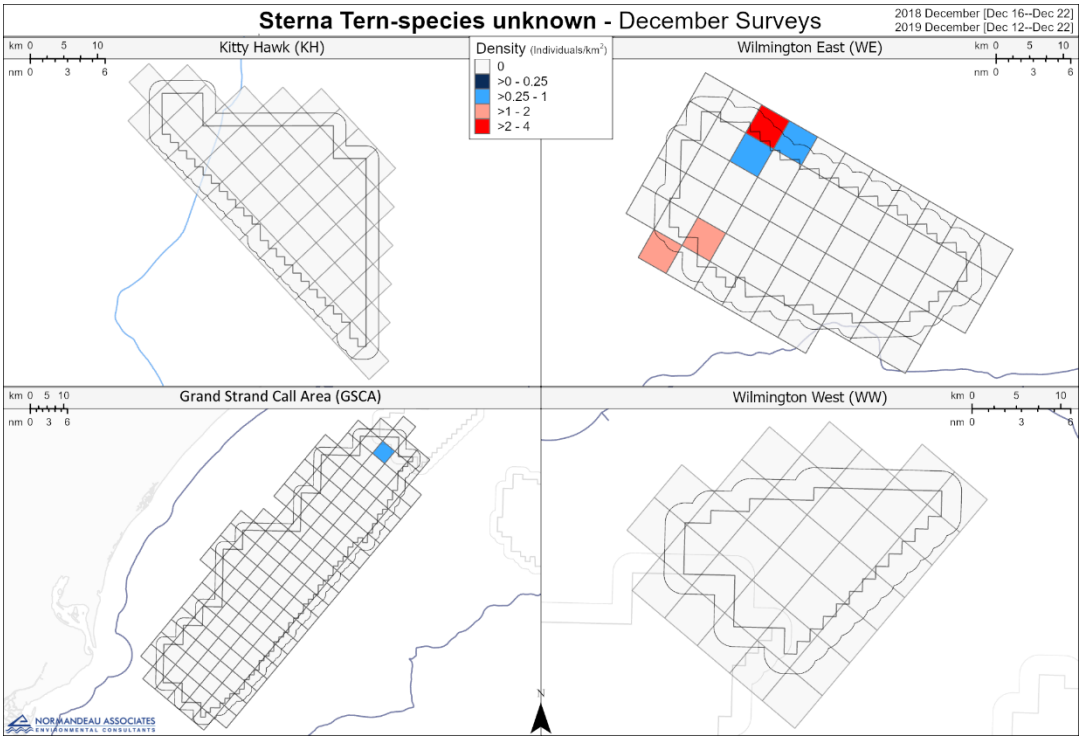


Figure C–256. Spatial distribution of *Sterna* tern-species unknown during the December surveys for all areas

C.4.20 Passerine

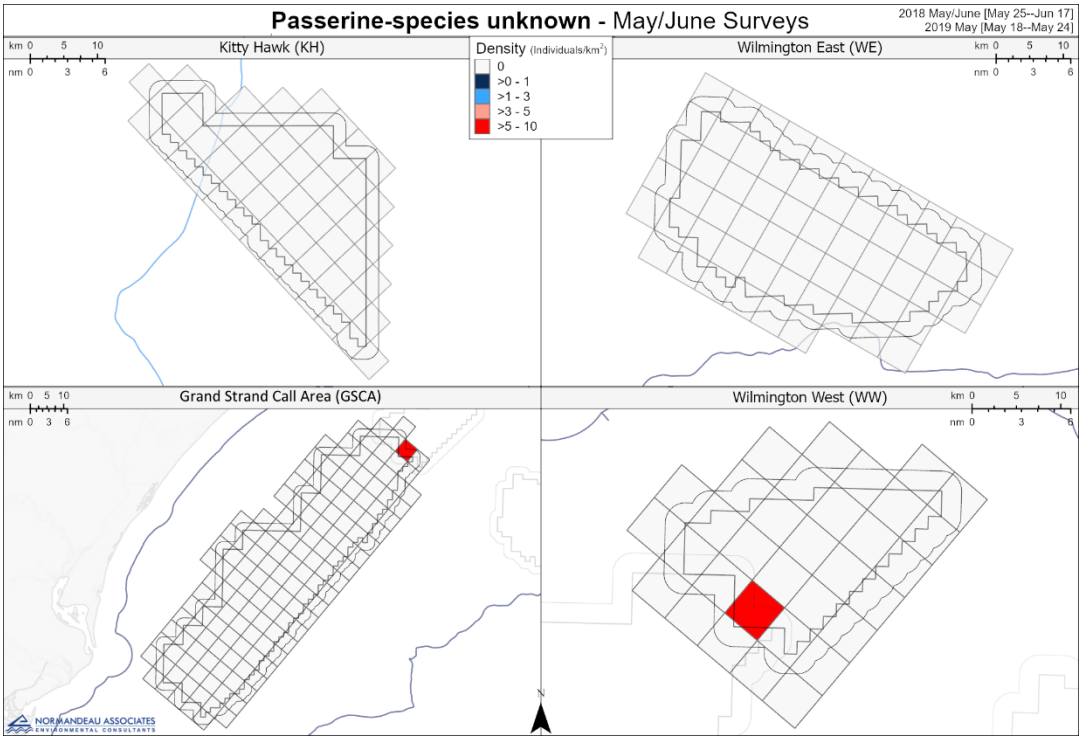


Figure C–257. Spatial distribution of passerine-species unknown during the May/June surveys for all areas

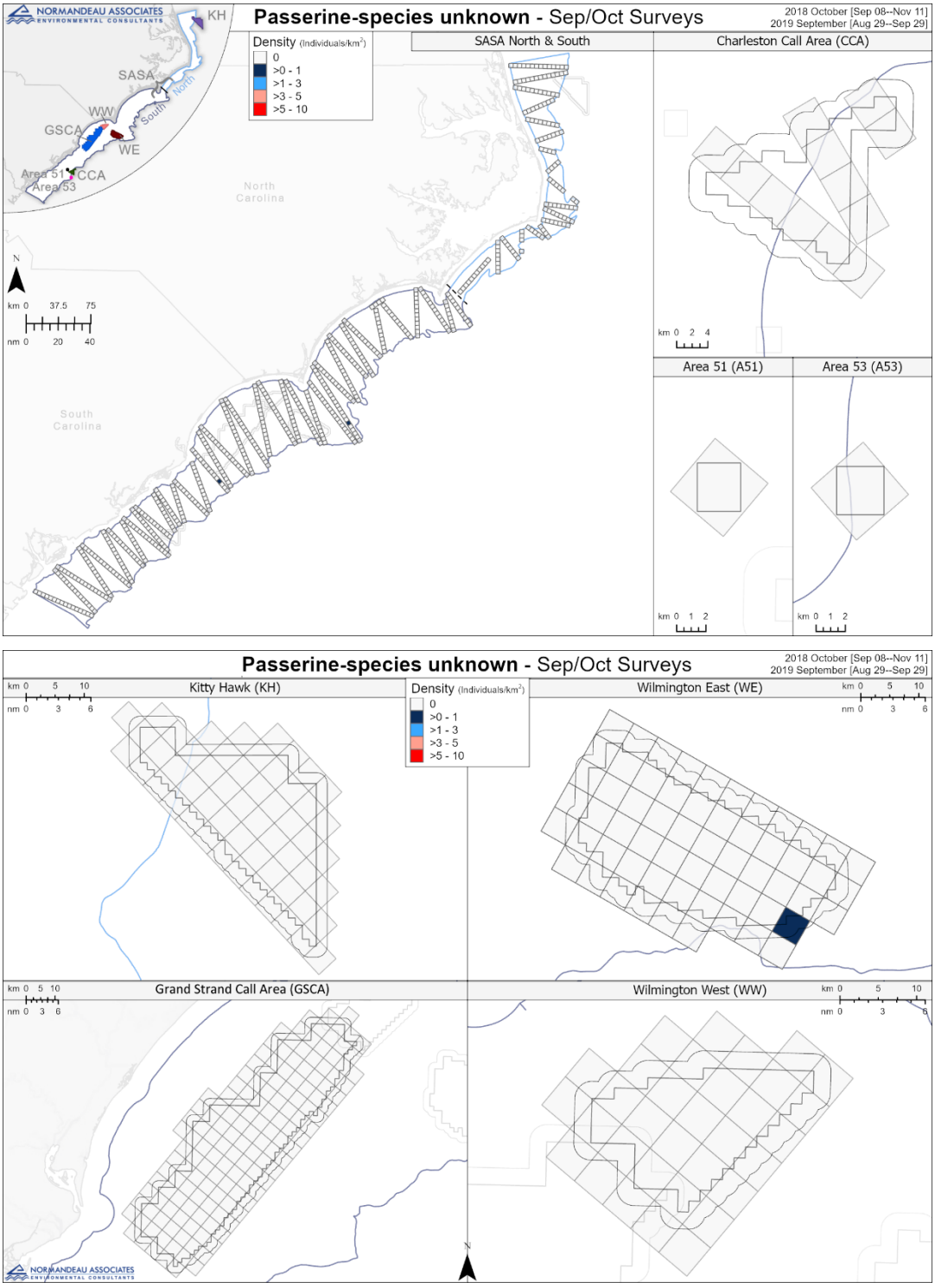


Figure C–258. Spatial distribution of passerine-species unknown during the September/October surveys for all areas

C.5 Avian Direction of Travel

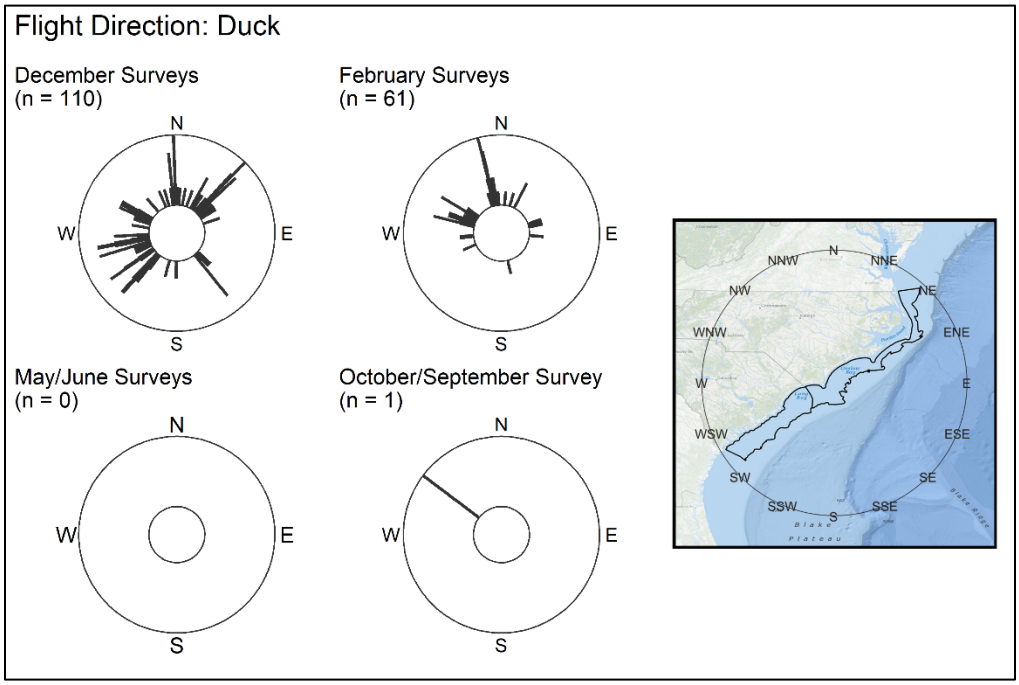


Figure C–259. Direction of travel for ducks observed during each survey in the South Atlantic Survey Area (SASA)

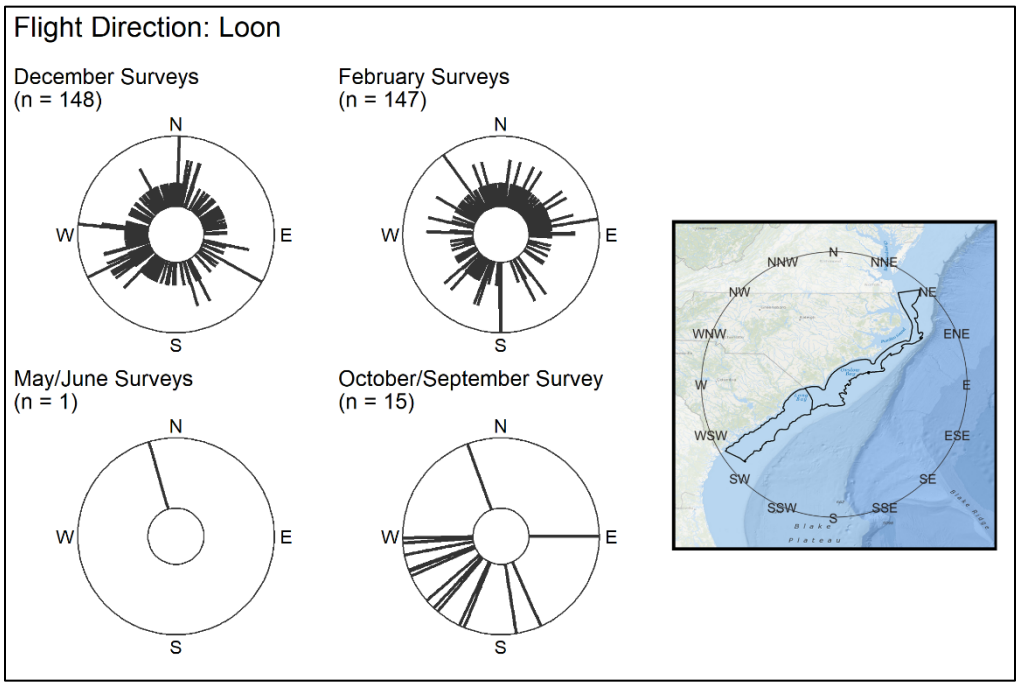


Figure C–260. Direction of travel for loons observed during each survey in the South Atlantic Survey Area (SASA)

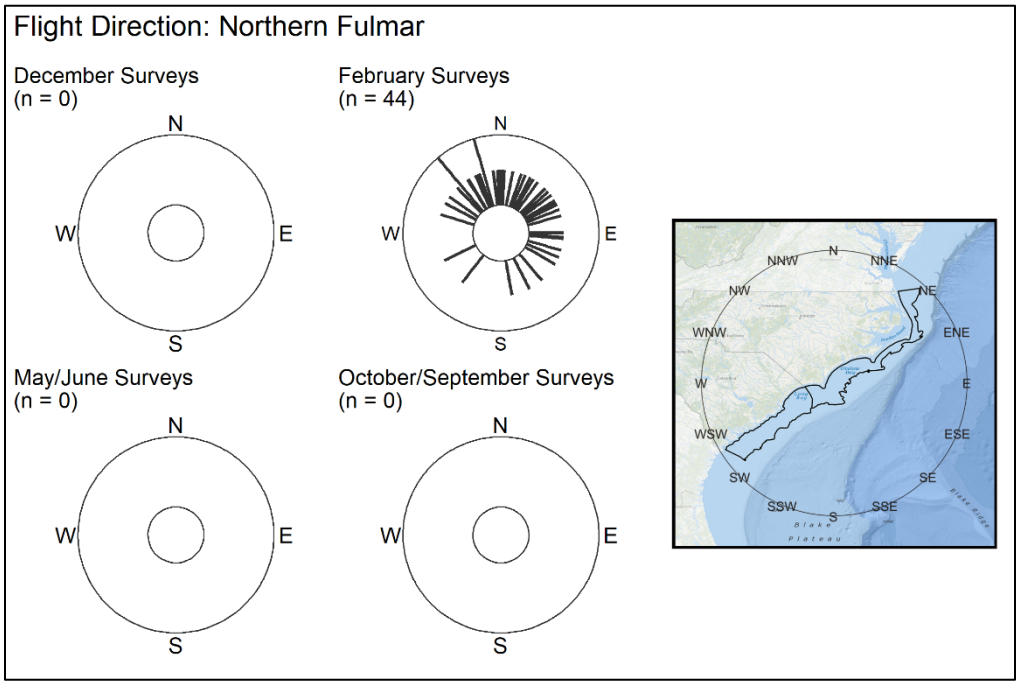


Figure C–261. Direction of travel for fulmars observed during each survey in the South Atlantic Survey Area (SASA)

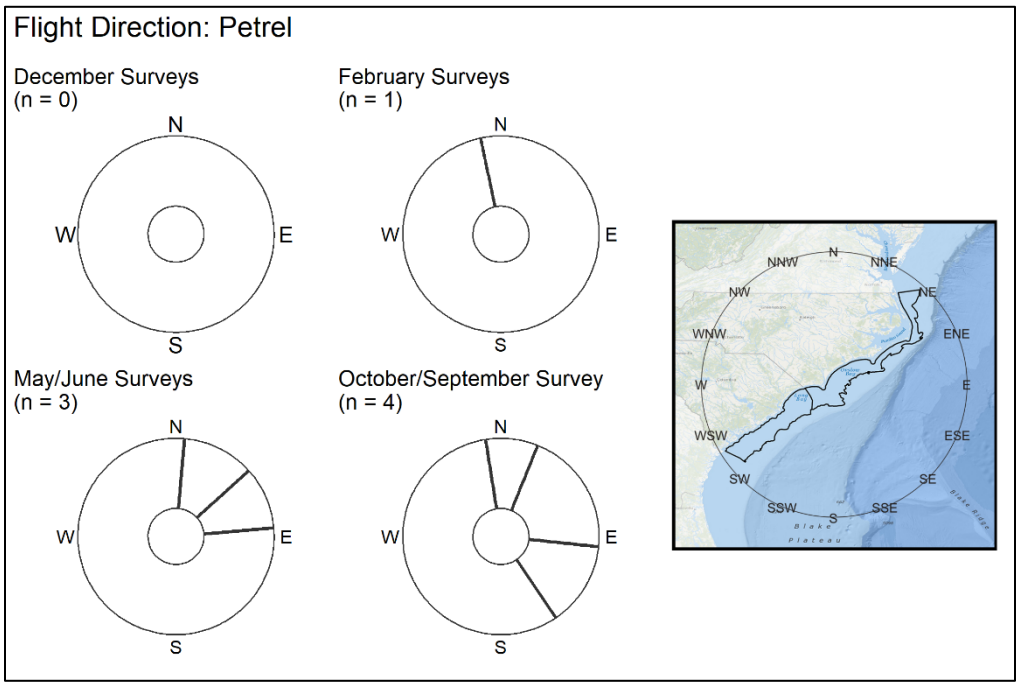


Figure C–262. Direction of travel for petrels observed during each survey in the South Atlantic Survey Area (SASA)

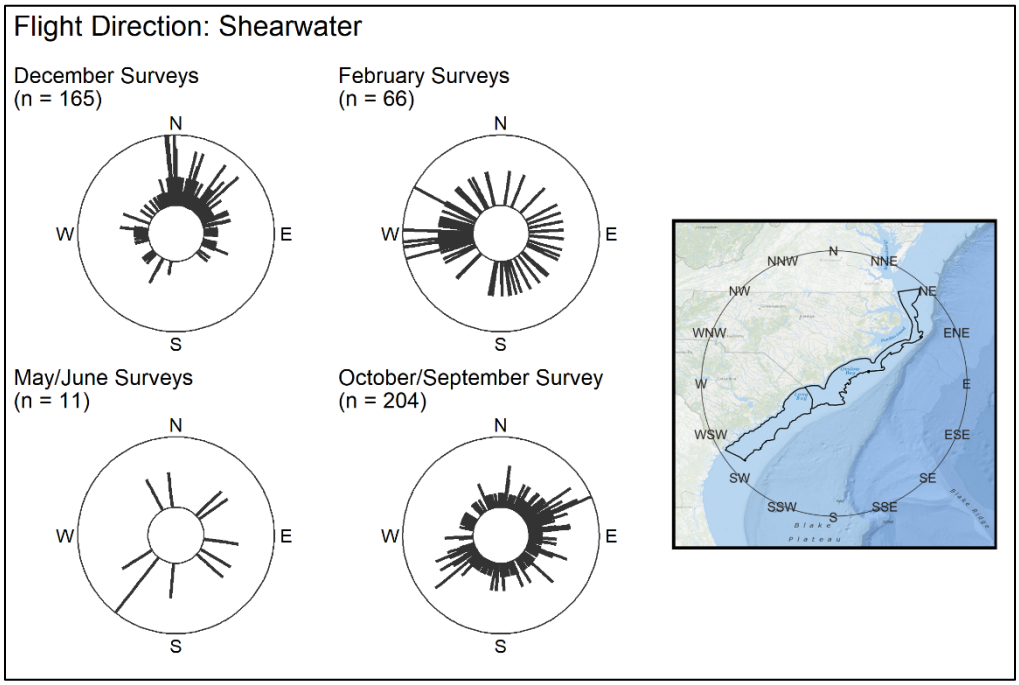


Figure C–263. Direction of travel for shearwaters observed during each survey in the South Atlantic Survey Area (SASA)

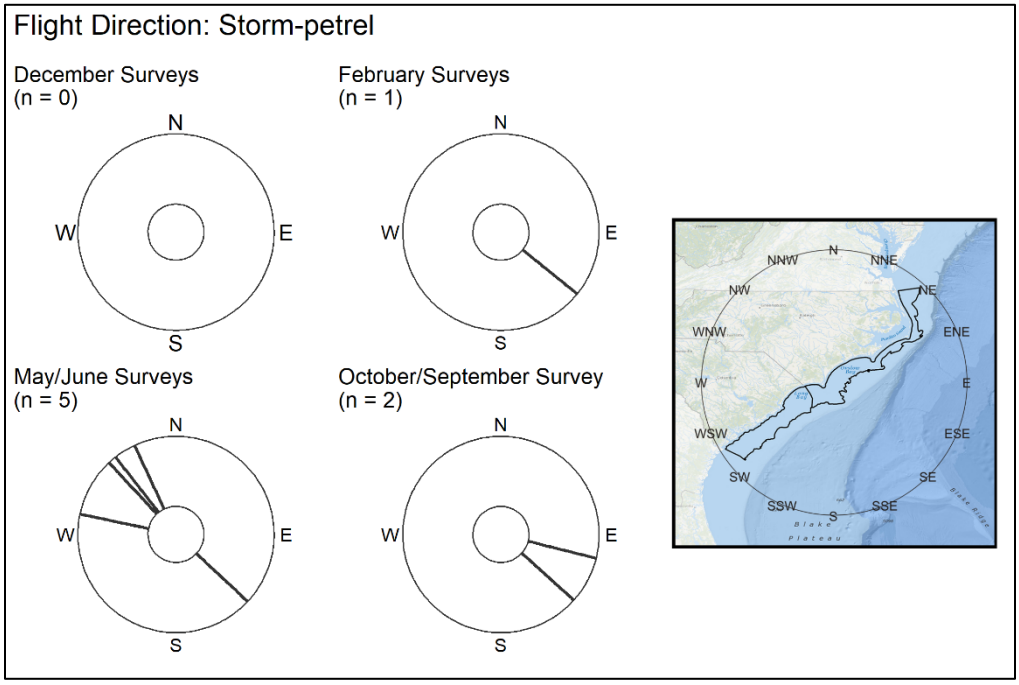


Figure C–264. Direction of travel for storm-petrels observed during each survey in the South Atlantic Survey Area (SASA)

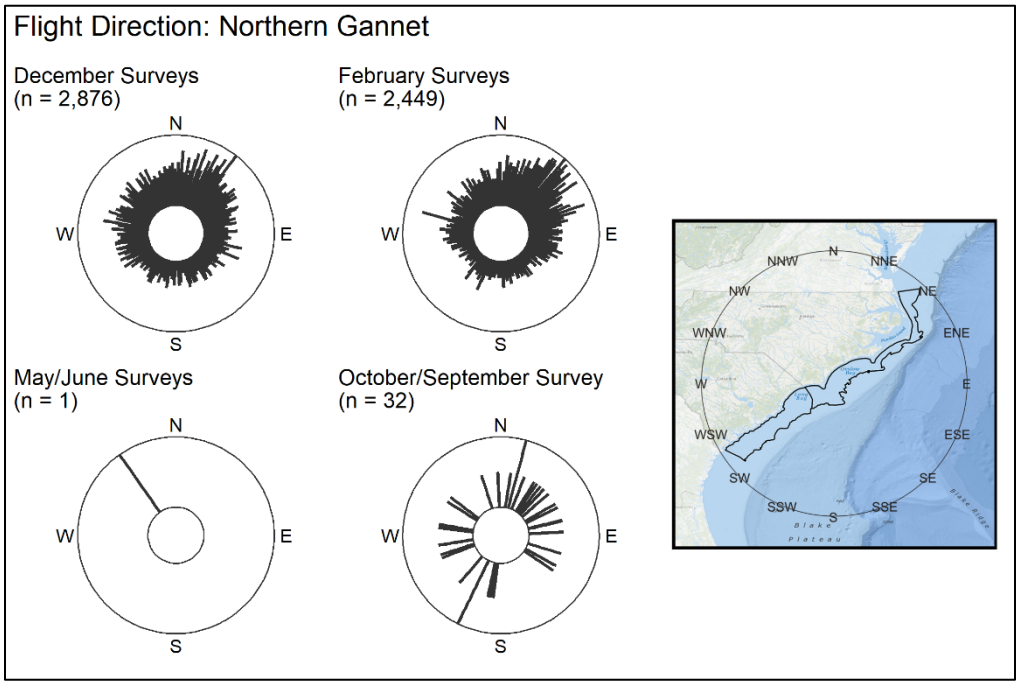


Figure C–265. Direction of travel for gannets observed during each survey in the South Atlantic Survey Area (SASA)

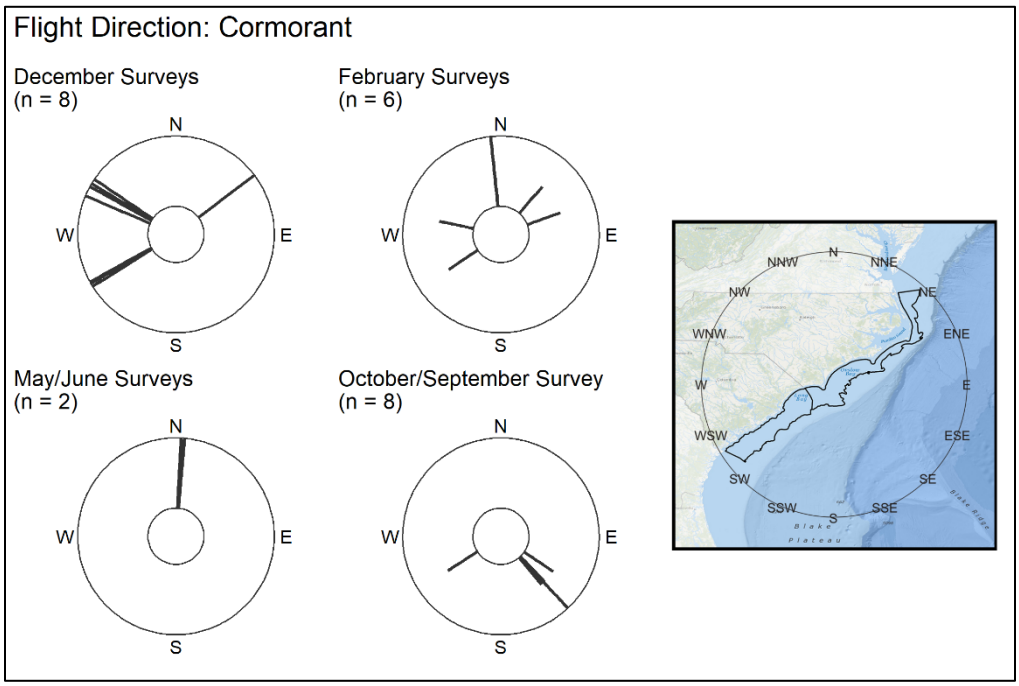


Figure C–266. Direction of travel for cormorants observed during each survey in the South Atlantic Survey Area (SASA)

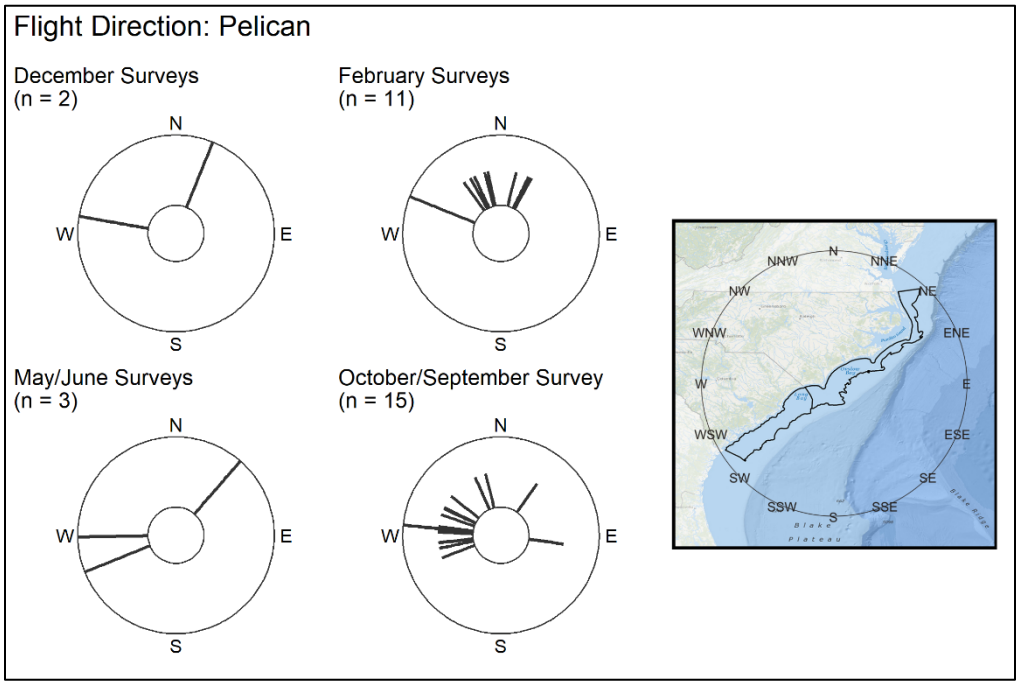


Figure C–267. Direction of travel for pelicans observed during each survey in the South Atlantic Survey Area (SASA)

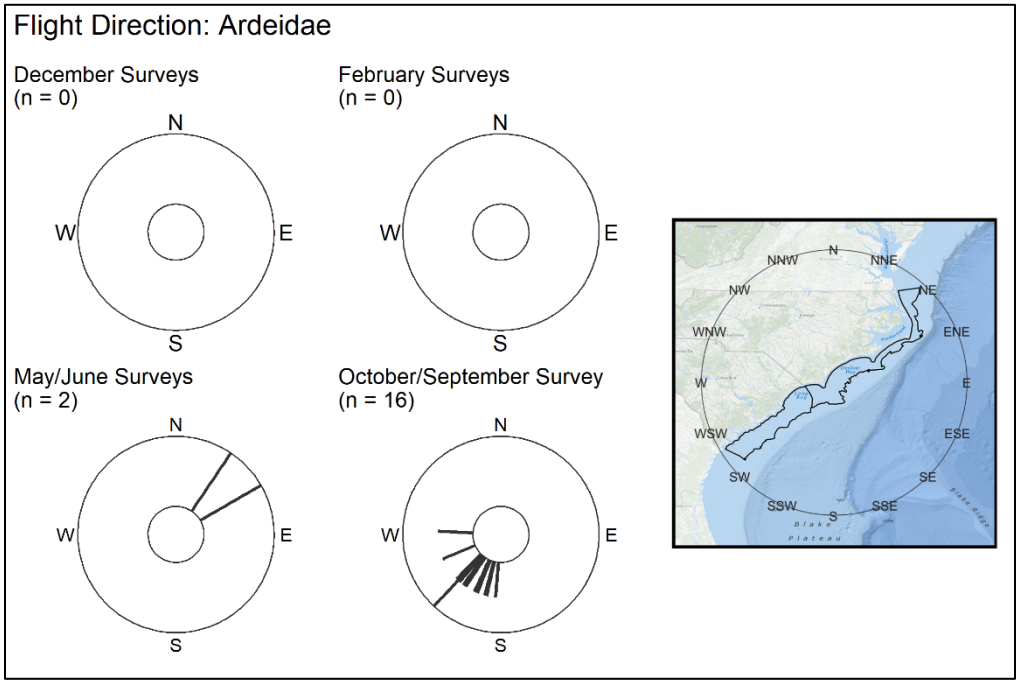


Figure C–268. Direction of travel for Ardeidae observed during each survey in the South Atlantic Survey Area (SASA)

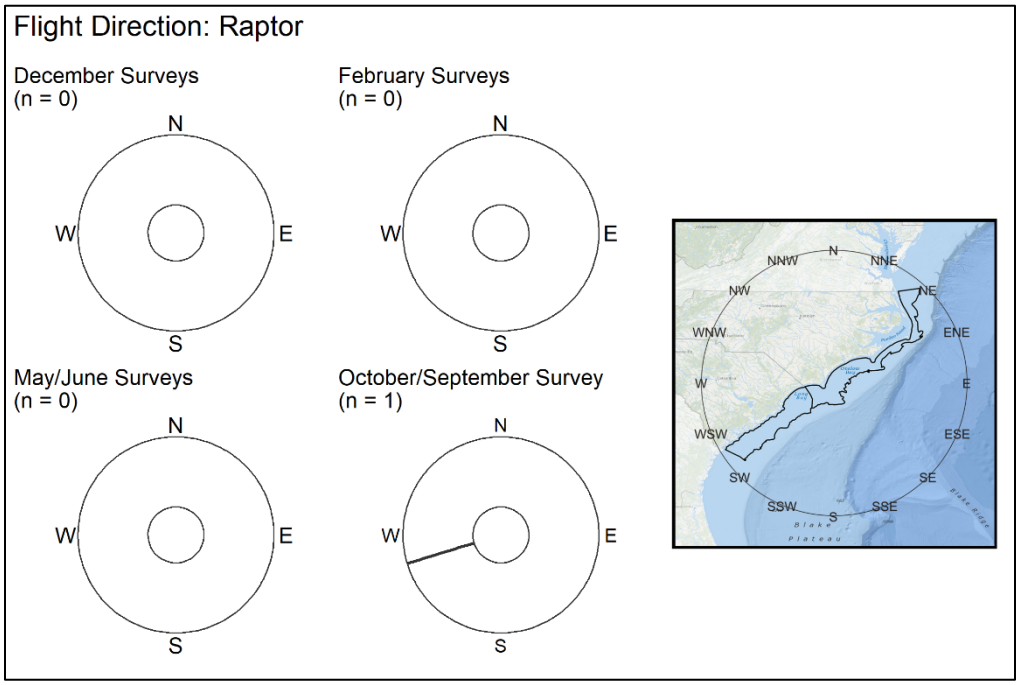


Figure C–269. Direction of travel for raptors observed during each survey in the South Atlantic Survey Area (SASA)

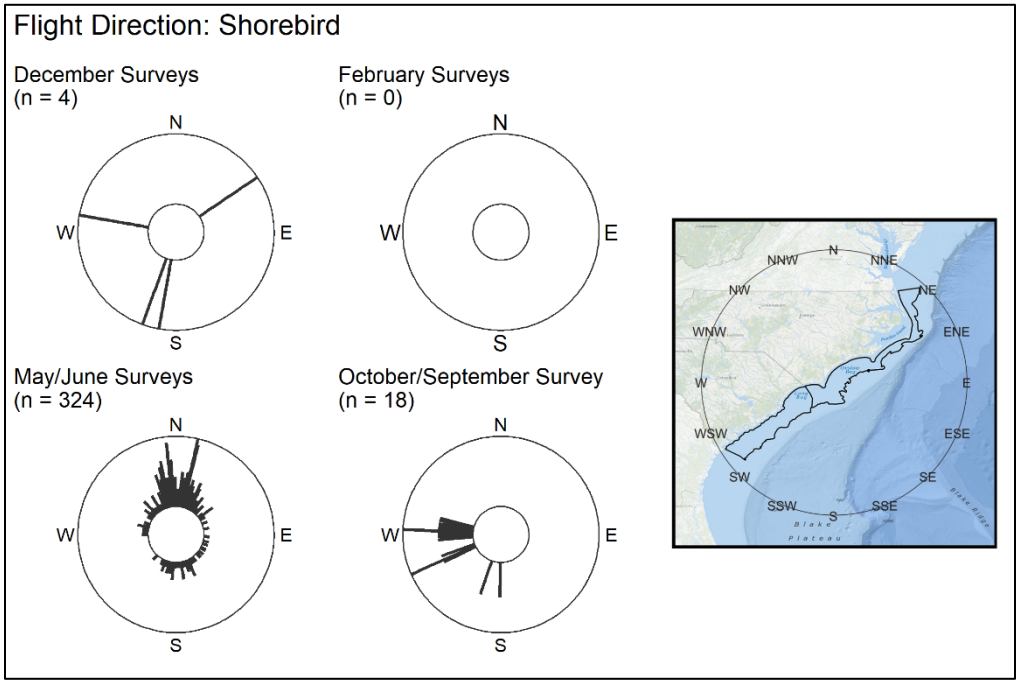


Figure C–270. Direction of travel for shorebirds observed during each survey in the South Atlantic Survey Area (SASA)

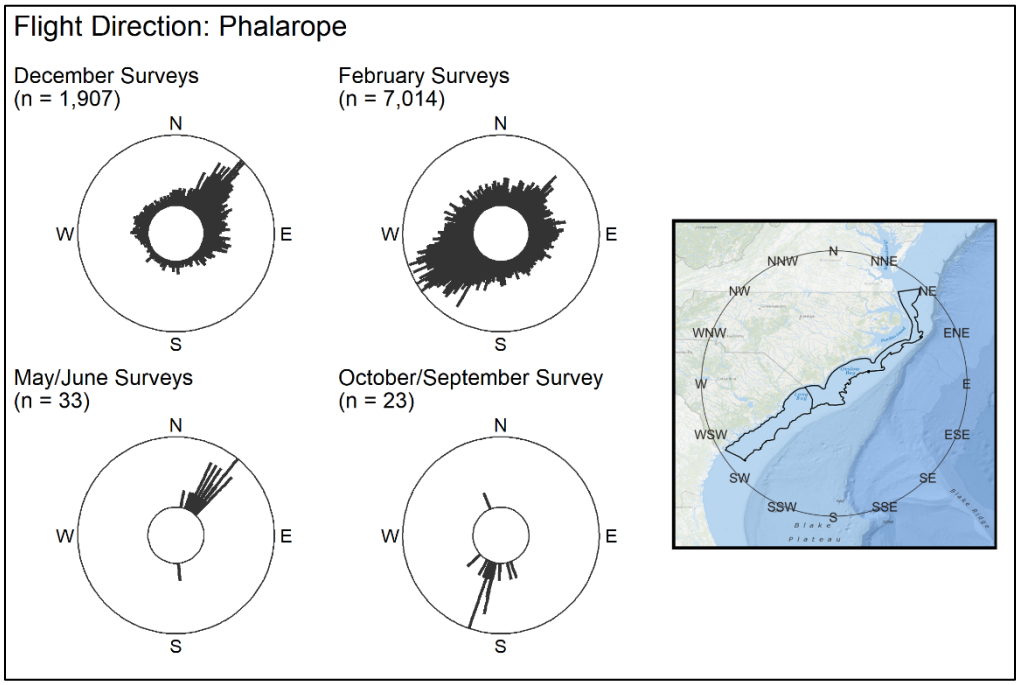


Figure C–271. Direction of travel for phalaropes observed during each survey in the South Atlantic Survey Area (SASA)

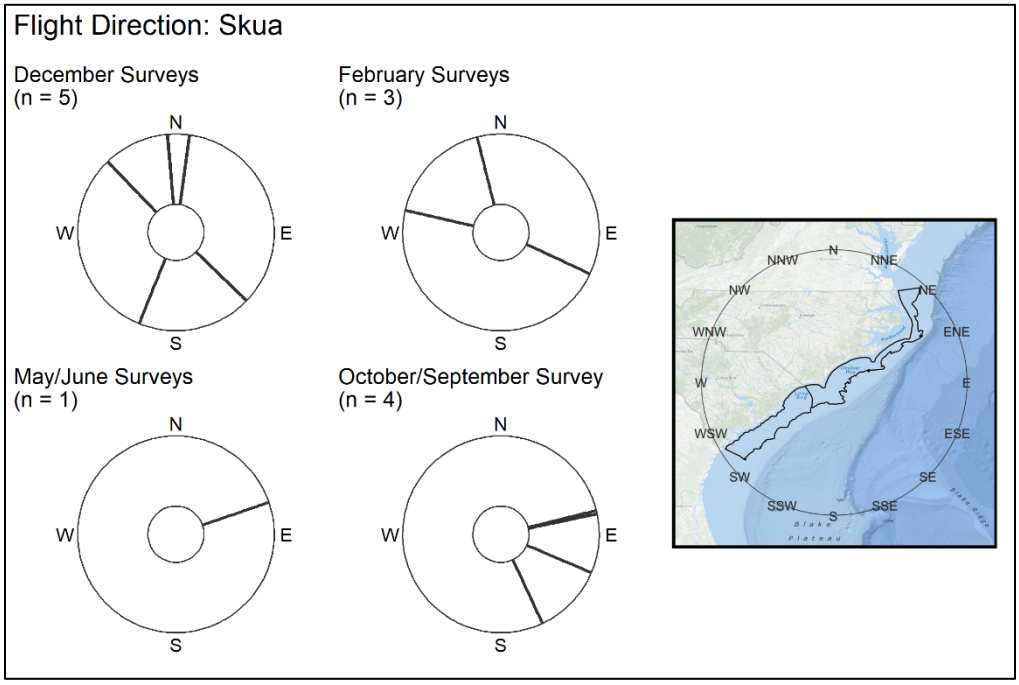


Figure C–272. Direction of travel for skua observed during each survey in the South Atlantic Survey Area (SASA)

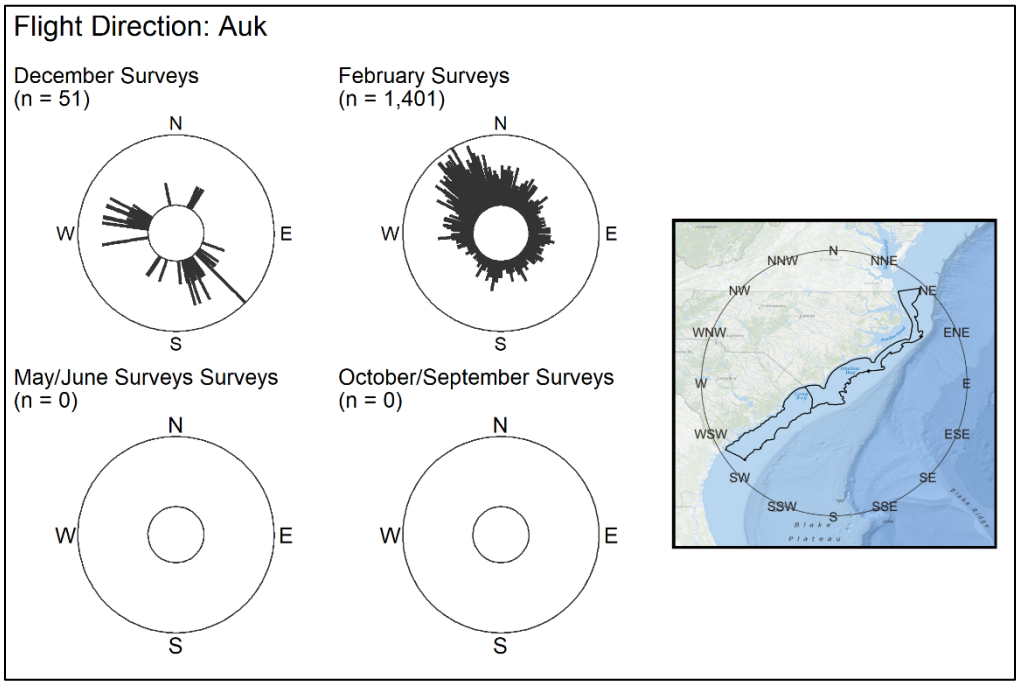


Figure C–273. Direction of travel for auks observed during each survey in the South Atlantic Survey Area (SASA)

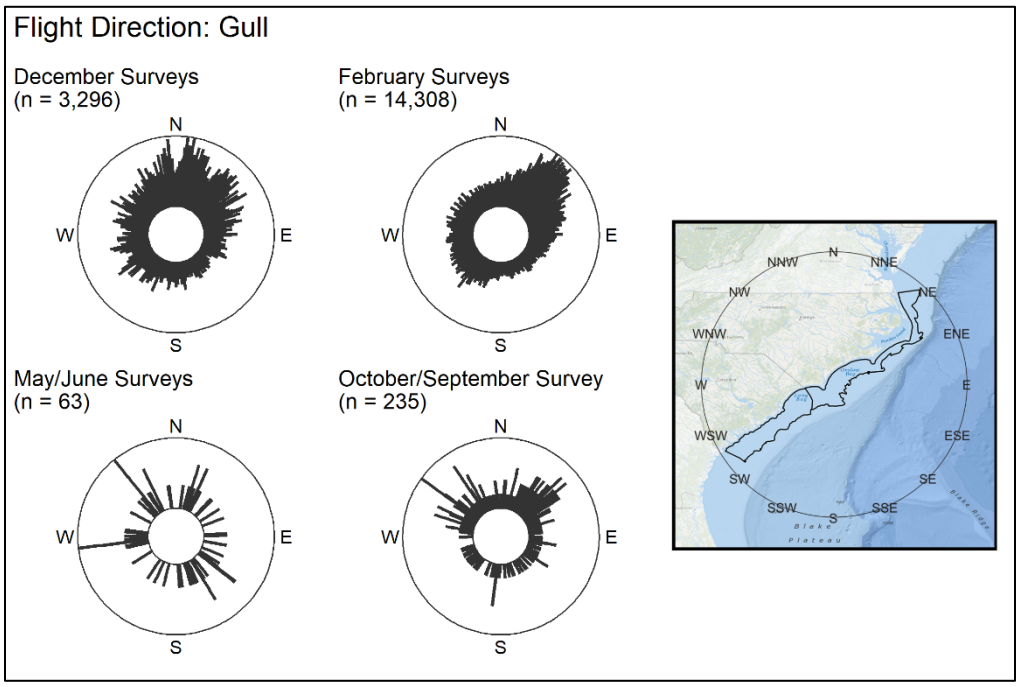


Figure C–274. Direction of travel for gulls observed during each survey in the South Atlantic Survey Area (SASA)

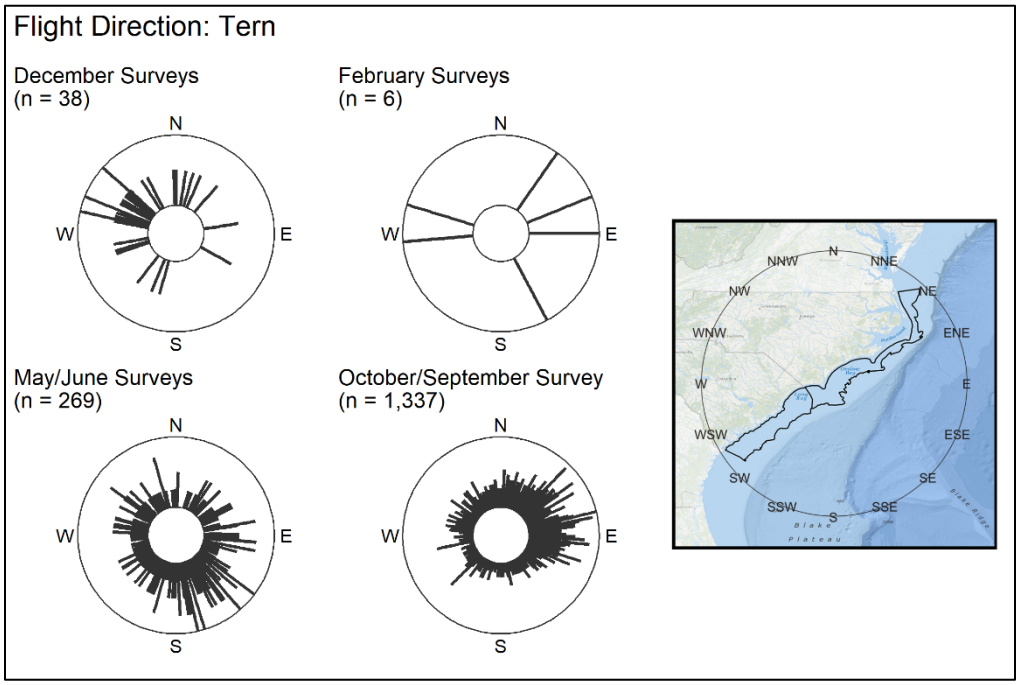


Figure C–275. Direction of travel for terns observed during each survey in the South Atlantic Survey Area (SASA)

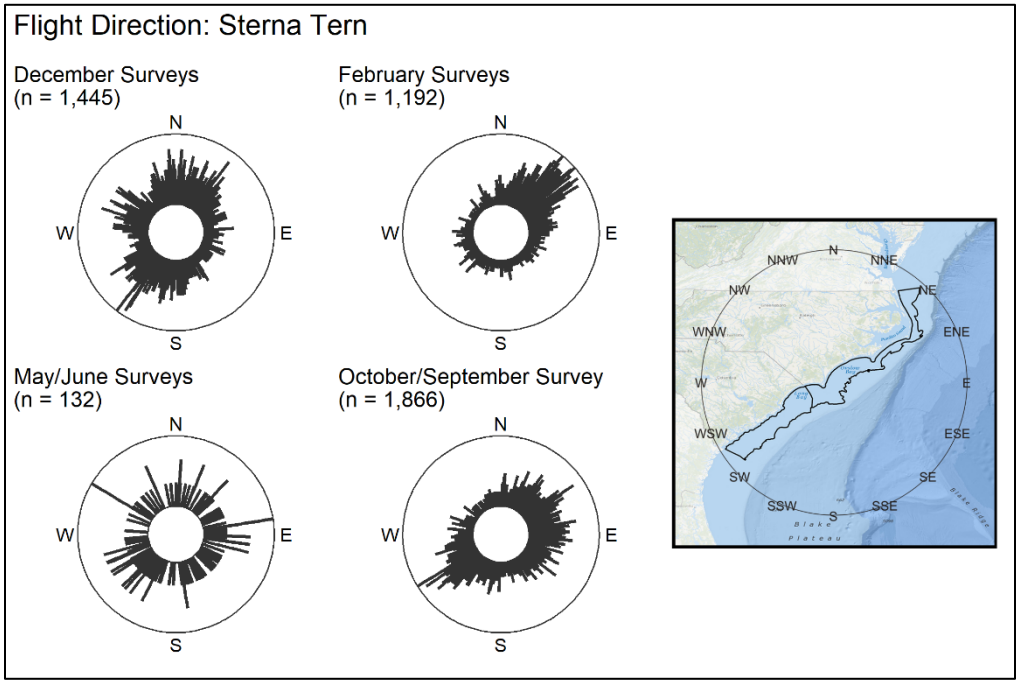


Figure C–276. Direction of travel for *Sterna* terns observed during each survey in the South Atlantic Survey Area (SASA)

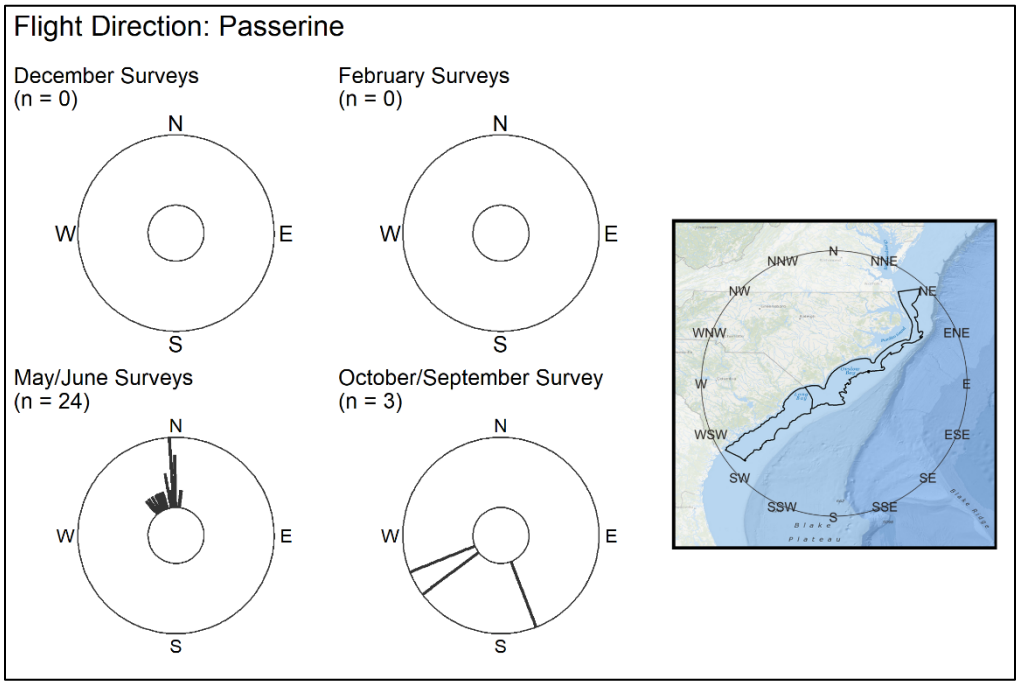


Figure C–277. Direction of travel for passerines observed during each survey in the South Atlantic Survey Area (SASA

C.6 Avian Flight Activity in the February 2018 through February 2020 Surveys

Table C–33. Avian flight activity in the February 2018 through February 2020 surveys for each species in all areas combined by survey

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Black Scoter	24	0.0103	26.97	—	—	—	1	0.0004	1.12	64	0.0274	71.91	89	0.0381
Long-tailed Duck	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Red-breasted Merganser	—	—	—	1	0.0004	33.33	2	0.0009	66.67	—	—	—	3	0.0013
Duck species unknown	—	—	—	—	—	—	2	0.0009	100.00	—	—	—	2	0.0009
Red-throated Loon	72	0.0308	0.60	14	0.0060	0.12	21	0.0090	0.18	11,871	5.0789	99.11	11,978	5.1247
Common Loon	6	0.0026	0.16	—	—	—	3	0.0013	0.08	3,742	1.6010	99.76	3,751	1.6048
Loon species unknown	1	0.0004	1.03	—	—	—	—	—	—	96	0.0411	98.97	97	0.0415
Horned Grebe	—	—	—	—	—	—	—	—	—	2	0.0009	100.00	2	0.0009
Northern Fulmar	23	0.0098	47.92	9	0.0039	18.75	11	0.0047	22.92	5	0.0021	10.42	48	0.0205
Great Shearwater	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Manx Shearwater	10	0.0043	35.71	—	—	—	—	—	—	18	0.0077	64.29	28	0.0120
Shearwater species unknown-Large	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Storm-petrel species unknown	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Northern Gannet	637	0.2725	9.98	261	0.1117	4.09	500	0.2139	7.84	4,982	2.1315	78.09	6,380	2.7296
Cormorant species unknown	—	—	—	—	—	—	1	0.0004	5.26	18	0.0077	94.74	19	0.0081
Red-necked Phalarope	1	0.0004	9.09	—	—	—	—	—	—	10	0.0043	90.91	11	0.0047
Red Phalarope	1,002	0.4287	9.65	301	0.1288	2.90	677	0.2896	6.52	8,399	3.5934	80.92	10,379	4.4405
Red/Red-necked Phalarope	515	0.2203	17.10	66	0.0282	2.19	68	0.0291	2.26	2,362	1.0106	78.45	3,011	1.2882
Great Skua	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Parasitic Jaeger	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Dovekie	—	—	—	—	—	—	—	—	—	3	0.0013	100.00	3	0.0013
Razorbill	640	0.2738	5.64	19	0.0081	0.17	8	0.0034	0.07	10,680	4.5693	94.12	11,347	4.8547
Murre/Razorbill	—	—	—	—	—	—	—	—	—	84	0.0359	100.00	84	0.0359
Atlantic Puffin	—	—	—	—	—	—	—	—	—	21	0.0090	100.00	21	0.0090

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Auk species unknown	3	0.0013	5.45	—	—	—	—	—	—	52	0.0222	94.55	55	0.0235
Black-legged Kittiwake	5	0.0021	41.67	—	—	—	4	0.0017	33.33	3	0.0013	25.00	12	0.0051
Bonaparte's Gull	3,001	1.2839	23.29	1,223	0.5232	9.49	2,945	1.2600	22.85	5,718	2.4464	44.37	12,887	5.5136
Little Gull	2	0.0009	100.00	—	—	—	—	—	—	—	—	—	2	0.0009
Laughing Gull	1	0.0004	2.86	—	—	—	—	—	—	34	0.0145	97.14	35	0.0150
Ring-billed Gull	2	0.0009	18.18	—	—	—	6	0.0026	54.55	3	0.0013	27.27	11	0.0047
Herring Gull	38	0.0163	7.80	18	0.0077	3.70	74	0.0317	15.20	357	0.1527	73.31	487	0.2084
Lesser Black-backed Gull	2	0.0009	10.53	—	—	—	—	—	—	17	0.0073	89.47	19	0.0081
Glaucous Gull	—	—	—	—	—	—	—	—	—	2	0.0009	100.00	2	0.0009
Great Black-backed Gull	5	0.0021	6.94	2	0.0009	2.78	5	0.0021	6.94	60	0.0257	83.33	72	0.0308
Gull species unknown - Large	—	—	—	—	—	—	—	—	—	10	0.0043	100.00	10	0.0043
Gull species unknown - Small	40	0.0171	31.01	5	0.0021	3.88	6	0.0026	4.65	78	0.0334	60.47	129	0.0552
Gull species unknown	1	0.0004	25.00	—	—	—	—	—	—	3	0.0013	75.00	4	0.0017
Forster's Tern	392	0.1677	67.35	71	0.0304	12.20	93	0.0398	15.98	26	0.0111	4.47	582	0.2490
Season Total	**6,424**	**2.7484**	**10.43**	**1,990**	**0.8514**	**3.23**	**4,429**	**1.8949**	**7.19**	**48,723**	**20.8456**	**79.14**	**61,566**	**26.3403**
2020 February														
Greater Scaup	13	0.0056	54.17	3	0.0013	12.50	8	0.0034	33.33	—	—	—	24	0.0103
Surf Scoter	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Black Scoter	5	0.0021	62.50	—	—	—	—	—	—	3	0.0013	37.50	8	0.0034
Scoter unid.	—	—	—	—	—	—	—	—	—	4	0.0017	100.00	4	0.0017
Duck species unknown	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Red-throated Loon	17	0.0073	1.87	1	0.0004	0.11	4	0.0017	0.44	888	0.3817	97.58	910	0.3912
Common Loon	5	0.0021	0.16	1	0.0004	0.03	—	—	—	3,208	1.3790	99.81	3,214	1.3816
Loon species unknown	2	0.0009	1.36	—	—	—	—	—	—	145	0.0623	98.64	147	0.0632
Northern Fulmar	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Black-capped Petrel	1	0.0004	50.00	—	—	—	—	—	—	1	0.0004	50.00	2	0.0009
Petrel species unknown	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Manx Shearwater	51	0.0219	67.11	3	0.0013	3.95	2	0.0009	2.63	20	0.0086	26.32	76	0.0327
Shearwater species unknown-Small	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Northern Gannet	501	0.2154	9.47	239	0.1027	4.52	311	0.1337	5.88	4,242	1.8235	80.14	5,293	2.2753
Double-crested Cormorant	—	—	—	—	—	—	—	—	—	1,143	0.4913	100.00	1,143	0.4913
Cormorant species unknown	2	0.0009	13.33	2	0.0009	13.33	1	0.0004	6.67	10	0.0043	66.67	15	0.0064
Brown Pelican	11	0.0047	22.45	—	—	—	—	—	—	38	0.0163	77.55	49	0.0211
Red Phalarope	2,257	0.9702	13.97	811	0.3486	5.02	1,320	0.5674	8.17	11,772	5.0604	72.85	16,160	6.9466
Parasitic Jaeger	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Common/Thick-billed Murre	—	—	—	—	—	—	—	—	—	4	0.0017	100.00	4	0.0017
Razorbill	663	0.2850	8.65	37	0.0159	0.48	23	0.0099	0.30	6,943	2.9846	90.57	7,666	3.2953
Murre/Razorbill	4	0.0017	1.52	—	—	—	1	0.0004	0.38	258	0.1109	98.10	263	0.1131
Atlantic Puffin	—	—	—	—	—	—	—	—	—	23	0.0099	100.00	23	0.0099
Auk species unknown	3	0.0013	14.29	—	—	—	—	—	—	18	0.0077	85.71	21	0.0090
Black-legged Kittiwake	12	0.0052	22.64	8	0.0034	15.09	18	0.0077	33.96	15	0.0064	28.30	53	0.0228
Bonaparte's Gull	2,591	1.1138	23.35	1,272	0.5468	11.46	2,578	1.1082	23.23	4,655	2.0010	41.95	11,096	4.7698
Little Gull	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Laughing Gull	2	0.0009	50.00	—	—	—	2	0.0009	50.00	—	—	—	4	0.0017
Ring-billed Gull	1	0.0004	25.00	1	0.0004	25.00	1	0.0004	25.00	1	0.0004	25.00	4	0.0017
Herring Gull	167	0.0718	12.49	64	0.0275	4.79	127	0.0546	9.50	979	0.4208	73.22	1,337	0.5747
Lesser Black-backed Gull	9	0.0039	13.64	1	0.0004	1.52	2	0.0009	3.03	54	0.0232	81.82	66	0.0284
Great Black-backed Gull	21	0.0090	23.08	2	0.0009	2.20	5	0.0021	5.49	63	0.0271	69.23	91	0.0391
Gull species unknown - Large	8	0.0034	20.00	—	—	—	—	—	—	32	0.0138	80.00	40	0.0172
Gull species unknown - Small	27	0.0116	4.46	2	0.0009	0.33	1	0.0004	0.17	576	0.2476	95.05	606	0.2605
Gull species unknown	3	0.0013	30.00	—	—	—	—	—	—	7	0.0030	70.00	10	0.0043
Tern species unknown	6	0.0026	100.00	—	—	—	—	—	—	—	—	—	6	0.0026
Forster's Tern	329	0.1414	69.85	50	0.0215	10.62	79	0.0340	16.77	13	0.0056	2.76	471	0.2025
Commic/Forster's Tern	116	0.0499	61.05	18	0.0077	9.47	42	0.0181	22.11	14	0.0060	7.37	190	0.0817

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Sterna Tern species unknown	—	—	—	—	—	—	2	0.0009	100.00	—	—	—	2	0.0009
Season Total	**6,830**	**2.9360**	**13.94**	**2,515**	**1.0811**	**5.13**	**4,529**	**1.9469**	**9.24**	**35,131**	**15.1016**	**71.69**	**49,005**	**21.0655**
2018 May/June														
Common Loon	—	—	—	—	—	—	—	—	—	10	0.0046	100.00	10	0.0046
Black-capped Petrel	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Petrel species unknown	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Cory's Shearwater	2	0.0009	33.33	2	0.0009	33.33	1	0.0005	16.67	1	0.0005	16.67	6	0.0028
Great Shearwater	2	0.0009	66.67	1	0.0005	33.33	—	—	—	—	—	—	3	0.0014
Shearwater species unknown-Large	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Shearwater species unknown-Small	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Northern Gannet	1	0.0005	33.33	—	—	—	—	—	—	2	0.0009	66.67	3	0.0014
Snowy Egret	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Red/Red-necked Phalarope	1	0.0005	50.00	—	—	—	—	—	—	1	0.0005	50.00	2	0.0009
Laughing Gull	16	0.0074	42.11	7	0.0032	18.42	10	0.0046	26.32	5	0.0023	13.16	38	0.0176
Caspian Tern	8	0.0037	61.54	—	—	—	5	0.0023	38.46	—	—	—	13	0.0060
Black Tern	22	0.0102	75.86	4	0.0019	13.79	3	0.0014	10.34	—	—	—	29	0.0134
Royal Tern	37	0.0171	50.68	4	0.0019	5.48	32	0.0148	43.84	—	—	—	73	0.0338
Sandwich Tern	22	0.0102	70.97	4	0.0019	12.90	5	0.0023	16.13	—	—	—	31	0.0144
Tern species unknown	3	0.0014	100.00	—	—	—	—	—	—	—	—	—	3	0.0014
Sterna Tern species unknown	35	0.0162	85.37	2	0.0009	4.88	4	0.0019	9.76	—	—	—	41	0.0190
Season Total	**153**	**0.0709**	**59.53**	**24**	**0.0111**	**9.34**	**60**	**0.0278**	**23.35**	**20**	**0.0093**	**7.78**	**257**	**0.1190**
2019 May														
Red-throated Loon	—	—	—	—	—	—	—	—	—	2	0.0009	100.00	2	0.0009
Common Loon	1	0.0004	1.96	—	—	—	—	—	—	50	0.0213	98.04	51	0.0217
Loon species unknown	—	—	—	—	—	—	—	—	—	3	0.0013	100.00	3	0.0013
Trindade Petrel	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Cory's Shearwater	1	0.0004	50.00	1	0.0004	50.00	—	—	—	—	—	—	2	0.0009
Great Shearwater	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Storm-petrel species unknown	5	0.0021	100.00	—	—	—	—	—	—	—	—	—	5	0.0021
Northern Gannet	—	—	—	—	—	—	—	—	—	6	0.0026	100.00	6	0.0026
Cormorant species unknown	2	0.0009	100.00	—	—	—	—	—	—	—	—	—	2	0.0009
Brown Pelican	3	0.0013	27.27	—	—	—	—	—	—	8	0.0034	72.73	11	0.0047
Snowy Egret	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Black-bellied Plover	12	0.0051	70.59	—	—	—	5	0.0021	29.41	—	—	—	17	0.0072
Ruddy Turnstone	—	—	—	—	—	—	2	0.0009	100.00	—	—	—	2	0.0009
Shorebird species unknown	285	0.1213	93.44	9	0.0038	2.95	11	0.0047	3.61	—	—	—	305	0.1298
Red/Red-necked Phalarope	31	0.0132	96.88	1	0.0004	3.13	—	—	—	—	—	—	32	0.0136
Long-tailed Jaeger	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Dovekie	—	—	—	—	—	—	—	—	—	8	0.0034	100.00	8	0.0034
Auk species unknown	—	—	—	—	—	—	—	—	—	2	0.0009	100.00	2	0.0009
Laughing Gull	20	0.0085	37.74	1	0.0004	1.89	7	0.0030	13.21	25	0.0106	47.17	53	0.0226
Herring Gull	1	0.0004	33.33	—	—	—	2	0.0009	66.67	—	—	—	3	0.0013
Great Black-backed Gull	—	—	—	—	—	—	—	—	—	2	0.0009	100.00	2	0.0009
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	3	0.0013	100.00	3	0.0013
Gull species unknown	1	0.0004	50.00	—	—	—	—	—	—	1	0.0004	50.00	2	0.0009
Gull-billed Tern	3	0.0013	75.00	—	—	—	1	0.0004	25.00	—	—	—	4	0.0017
Caspian Tern	—	—	—	—	—	—	4	0.0017	100.00	—	—	—	4	0.0017
Black Tern	1	0.0004	50.00	—	—	—	1	0.0004	50.00	—	—	—	2	0.0009
Royal Tern	25	0.0106	27.47	12	0.0051	13.19	51	0.0217	56.04	3	0.0013	3.30	91	0.0387
Royal/Caspian Tern	4	0.0017	36.36	2	0.0009	18.18	5	0.0021	45.45	—	—	—	11	0.0047
Sandwich Tern	2	0.0009	50.00	1	0.0004	25.00	1	0.0004	25.00	—	—	—	4	0.0017
Tern species unknown	4	0.0017	57.14	—	—	—	3	0.0013	42.86	—	—	—	7	0.0030
Common Tern	26	0.0111	63.41	6	0.0026	14.63	9	0.0038	21.95	—	—	—	41	0.0175
Forster's Tern	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Commic/Forster's Tern	32	0.0136	62.75	6	0.0026	11.76	11	0.0047	21.57	2	0.0009	3.92	51	0.0217
Passerine species unknown	24	0.0102	100.00	—	—	—	—	—	—	—	—	—	24	0.0102
Season Total	**487**	**0.2073**	**64.50**	**39**	**0.0166**	**5.17**	**113**	**0.0481**	**14.97**	**116**	**0.0494**	**15.36**	**755**	**0.3214**
2018 October														
Red-throated Loon	—	—	—	—	—	—	—	—	—	3	0.0013	100.00	3	0.0013
Common Loon	13	0.0057	12.04	1	0.0004	0.93	1	0.0004	0.93	93	0.0411	86.11	108	0.0477
Northern Fulmar	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Black-capped Petrel	—	—	—	—	—	—	1	0.0004	50.00	1	0.0004	50.00	2	0.0009
Petrel species unknown	1	0.0004	33.33	—	—	—	—	—	—	2	0.0009	66.67	3	0.0013
Cory's Shearwater	32	0.0141	82.05	6	0.0027	15.38	1	0.0004	2.56	—	—	—	39	0.0172
Great Shearwater	3	0.0013	75.00	—	—	—	—	—	—	1	0.0004	25.00	4	0.0018
Shearwater species unknown-Large	3	0.0013	23.08	—	—	—	—	—	—	10	0.0044	76.92	13	0.0057
Shearwater species unknown-Small	—	—	—	—	—	—	—	—	—	2	0.0009	100.00	2	0.0009
Storm-petrel species unknown	2	0.0009	100.00	—	—	—	—	—	—	—	—	—	2	0.0009
Northern Gannet	17	0.0075	26.15	2	0.0009	3.08	13	0.0057	20.00	33	0.0146	50.77	65	0.0287
Double-crested Cormorant	2	0.0009	25.00	1	0.0004	12.50	5	0.0022	62.50	—	—	—	8	0.0035
Brown Pelican	11	0.0049	57.89	—	—	—	1	0.0004	5.26	7	0.0031	36.84	19	0.0084
American White Pelican	2	0.0009	100.00	—	—	—	—	—	—	—	—	—	2	0.0009
Great Blue Heron	—	—	—	—	—	—	13	0.0057	100.00	—	—	—	13	0.0057
Great Egret	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Green Heron	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Peregrine Falcon	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Dunlin	1	0.0004	25.00	—	—	—	3	0.0013	75.00	—	—	—	4	0.0018
Shorebird species unknown	5	0.0022	41.67	1	0.0004	8.33	6	0.0027	50.00	—	—	—	12	0.0053
Red Phalarope	3	0.0013	10.71	2	0.0009	7.14	5	0.0022	17.86	18	0.0080	64.29	28	0.0124
Red/Red-necked Phalarope	—	—	—	—	—	—	—	—	—	6	0.0027	100.00	6	0.0027

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Pomarine Jaeger	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Parasitic Jaeger	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Auk species unknown	—	—	—	—	—	—	—	—	—	2	0.0009	100.00	2	0.0009
Black-legged Kittiwake	2	0.0009	100.00	—	—	—	—	—	—	—	—	—	2	0.0009
Bonaparte's Gull	2	0.0009	33.33	—	—	—	4	0.0018	66.67	—	—	—	6	0.0027
Laughing Gull	68	0.0301	32.23	23	0.0102	10.90	56	0.0248	26.54	64	0.0283	30.33	211	0.0933
Ring-billed Gull	1	0.0004	33.33	—	—	—	2	0.0009	66.67	—	—	—	3	0.0013
Herring Gull	12	0.0053	7.27	7	0.0031	4.24	12	0.0053	7.27	134	0.0592	81.21	165	0.0729
Lesser Black-backed Gull	3	0.0013	8.57	1	0.0004	2.86	—	—	—	31	0.0137	88.57	35	0.0155
Great Black-backed Gull	5	0.0022	18.52	3	0.0013	11.11	2	0.0009	7.41	17	0.0075	62.96	27	0.0119
Gull species unknown - Large	1	0.0004	33.33	—	—	—	—	—	—	2	0.0009	66.67	3	0.0013
Gull species unknown - Small	3	0.0013	13.04	1	0.0004	4.35	2	0.0009	8.70	17	0.0075	73.91	23	0.0102
Gull species unknown	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Bridled Tern	2	0.0009	66.67	1	0.0004	33.33	—	—	—	—	—	—	3	0.0013
Gull-billed Tern	8	0.0035	57.14	2	0.0009	14.29	4	0.0018	28.57	—	—	—	14	0.0062
Caspian Tern	4	0.0018	50.00	1	0.0004	12.50	3	0.0013	37.50	—	—	—	8	0.0035
Royal Tern	87	0.0385	71.31	14	0.0062	11.48	17	0.0075	13.93	4	0.0018	3.28	122	0.0539
Royal/Caspian Tern	56	0.0248	64.37	10	0.0044	11.49	21	0.0093	24.14	—	—	—	87	0.0385
Sandwich Tern	53	0.0234	80.30	9	0.0040	13.64	4	0.0018	6.06	—	—	—	66	0.0292
Tern species unknown	206	0.0911	73.84	12	0.0053	4.30	16	0.0071	5.73	45	0.0199	16.13	279	0.1233
Common Tern	97	0.0429	82.20	15	0.0066	12.71	6	0.0027	5.08	—	—	—	118	0.0522
Commic Tern	—	—	—	1	0.0004	100.00	—	—	—	—	—	—	1	0.0004
Forster's Tern	72	0.0318	78.26	12	0.0053	13.04	8	0.0035	8.70	—	—	—	92	0.0407
Commic/Forster's Tern	379	0.1676	71.11	46	0.0203	8.63	58	0.0256	10.88	50	0.0221	9.38	533	0.2356
Sterna Tern species unknown	16	0.0071	40.00	2	0.0009	5.00	2	0.0009	5.00	20	0.0088	50.00	40	0.0177
Passerine species unknown	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Season Total	**1,174**	**0.5190**	**53.83**	**173**	**0.0765**	**7.93**	**270**	**0.1194**	**12.38**	**564**	**0.2493**	**25.86**	**2,181**	**0.9642**

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2019 September														
Redhead	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Duck species unknown	1	0.0004	14.29	—	—	—	—	—	—	6	0.0026	85.71	7	0.0030
Black-capped Petrel	1	0.0004	33.33	—	—	—	1	0.0004	33.33	1	0.0004	33.33	3	0.0013
Cory's Shearwater	77	0.0330	67.54	7	0.0030	6.14	4	0.0017	3.51	26	0.0111	22.81	114	0.0488
Great Shearwater	8	0.0034	50.00	—	—	—	—	—	—	8	0.0034	50.00	16	0.0068
Sooty Shearwater	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Audubon's Shearwater	30	0.0128	69.77	2	0.0009	4.65	2	0.0009	4.65	9	0.0039	20.93	43	0.0184
Shearwater species unknown-Large	5	0.0021	45.45	—	—	—	—	—	—	6	0.0026	54.55	11	0.0047
Shearwater species unknown-Small	15	0.0064	31.25	—	—	—	—	—	—	33	0.0141	68.75	48	0.0205
Shearwater species unknown	7	0.0030	87.50	—	—	—	1	0.0004	12.50	—	—	—	8	0.0034
Brown Pelican	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Great Blue Heron	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Shorebird species unknown	2	0.0009	100.00	—	—	—	—	—	—	—	—	—	2	0.0009
Red-necked Phalarope	3	0.0013	60.00	—	—	—	—	—	—	2	0.0009	40.00	5	0.0021
Red Phalarope	5	0.0021	50.00	2	0.0009	20.00	3	0.0013	30.00	—	—	—	10	0.0043
Red/Red-necked Phalarope	—	—	—	—	—	—	—	—	—	16	0.0068	100.00	16	0.0068
Skua species unknown	1	0.0004	50.00	1	0.0004	50.00	—	—	—	—	—	—	2	0.0009
Black-legged Kittiwake	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Little Gull	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Laughing Gull	12	0.0051	30.77	1	0.0004	2.56	7	0.0030	17.95	19	0.0081	48.72	39	0.0167
Herring Gull	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Great Black-backed Gull	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Gull species unknown - Large	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	3	0.0013	100.00	3	0.0013
Sooty Tern	7	0.0030	100.00	—	—	—	—	—	—	—	—	—	7	0.0030

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Bridled Tern	24	0.0103	100.00	—	—	—	—	—	—	—	—	—	24	0.0103
Sooty/Bridled Tern	7	0.0030	87.50	—	—	—	—	—	—	1	0.0004	12.50	8	0.0034
Least Tern	11	0.0047	78.57	2	0.0009	14.29	1	0.0004	7.14	—	—	—	14	0.0060
Gull-billed Tern	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Caspian Tern	—	—	—	1	0.0004	100.00	—	—	—	—	—	—	1	0.0004
Black Tern	268	0.1147	67.68	34	0.0146	8.59	84	0.0359	21.21	10	0.0043	2.53	396	0.1695
Royal Tern	121	0.0518	48.79	46	0.0197	18.55	77	0.0330	31.05	4	0.0017	1.61	248	0.1061
Royal/Caspian Tern	6	0.0026	66.67	2	0.0009	22.22	—	—	—	1	0.0004	11.11	9	0.0039
Sandwich Tern	45	0.0193	54.88	9	0.0039	10.98	27	0.0116	32.93	1	0.0004	1.22	82	0.0351
Thalasseus Tern unid.	5	0.0021	21.74	—	—	—	—	—	—	18	0.0077	78.26	23	0.0098
Tern species unknown	25	0.0107	78.13	1	0.0004	3.13	3	0.0013	9.38	3	0.0013	9.38	32	0.0137
Common Tern	459	0.1964	69.55	67	0.0287	10.15	134	0.0573	20.30	—	—	—	660	0.2825
Forster's Tern	7	0.0030	63.64	2	0.0009	18.18	2	0.0009	18.18	—	—	—	11	0.0047
Commic/Forster's Tern	346	0.1481	70.47	40	0.0171	8.15	88	0.0377	17.92	17	0.0073	3.46	491	0.2101
Sterna Tern species unknown	5	0.0021	71.43	1	0.0004	14.29	1	0.0004	14.29	—	—	—	7	0.0030
Passerine species unknown	2	0.0009	100.00	—	—	—	—	—	—	—	—	—	2	0.0009
Season Total	**1,512**	**0.6471**	**64.29**	**218**	**0.0933**	**9.27**	**437**	**0.1870**	**18.58**	**185**	**0.0792**	**7.87**	**2,352**	**1.0066**
2018 December														
American Black Duck	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Greater Scaup	10	0.0043	100.00	—	—	—	—	—	—	—	—	—	10	0.0043
Lesser Scaup	4	0.0017	100.00	—	—	—	—	—	—	—	—	—	4	0.0017
Surf Scoter	3	0.0013	100.00	—	—	—	—	—	—	—	—	—	3	0.0013
White-winged Scoter	—	—	—	—	—	—	—	—	—	8	0.0034	100.00	8	0.0034
Black Scoter	29	0.0124	5.19	4	0.0017	0.72	8	0.0034	1.43	518	0.2206	92.67	559	0.2381
Scoter unid.	—	—	—	—	—	—	—	—	—	2	0.0009	100.00	2	0.0009
Red-breasted Merganser	5	0.0021	45.45	—	—	—	4	0.0017	36.36	2	0.0009	18.18	11	0.0047
Duck species unknown	10	0.0043	76.92	—	—	—	—	—	—	3	0.0013	23.08	13	0.0055
Red-throated Loon	36	0.0153	7.36	2	0.0009	0.41	4	0.0017	0.82	447	0.1904	91.41	489	0.2083

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Common Loon	26	0.0111	1.36	1	0.0004	0.05	3	0.0013	0.16	1,880	0.8007	98.43	1,910	0.8135
Loon species unknown	1	0.0004	3.70	—	—	—	—	—	—	26	0.0111	96.30	27	0.0115
Northern Fulmar	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Cory's Shearwater	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Sooty Shearwater	4	0.0017	100.00	—	—	—	—	—	—	—	—	—	4	0.0017
Manx Shearwater	143	0.0609	49.31	—	—	—	3	0.0013	1.03	144	0.0613	49.66	290	0.1235
Shearwater species unknown-Large	—	—	—	—	—	—	—	—	—	3	0.0013	100.00	3	0.0013
Northern Gannet	1,072	0.4566	19.33	211	0.0899	3.80	242	0.1031	4.36	4,021	1.7127	72.50	5,546	2.3622
Double-crested Cormorant	—	—	—	—	—	—	2	0.0009	100.00	—	—	—	2	0.0009
Cormorant species unknown	1	0.0004	50.00	1	0.0004	50.00	—	—	—	—	—	—	2	0.0009
Brown Pelican	2	0.0009	4.55	—	—	—	—	—	—	42	0.0179	95.45	44	0.0187
Red-necked Phalarope	—	—	—	—	—	—	—	—	—	10	0.0043	100.00	10	0.0043
Red Phalarope	52	0.0221	7.00	6	0.0026	0.81	2	0.0009	0.27	683	0.2909	91.92	743	0.3165
Red/Red-necked Phalarope	2	0.0009	2.47	—	—	—	—	—	—	79	0.0336	97.53	81	0.0345
Pomarine Jaeger	1	0.0004	100.00	—	—	—	—	—	—	—	—	—	1	0.0004
Parasitic Jaeger	1	0.0004	50.00	—	—	—	—	—	—	1	0.0004	50.00	2	0.0009
Skua species unknown	1	0.0004	33.33	—	—	—	—	—	—	2	0.0009	66.67	3	0.0013
Common/Thick-billed Murre	—	—	—	—	—	—	—	—	—	4	0.0017	100.00	4	0.0017
Razorbill	37	0.0158	9.49	7	0.0030	1.79	3	0.0013	0.77	343	0.1461	87.95	390	0.1661
Murre/Razorbill	1	0.0004	1.16	—	—	—	—	—	—	85	0.0362	98.84	86	0.0366
Atlantic Puffin	1	0.0004	20.00	—	—	—	1	0.0004	20.00	3	0.0013	60.00	5	0.0021
Black-legged Kittiwake	314	0.1337	55.77	88	0.0375	15.63	80	0.0341	14.21	81	0.0345	14.39	563	0.2398
Bonaparte's Gull	761	0.3241	48.32	250	0.1065	15.87	199	0.0848	12.63	365	0.1555	23.17	1,575	0.6708
Little Gull	—	—	—	—	—	—	—	—	—	1	0.0004	100.00	1	0.0004
Laughing Gull	176	0.0750	52.23	39	0.0166	11.57	55	0.0234	16.32	67	0.0285	19.88	337	0.1435
Ring-billed Gull	29	0.0124	30.53	8	0.0034	8.42	17	0.0072	17.89	41	0.0175	43.16	95	0.0405
Herring Gull	247	0.1052	10.70	59	0.0251	2.56	154	0.0656	6.67	1,849	0.7875	80.08	2,309	0.9835

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Iceland Gull	—	—	—	—	—	—	—	—	—	3	0.0013	100.00	3	0.0013
Lesser Black-backed Gull	9	0.0038	17.65	5	0.0021	9.80	1	0.0004	1.96	36	0.0153	70.59	51	0.0217
Great Black-backed Gull	22	0.0094	7.46	14	0.0060	4.75	27	0.0115	9.15	232	0.0988	78.64	295	0.1256
Gull species unknown - Large	10	0.0043	7.04	—	—	—	—	—	—	132	0.0562	92.96	142	0.0605
Gull species unknown - Small	30	0.0128	2.17	1	0.0004	0.07	3	0.0013	0.22	1,347	0.5737	97.54	1,381	0.5882
Gull species unknown	1	0.0004	20.00	—	—	—	—	—	—	4	0.0017	80.00	5	0.0021
Royal Tern	—	—	—	—	—	—	1	0.0004	100.00	—	—	—	1	0.0004
Tern species unknown	26	0.0111	78.79	1	0.0004	3.03	—	—	—	6	0.0026	18.18	33	0.0141
Common Tern	—	—	—	1	0.0004	100.00	—	—	—	—	—	—	1	0.0004
Forster's Tern	364	0.1550	75.99	54	0.0230	11.27	52	0.0221	10.86	9	0.0038	1.88	479	0.2040
Commic/Forster's Tern	76	0.0324	67.26	9	0.0038	7.96	7	0.0030	6.19	21	0.0089	18.58	113	0.0481
Season Total	**3,509**	**1.4946**	**19.89**	**761**	**0.3241**	**4.31**	**868**	**0.3697**	**4.92**	**12,501**	**5.3245**	**70.87**	**17,639**	**7.5129**
2019 December														
Gadwall	5	0.0023	100.00	—	—	—	—	—	—	—	—	—	5	0.0023
Greater Scaup	—	—	—	—	—	—	3	0.0014	100.00	—	—	—	3	0.0014
White-winged Scoter	—	—	—	1	0.0005	100.00	—	—	—	—	—	—	1	0.0005
Black Scoter	9	0.0041	3.98	4	0.0018	1.77	5	0.0023	2.21	208	0.0939	92.04	226	0.1021
Red-breasted Merganser	3	0.0014	60.00	—	—	—	2	0.0009	40.00	—	—	—	5	0.0023
Duck species unknown	—	—	—	—	—	—	—	—	—	3	0.0014	100.00	3	0.0014
Red-throated Loon	20	0.0090	5.00	4	0.0018	1.00	4	0.0018	1.00	372	0.1680	93.00	400	0.1806
Common Loon	36	0.0163	1.89	2	0.0009	0.10	5	0.0023	0.26	1,866	0.8426	97.75	1,909	0.8620
Loon species unknown	3	0.0014	4.62	1	0.0005	1.54	—	—	—	61	0.0275	93.85	65	0.0294
Manx Shearwater	13	0.0059	14.29	1	0.0005	1.10	—	—	—	77	0.0348	84.62	91	0.0411
Northern Gannet	763	0.3445	22.01	288	0.1300	8.31	300	0.1355	8.65	2,116	0.9555	61.03	3,467	1.5655
Cormorant species unknown	3	0.0014	75.00	—	—	—	1	0.0005	25.00	—	—	—	4	0.0018
Shorebird species unknown	4	0.0018	100.00	—	—	—	—	—	—	—	—	—	4	0.0018
Red-necked Phalarope	—	—	—	—	—	—	—	—	—	6	0.0027	100.00	6	0.0027
Red Phalarope	1,351	0.6100	28.05	138	0.0623	2.87	103	0.0465	2.14	3,224	1.4558	66.94	4,816	2.1747

(continued)

Table C–33. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Red/Red-necked Phalarope	178	0.0804	16.27	26	0.0117	2.38	49	0.0221	4.48	841	0.3798	76.87	1,094	0.4940
Great Skua	—	—	—	1	0.0005	100.00	—	—	—	—	—	—	1	0.0005
Pomarine Jaeger	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Skua species unknown	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Common/Thick-billed Murre	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Razorbill	—	—	—	—	—	—	—	—	—	3	0.0014	100.00	3	0.0014
Murre/Razorbill	1	0.0005	5.26	—	—	—	—	—	—	18	0.0081	94.74	19	0.0086
Atlantic Puffin	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Auk species unknown	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Black-legged Kittiwake	1	0.0005	33.33	—	—	—	2	0.0009	66.67	—	—	—	3	0.0014
Bonaparte's Gull	49	0.0221	28.99	18	0.0081	10.65	15	0.0068	8.88	87	0.0393	51.48	169	0.0763
Laughing Gull	175	0.0790	42.79	66	0.0298	16.14	108	0.0488	26.41	60	0.0271	14.67	409	0.1847
Ring-billed Gull	4	0.0018	57.14	2	0.0009	28.57	1	0.0005	14.29	—	—	—	7	0.0032
Herring Gull	108	0.0488	26.15	41	0.0185	9.93	66	0.0298	15.98	198	0.0894	47.94	413	0.1865
Lesser Black-backed Gull	—	—	—	—	—	—	1	0.0005	50.00	1	0.0005	50.00	2	0.0009
Great Black-backed Gull	19	0.0086	28.36	6	0.0027	8.96	13	0.0059	19.40	29	0.0131	43.28	67	0.0303
Gull species unknown - Large	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Gull species unknown - Small	2	0.0009	1.72	—	—	—	—	—	—	114	0.0515	98.28	116	0.0524
Gull species unknown	1	0.0005	10.00	—	—	—	—	—	—	9	0.0041	90.00	10	0.0045
Tern species unknown	9	0.0041	90.00	—	—	—	1	0.0005	10.00	—	—	—	10	0.0045
Forster's Tern	570	0.2574	66.90	111	0.0501	13.03	121	0.0546	14.20	50	0.0226	5.87	852	0.3847
Commic/Forster's Tern	50	0.0226	42.74	8	0.0036	6.84	15	0.0068	12.82	44	0.0199	37.61	117	0.0528
Sterna Tern species unknown	7	0.0032	43.75	1	0.0005	6.25	—	—	—	8	0.0036	50.00	16	0.0072
Season Total	**3,385**	**1.5285**	**23.64**	**719**	**0.3247**	**5.02**	**815**	**0.3680**	**5.69**	**9,400**	**4.2446**	**65.65**	**14,319**	**6.4658**

Table C–34. Avian flight activity in the February 2018 through February 2020 surveys for each species in the South Atlantic Survey Area (SASA; counts include all of A51, part of A53, and part of CCA)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Black Scoter	22	0.0115	25.88	—	—	—	1	0.0005	1.18	62	0.0324	72.94	85	0.0444
Red-breasted Merganser	—	—	—	1	0.0005	33.33	2	0.0010	66.67	—	—	—	3	0.0016
Duck species unknown	—	—	—	—	—	—	2	0.0010	100.00	—	—	—	2	0.0010
Red-throated Loon	72	0.0376	0.60	14	0.0073	0.12	21	0.0110	0.18	11,846	6.1824	99.10	11,953	6.2383
Common Loon	6	0.0031	0.19	—	—	—	3	0.0016	0.09	3,221	1.6810	99.72	3,230	1.6857
Loon species unknown	1	0.0005	1.09	—	—	—	—	—	—	91	0.0475	98.91	92	0.0480
Horned Grebe	—	—	—	—	—	—	—	—	—	2	0.0010	100.00	2	0.0010
Northern Fulmar	23	0.0120	51.11	8	0.0042	17.78	10	0.0052	22.22	4	0.0021	8.89	45	0.0235
Great Shearwater	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Manx Shearwater	10	0.0052	50.00	—	—	—	—	—	—	10	0.0052	50.00	20	0.0104
Shearwater species unknown-Large	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Storm-petrel species unknown	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Northern Gannet	594	0.3100	10.10	243	0.1268	4.13	454	0.2369	7.72	4,590	2.3955	78.05	5,881	3.0693
Cormorant species unknown	—	—	—	—	—	—	1	0.0005	5.26	18	0.0094	94.74	19	0.0099
Red-necked Phalarope	1	0.0005	9.09	—	—	—	—	—	—	10	0.0052	90.91	11	0.0057
Red Phalarope	865	0.4514	10.63	265	0.1383	3.26	638	0.3330	7.84	6,372	3.3256	78.28	8,140	4.2483
Red/Red-necked Phalarope	513	0.2677	17.09	66	0.0344	2.20	68	0.0355	2.27	2,354	1.2286	78.44	3,001	1.5662
Parasitic Jaeger	—	—	—	—	—	—	1	0.0005	100.00	—	—	—	1	0.0005
Dovekie	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016
Razorbill	623	0.3251	5.72	19	0.0099	0.17	8	0.0042	0.07	10,238	5.3432	94.03	10,888	5.6825
Murre/Razorbill	—	—	—	—	—	—	—	—	—	75	0.0391	100.00	75	0.0391
Atlantic Puffin	—	—	—	—	—	—	—	—	—	16	0.0084	100.00	16	0.0084
Auk species unknown	3	0.0016	5.45	—	—	—	—	—	—	52	0.0271	94.55	55	0.0287
Black-legged Kittiwake	4	0.0021	57.14	—	—	—	2	0.0010	28.57	1	0.0005	14.29	7	0.0037
Bonaparte's Gull	2,646	1.3810	22.51	1,119	0.5840	9.52	2,865	1.4952	24.37	5,126	2.6753	43.60	11,756	6.1355
Little Gull	2	0.0010	100.00	—	—	—	—	—	—	—	—	—	2	0.0010

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Laughing Gull	1	0.0005	2.86	—	—	—	—	—	—	34	0.0177	97.14	35	0.0183
Ring-billed Gull	2	0.0010	20.00	—	—	—	5	0.0026	50.00	3	0.0016	30.00	10	0.0052
Herring Gull	36	0.0188	7.69	17	0.0089	3.63	72	0.0376	15.38	343	0.1790	73.29	468	0.2442
Lesser Black-backed Gull	2	0.0010	11.76	—	—	—	—	—	—	15	0.0078	88.24	17	0.0089
Glaucous Gull	—	—	—	—	—	—	—	—	—	2	0.0010	100.00	2	0.0010
Great Black-backed Gull	5	0.0026	7.58	2	0.0010	3.03	4	0.0021	6.06	55	0.0287	83.33	66	0.0344
Gull species unknown - Large	—	—	—	—	—	—	—	—	—	9	0.0047	100.00	9	0.0047
Gull species unknown - Small	40	0.0209	31.25	5	0.0026	3.91	6	0.0031	4.69	77	0.0402	60.16	128	0.0668
Gull species unknown	1	0.0005	25.00	—	—	—	—	—	—	3	0.0016	75.00	4	0.0021
Forster's Tern	343	0.1790	67.39	62	0.0324	12.18	92	0.0480	18.07	12	0.0063	2.36	509	0.2656
Season Total	**5,816**	**3.0354**	**10.29**	**1,821**	**0.9504**	**3.22**	**4,255**	**2.2207**	**7.53**	**44,646**	**23.3008**	**78.97**	**56,538**	**29.5073**
2020 February														
Greater Scaup	13	0.0068	54.17	3	0.0016	12.50	8	0.0042	33.33	—	—	—	24	0.0126
Surf Scoter	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Black Scoter	3	0.0016	100.00	—	—	—	—	—	—	—	—	—	3	0.0016
Red-throated Loon	17	0.0089	1.93	1	0.0005	0.11	4	0.0021	0.45	860	0.4513	97.51	882	0.4628
Common Loon	4	0.0021	0.15	—	—	—	—	—	—	2,639	1.3847	99.85	2,643	1.3868
Loon species unknown	1	0.0005	0.68	—	—	—	—	—	—	145	0.0761	99.32	146	0.0766
Black-capped Petrel	1	0.0005	50.00	—	—	—	—	—	—	1	0.0005	50.00	2	0.0010
Manx Shearwater	49	0.0257	69.01	3	0.0016	4.23	2	0.0010	2.82	17	0.0089	23.94	71	0.0373
Shearwater species unknown-Small	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Northern Gannet	446	0.2340	9.60	215	0.1128	4.63	265	0.1390	5.70	3,720	1.9519	80.07	4,646	2.4378
Double-crested Cormorant	—	—	—	—	—	—	—	—	—	1,143	0.5997	100.00	1,143	0.5997
Cormorant species unknown	2	0.0010	15.38	2	0.0010	15.38	1	0.0005	7.69	8	0.0042	61.54	13	0.0068
Brown Pelican	11	0.0058	22.45	—	—	—	—	—	—	38	0.0199	77.55	49	0.0257
Red Phalarope	699	0.3668	8.27	256	0.1343	3.03	705	0.3699	8.34	6,796	3.5659	80.37	8,456	4.4370
Parasitic Jaeger	—	—	—	—	—	—	1	0.0005	100.00	—	—	—	1	0.0005
Common/Thick-billed Murre	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Razorbill	570	0.2991	8.23	34	0.0178	0.49	22	0.0115	0.32	6,299	3.3052	90.96	6,925	3.6336
Murre/Razorbill	4	0.0021	1.54	—	—	—	1	0.0005	0.39	254	0.1333	98.07	259	0.1359
Atlantic Puffin	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Auk species unknown	1	0.0005	5.26	—	—	—	—	—	—	18	0.0094	94.74	19	0.0100
Black-legged Kittiwake	10	0.0052	20.41	7	0.0037	14.29	18	0.0094	36.73	14	0.0073	28.57	49	0.0257
Bonaparte's Gull	1,915	1.0048	22.46	958	0.5027	11.24	2,177	1.1423	25.54	3,475	1.8234	40.76	8,525	4.4732
Laughing Gull	2	0.0010	50.00	—	—	—	2	0.0010	50.00	—	—	—	4	0.0021
Ring-billed Gull	1	0.0005	25.00	1	0.0005	25.00	1	0.0005	25.00	1	0.0005	25.00	4	0.0021
Herring Gull	163	0.0855	12.69	61	0.0320	4.75	110	0.0577	8.57	950	0.4985	73.99	1,284	0.6737
Lesser Black-backed Gull	8	0.0042	12.50	1	0.0005	1.56	2	0.0010	3.13	53	0.0278	82.81	64	0.0336
Great Black-backed Gull	20	0.0105	22.47	2	0.0010	2.25	4	0.0021	4.49	63	0.0331	70.79	89	0.0467
Gull species unknown - Large	8	0.0042	20.00	—	—	—	—	—	—	32	0.0168	80.00	40	0.0210
Gull species unknown - Small	12	0.0063	2.21	2	0.0010	0.37	1	0.0005	0.18	528	0.2770	97.24	543	0.2849
Gull species unknown	1	0.0005	14.29	—	—	—	—	—	—	6	0.0031	85.71	7	0.0037
Tern species unknown	4	0.0021	100.00	—	—	—	—	—	—	—	—	—	4	0.0021
Forster's Tern	301	0.1579	69.35	48	0.0252	11.06	72	0.0378	16.59	13	0.0068	3.00	434	0.2277
Commic/Forster's Tern	116	0.0609	61.05	18	0.0094	9.47	42	0.0220	22.11	14	0.0073	7.37	190	0.0997
Season Total	**4,383**	**2.2998**	**12.00**	**1,612**	**0.8458**	**4.41**	**3,438**	**1.8040**	**9.41**	**27,092**	**14.2155**	**74.17**	**36,525**	**19.1651**
2018 May/June														
Common Loon	—	—	—	—	—	—	—	—	—	10	0.0058	100.00	10	0.0058
Black-capped Petrel	1	0.0006	100.00	—	—	—	—	—	—	—	—	—	1	0.0006
Petrel species unknown	1	0.0006	100.00	—	—	—	—	—	—	—	—	—	1	0.0006
Cory's Shearwater	2	0.0012	40.00	2	0.0012	40.00	—	—	—	1	0.0006	20.00	5	0.0029
Great Shearwater	2	0.0012	66.67	1	0.0006	33.33	—	—	—	—	—	—	3	0.0017
Shearwater species unknown-Small	1	0.0006	100.00	—	—	—	—	—	—	—	—	—	1	0.0006
Northern Gannet	1	0.0006	33.33	—	—	—	—	—	—	2	0.0012	66.67	3	0.0017
Snowy Egret	1	0.0006	100.00	—	—	—	—	—	—	—	—	—	1	0.0006
Red/Red-necked Phalarope	1	0.0006	50.00	—	—	—	—	—	—	1	0.0006	50.00	2	0.0012

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Laughing Gull	16	0.0092	42.11	7	0.0040	18.42	10	0.0058	26.32	5	0.0029	13.16	38	0.0219
Caspian Tern	8	0.0046	61.54	—	—	—	5	0.0029	38.46	—	—	—	13	0.0075
Black Tern	22	0.0127	75.86	4	0.0023	13.79	3	0.0017	10.34	—	—	—	29	0.0167
Royal Tern	37	0.0213	51.39	4	0.0023	5.56	31	0.0179	43.06	—	—	—	72	0.0415
Sandwich Tern	22	0.0127	70.97	4	0.0023	12.90	5	0.0029	16.13	—	—	—	31	0.0179
Tern species unknown	3	0.0017	100.00	—	—	—	—	—	—	—	—	—	3	0.0017
Sterna Tern species unknown	33	0.0190	84.62	2	0.0012	5.13	4	0.0023	10.26	—	—	—	39	0.0225
Season Total	**151**	**0.0871**	**59.92**	**24**	**0.0138**	**9.52**	**58**	**0.0334**	**23.02**	**19**	**0.0110**	**7.54**	**252**	**0.1453**
2019 May														
Red-throated Loon	—	—	—	—	—	—	—	—	—	2	0.0010	100.00	2	0.0010
Common Loon	1	0.0005	2.38	—	—	—	—	—	—	41	0.0215	97.62	42	0.0220
Loon species unknown	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016
Cory's Shearwater	1	0.0005	50.00	1	0.0005	50.00	—	—	—	—	—	—	2	0.0010
Great Shearwater	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Storm-petrel species unknown	5	0.0026	100.00	—	—	—	—	—	—	—	—	—	5	0.0026
Northern Gannet	—	—	—	—	—	—	—	—	—	6	0.0031	100.00	6	0.0031
Cormorant species unknown	2	0.0010	100.00	—	—	—	—	—	—	—	—	—	2	0.0010
Brown Pelican	3	0.0016	27.27	—	—	—	—	—	—	8	0.0042	72.73	11	0.0058
Snowy Egret	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Black-bellied Plover	12	0.0063	70.59	—	—	—	5	0.0026	29.41	—	—	—	17	0.0089
Ruddy Turnstone	—	—	—	—	—	—	2	0.0010	100.00	—	—	—	2	0.0010
Shorebird species unknown	283	0.1485	93.40	9	0.0047	2.97	11	0.0058	3.63	—	—	—	303	0.1590
Red/Red-necked Phalarope	31	0.0163	96.88	1	0.0005	3.13	—	—	—	—	—	—	32	0.0168
Long-tailed Jaeger	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Auk species unknown	—	—	—	—	—	—	—	—	—	2	0.0010	100.00	2	0.0010
Laughing Gull	20	0.0105	37.74	1	0.0005	1.89	7	0.0037	13.21	25	0.0131	47.17	53	0.0278
Herring Gull	1	0.0005	33.33	—	—	—	2	0.0010	66.67	—	—	—	3	0.0016
Great Black-backed Gull	—	—	—	—	—	—	—	—	—	2	0.0010	100.00	2	0.0010

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016
Gull species unknown	1	0.0005	50.00	—	—	—	—	—	—	1	0.0005	50.00	2	0.0010
Gull-billed Tern	3	0.0016	75.00	—	—	—	1	0.0005	25.00	—	—	—	4	0.0021
Caspian Tern	—	—	—	—	—	—	4	0.0021	100.00	—	—	—	4	0.0021
Black Tern	1	0.0005	50.00	—	—	—	1	0.0005	50.00	—	—	—	2	0.0010
Royal Tern	24	0.0126	28.92	10	0.0052	12.05	46	0.0241	55.42	3	0.0016	3.61	83	0.0435
Royal/Caspian Tern	4	0.0021	36.36	2	0.0010	18.18	5	0.0026	45.45	—	—	—	11	0.0058
Sandwich Tern	2	0.0010	50.00	1	0.0005	25.00	1	0.0005	25.00	—	—	—	4	0.0021
Tern species unknown	4	0.0021	57.14	—	—	—	3	0.0016	42.86	—	—	—	7	0.0037
Common Tern	26	0.0136	65.00	6	0.0031	15.00	8	0.0042	20.00	—	—	—	40	0.0210
Forster's Tern	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Commic/Forster's Tern	30	0.0157	69.77	4	0.0021	9.30	9	0.0047	20.93	—	—	—	43	0.0226
Season Total	**457**	**0.2397**	**65.85**	**35**	**0.0184**	**5.04**	**105**	**0.0551**	**15.13**	**97**	**0.0509**	**13.98**	**694**	**0.3641**
2018 October														
Red-throated Loon	—	—	—	—	—	—	—	—	—	3	0.0017	100.00	3	0.0017
Common Loon	13	0.0072	18.06	1	0.0006	1.39	1	0.0006	1.39	57	0.0315	79.17	72	0.0398
Northern Fulmar	—	—	—	—	—	—	—	—	—	1	0.0006	100.00	1	0.0006
Black-capped Petrel	—	—	—	—	—	—	1	0.0006	50.00	1	0.0006	50.00	2	0.0011
Petrel species unknown	1	0.0006	33.33	—	—	—	—	—	—	2	0.0011	66.67	3	0.0017
Cory's Shearwater	29	0.0160	82.86	5	0.0028	14.29	1	0.0006	2.86	—	—	—	35	0.0194
Great Shearwater	2	0.0011	100.00	—	—	—	—	—	—	—	—	—	2	0.0011
Shearwater species unknown-Large	3	0.0017	23.08	—	—	—	—	—	—	10	0.0055	76.92	13	0.0072
Shearwater species unknown-Small	—	—	—	—	—	—	—	—	—	2	0.0011	100.00	2	0.0011
Storm-petrel species unknown	2	0.0011	100.00	—	—	—	—	—	—	—	—	—	2	0.0011
Northern Gannet	16	0.0088	25.81	2	0.0011	3.23	13	0.0072	20.97	31	0.0171	50.00	62	0.0343
Double-crested Cormorant	2	0.0011	25.00	1	0.0006	12.50	5	0.0028	62.50	—	—	—	8	0.0044
Brown Pelican	11	0.0061	57.89	—	—	—	1	0.0006	5.26	7	0.0039	36.84	19	0.0105
American White Pelican	2	0.0011	100.00	—	—	—	—	—	—	—	—	—	2	0.0011

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Great Blue Heron	—	—	—	—	—	—	13	0.0072	100.00	—	—	—	13	0.0072
Great Egret	—	—	—	—	—	—	1	0.0006	100.00	—	—	—	1	0.0006
Green Heron	—	—	—	—	—	—	1	0.0006	100.00	—	—	—	1	0.0006
Peregrine Falcon	—	—	—	—	—	—	1	0.0006	100.00	—	—	—	1	0.0006
Dunlin	1	0.0006	25.00	—	—	—	3	0.0017	75.00	—	—	—	4	0.0022
Shorebird species unknown	5	0.0028	41.67	1	0.0006	8.33	6	0.0033	50.00	—	—	—	12	0.0066
Red Phalarope	3	0.0017	13.04	2	0.0011	8.70	5	0.0028	21.74	13	0.0072	56.52	23	0.0127
Red/Red-necked Phalarope	—	—	—	—	—	—	—	—	—	6	0.0033	100.00	6	0.0033
Pomarine Jaeger	1	0.0006	100.00	—	—	—	—	—	—	—	—	—	1	0.0006
Auk species unknown	—	—	—	—	—	—	—	—	—	2	0.0011	100.00	2	0.0011
Black-legged Kittiwake	1	0.0006	100.00	—	—	—	—	—	—	—	—	—	1	0.0006
Bonaparte's Gull	2	0.0011	33.33	—	—	—	4	0.0022	66.67	—	—	—	6	0.0033
Laughing Gull	68	0.0376	32.23	23	0.0127	10.90	56	0.0310	26.54	64	0.0354	30.33	211	0.1167
Ring-billed Gull	1	0.0006	33.33	—	—	—	2	0.0011	66.67	—	—	—	3	0.0017
Herring Gull	12	0.0066	7.27	7	0.0039	4.24	12	0.0066	7.27	134	0.0741	81.21	165	0.0913
Lesser Black-backed Gull	3	0.0017	8.57	1	0.0006	2.86	—	—	—	31	0.0171	88.57	35	0.0194
Great Black-backed Gull	5	0.0028	18.52	3	0.0017	11.11	2	0.0011	7.41	17	0.0094	62.96	27	0.0149
Gull species unknown - Large	1	0.0006	33.33	—	—	—	—	—	—	2	0.0011	66.67	3	0.0017
Gull species unknown - Small	3	0.0017	16.67	1	0.0006	5.56	2	0.0011	11.11	12	0.0066	66.67	18	0.0100
Gull species unknown	—	—	—	—	—	—	—	—	—	1	0.0006	100.00	1	0.0006
Gull-billed Tern	8	0.0044	57.14	2	0.0011	14.29	4	0.0022	28.57	—	—	—	14	0.0077
Caspian Tern	3	0.0017	42.86	1	0.0006	14.29	3	0.0017	42.86	—	—	—	7	0.0039
Royal Tern	63	0.0348	72.41	12	0.0066	13.79	12	0.0066	13.79	—	—	—	87	0.0481
Royal/Caspian Tern	39	0.0216	60.00	9	0.0050	13.85	17	0.0094	26.15	—	—	—	65	0.0359
Sandwich Tern	50	0.0277	80.65	8	0.0044	12.90	4	0.0022	6.45	—	—	—	62	0.0343
Tern species unknown	185	0.1023	86.85	12	0.0066	5.63	15	0.0083	7.04	1	0.0006	0.47	213	0.1178
Common Tern	48	0.0265	84.21	8	0.0044	14.04	1	0.0006	1.75	—	—	—	57	0.0315
Commic Tern	—	—	—	1	0.0006	100.00	—	—	—	—	—	—	1	0.0006

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Forster's Tern	11	0.0061	73.33	3	0.0017	20.00	1	0.0006	6.67	—	—	—	15	0.0083
Commic/Forster's Tern	171	0.0946	70.08	32	0.0177	13.11	41	0.0227	16.80	—	—	—	244	0.1349
Sterna Tern species unknown	12	0.0066	33.33	2	0.0011	5.56	2	0.0011	5.56	20	0.0111	55.56	36	0.0199
Passerine species unknown	1	0.0006	100.00	—	—	—	—	—	—	—	—	—	1	0.0006
Season Total	**778**	**0.4303**	**49.81**	**137**	**0.0758**	**8.77**	**230**	**0.1272**	**14.72**	**417**	**0.2306**	**26.70**	**1,562**	**0.8639**
2019 September														
Redhead	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Duck species unknown	1	0.0005	14.29	—	—	—	—	—	—	6	0.0031	85.71	7	0.0037
Black-capped Petrel	—	—	—	—	—	—	1	0.0005	100.00	—	—	—	1	0.0005
Cory's Shearwater	39	0.0203	60.00	6	0.0031	9.23	3	0.0016	4.62	17	0.0089	26.15	65	0.0339
Great Shearwater	3	0.0016	100.00	—	—	—	—	—	—	—	—	—	3	0.0016
Sooty Shearwater	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Audubon's Shearwater	13	0.0068	61.90	2	0.0010	9.52	1	0.0005	4.76	5	0.0026	23.81	21	0.0110
Shearwater species unknown-Large	4	0.0021	57.14	—	—	—	—	—	—	3	0.0016	42.86	7	0.0037
Shearwater species unknown-Small	5	0.0026	31.25	—	—	—	—	—	—	11	0.0057	68.75	16	0.0083
Shearwater species unknown	4	0.0021	80.00	—	—	—	1	0.0005	20.00	—	—	—	5	0.0026
Brown Pelican	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Great Blue Heron	—	—	—	—	—	—	1	0.0005	100.00	—	—	—	1	0.0005
Shorebird species unknown	2	0.0010	100.00	—	—	—	—	—	—	—	—	—	2	0.0010
Red-necked Phalarope	3	0.0016	60.00	—	—	—	—	—	—	2	0.0010	40.00	5	0.0026
Red Phalarope	5	0.0026	50.00	2	0.0010	20.00	3	0.0016	30.00	—	—	—	10	0.0052
Red/Red-necked Phalarope	—	—	—	—	—	—	—	—	—	16	0.0083	100.00	16	0.0083
Skua species unknown	1	0.0005	50.00	1	0.0005	50.00	—	—	—	—	—	—	2	0.0010
Black-legged Kittiwake	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Little Gull	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Laughing Gull	12	0.0063	30.77	1	0.0005	2.56	7	0.0037	17.95	19	0.0099	48.72	39	0.0203
Great Black-backed Gull	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Gull species unknown - Large	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	2	0.0010	100.00	2	0.0010
Sooty Tern	5	0.0026	100.00	—	—	—	—	—	—	—	—	—	5	0.0026
Bridled Tern	16	0.0083	100.00	—	—	—	—	—	—	—	—	—	16	0.0083
Sooty/Bridled Tern	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Least Tern	11	0.0057	78.57	2	0.0010	14.29	1	0.0005	7.14	—	—	—	14	0.0073
Caspian Tern	—	—	—	1	0.0005	100.00	—	—	—	—	—	—	1	0.0005
Black Tern	264	0.1377	67.87	34	0.0177	8.74	81	0.0423	20.82	10	0.0052	2.57	389	0.2030
Royal Tern	90	0.0470	53.89	24	0.0125	14.37	52	0.0271	31.14	1	0.0005	0.60	167	0.0871
Royal/Caspian Tern	—	—	—	2	0.0010	100.00	—	—	—	—	—	—	2	0.0010
Sandwich Tern	43	0.0224	55.84	9	0.0047	11.69	24	0.0125	31.17	1	0.0005	1.30	77	0.0402
Thalasseus Tern unid.	4	0.0021	18.18	—	—	—	—	—	—	18	0.0094	81.82	22	0.0115
Tern species unknown	23	0.0120	85.19	—	—	—	1	0.0005	3.70	3	0.0016	11.11	27	0.0141
Common Tern	423	0.2207	68.67	64	0.0334	10.39	129	0.0673	20.94	—	—	—	616	0.3214
Forster's Tern	6	0.0031	60.00	2	0.0010	20.00	2	0.0010	20.00	—	—	—	10	0.0052
Commic/Forster's Tern	307	0.1602	70.57	36	0.0188	8.28	75	0.0391	17.24	17	0.0089	3.91	435	0.2270
Sterna Tern species unknown	5	0.0026	71.43	1	0.0005	14.29	1	0.0005	14.29	—	—	—	7	0.0037
Passerine species unknown	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Season Total	**1,296**	**0.6762**	**64.83**	**187**	**0.0976**	**9.35**	**383**	**0.1998**	**19.16**	**133**	**0.0694**	**6.65**	**1,999**	**1.0429**
2018 December														
American Black Duck	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Greater Scaup	10	0.0052	100.00	—	—	—	—	—	—	—	—	—	10	0.0052
Surf Scoter	3	0.0016	100.00	—	—	—	—	—	—	—	—	—	3	0.0016
White-winged Scoter	—	—	—	—	—	—	—	—	—	7	0.0037	100.00	7	0.0037
Black Scoter	26	0.0136	4.68	4	0.0021	0.72	8	0.0042	1.44	517	0.2700	93.15	555	0.2898
Scoter unid.	—	—	—	—	—	—	—	—	—	2	0.0010	100.00	2	0.0010
Red-breasted Merganser	5	0.0026	45.45	—	—	—	4	0.0021	36.36	2	0.0010	18.18	11	0.0057
Duck species unknown	8	0.0042	72.73	—	—	—	—	—	—	3	0.0016	27.27	11	0.0057
Red-throated Loon	36	0.0188	7.69	2	0.0010	0.43	4	0.0021	0.85	426	0.2224	91.03	468	0.2444

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Common Loon	21	0.0110	1.33	1	0.0005	0.06	2	0.0010	0.13	1,560	0.8146	98.48	1,584	0.8271
Loon species unknown	1	0.0005	4.00	—	—	—	—	—	—	24	0.0125	96.00	25	0.0131
Northern Fulmar	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Manx Shearwater	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Shearwater species unknown-Large	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016
Northern Gannet	720	0.3760	15.72	184	0.0961	4.02	224	0.1170	4.89	3,453	1.8030	75.38	4,581	2.3920
Double-crested Cormorant	—	—	—	—	—	—	2	0.0010	100.00	—	—	—	2	0.0010
Cormorant species unknown	1	0.0005	50.00	1	0.0005	50.00	—	—	—	—	—	—	2	0.0010
Brown Pelican	2	0.0010	4.55	—	—	—	—	—	—	42	0.0219	95.45	44	0.0230
Red-necked Phalarope	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016
Red Phalarope	11	0.0057	4.09	1	0.0005	0.37	1	0.0005	0.37	256	0.1337	95.17	269	0.1405
Red/Red-necked Phalarope	2	0.0010	12.50	—	—	—	—	—	—	14	0.0073	87.50	16	0.0084
Parasitic Jaeger	1	0.0005	50.00	—	—	—	—	—	—	1	0.0005	50.00	2	0.0010
Skua species unknown	—	—	—	—	—	—	—	—	—	2	0.0010	100.00	2	0.0010
Common/Thick-billed Murre	—	—	—	—	—	—	—	—	—	4	0.0021	100.00	4	0.0021
Razorbill	35	0.0183	9.36	7	0.0037	1.87	3	0.0016	0.80	329	0.1718	87.97	374	0.1953
Murre/Razorbill	—	—	—	—	—	—	—	—	—	81	0.0423	100.00	81	0.0423
Atlantic Puffin	1	0.0005	20.00	—	—	—	1	0.0005	20.00	3	0.0016	60.00	5	0.0026
Black-legged Kittiwake	5	0.0026	35.71	2	0.0010	14.29	1	0.0005	7.14	6	0.0031	42.86	14	0.0073
Bonaparte's Gull	184	0.0961	38.25	33	0.0172	6.86	52	0.0272	10.81	212	0.1107	44.07	481	0.2512
Little Gull	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Laughing Gull	155	0.0809	50.49	38	0.0198	12.38	55	0.0287	17.92	59	0.0308	19.22	307	0.1603
Ring-billed Gull	28	0.0146	36.36	8	0.0042	10.39	16	0.0084	20.78	25	0.0131	32.47	77	0.0402
Herring Gull	234	0.1222	10.32	58	0.0303	2.56	153	0.0799	6.75	1,823	0.9519	80.38	2,268	1.1843
Iceland Gull	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016
Lesser Black-backed Gull	8	0.0042	16.00	5	0.0026	10.00	1	0.0005	2.00	36	0.0188	72.00	50	0.0261
Great Black-backed Gull	17	0.0089	6.27	12	0.0063	4.43	25	0.0131	9.23	217	0.1133	80.07	271	0.1415
Gull species unknown - Large	10	0.0052	7.19	—	—	—	—	—	—	129	0.0674	92.81	139	0.0726

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Gull species unknown - Small	19	0.0099	5.59	1	0.0005	0.29	3	0.0016	0.88	317	0.1655	93.24	340	0.1775
Gull species unknown	1	0.0005	20.00	—	—	—	—	—	—	4	0.0021	80.00	5	0.0026
Royal Tern	—	—	—	—	—	—	1	0.0005	100.00	—	—	—	1	0.0005
Tern species unknown	23	0.0120	76.67	1	0.0005	3.33	—	—	—	6	0.0031	20.00	30	0.0157
Common Tern	—	—	—	1	0.0005	100.00	—	—	—	—	—	—	1	0.0005
Forster's Tern	308	0.1608	72.99	53	0.0277	12.56	52	0.0272	12.32	9	0.0047	2.13	422	0.2204
Commic/Forster's Tern	52	0.0272	58.43	9	0.0047	10.11	7	0.0037	7.87	21	0.0110	23.60	89	0.0465
Season Total	**1,929**	**1.0072**	**15.35**	**421**	**0.2198**	**3.35**	**615**	**0.3211**	**4.89**	**9,601**	**5.0132**	**76.40**	**12,566**	**6.5614**
2019 December														
Gadwall	5	0.0026	100.00	—	—	—	—	—	—	—	—	—	5	0.0026
Greater Scaup	—	—	—	—	—	—	3	0.0016	100.00	—	—	—	3	0.0016
White-winged Scoter	—	—	—	1	0.0005	100.00	—	—	—	—	—	—	1	0.0005
Black Scoter	9	0.0047	3.98	4	0.0021	1.77	5	0.0026	2.21	208	0.1090	92.04	226	0.1184
Red-breasted Merganser	3	0.0016	60.00	—	—	—	2	0.0010	40.00	—	—	—	5	0.0026
Duck species unknown	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016
Red-throated Loon	20	0.0105	5.08	4	0.0021	1.02	3	0.0016	0.76	367	0.1923	93.15	394	0.2065
Common Loon	32	0.0168	1.89	2	0.0010	0.12	4	0.0021	0.24	1,653	0.8663	97.75	1,691	0.8862
Loon species unknown	3	0.0016	4.76	1	0.0005	1.59	—	—	—	59	0.0309	93.65	63	0.0330
Manx Shearwater	12	0.0063	13.33	1	0.0005	1.11	—	—	—	77	0.0404	85.56	90	0.0472
Northern Gannet	701	0.3674	21.38	261	0.1368	7.96	281	0.1473	8.57	2,035	1.0665	62.08	3,278	1.7179
Cormorant species unknown	3	0.0016	75.00	—	—	—	1	0.0005	25.00	—	—	—	4	0.0021
Shorebird species unknown	4	0.0021	100.00	—	—	—	—	—	—	—	—	—	4	0.0021
Red-necked Phalarope	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Red Phalarope	213	0.1116	18.22	63	0.0330	5.39	69	0.0362	5.90	824	0.4318	70.49	1,169	0.6126
Red/Red-necked Phalarope	106	0.0556	12.65	22	0.0115	2.63	41	0.0215	4.89	669	0.3506	79.83	838	0.4392
Great Skua	—	—	—	1	0.0005	100.00	—	—	—	—	—	—	1	0.0005
Pomarine Jaeger	1	0.0005	100.00	—	—	—	—	—	—	—	—	—	1	0.0005
Skua species unknown	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005

(continued)

Table C–34. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Common/Thick-billed Murre	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Razorbill	—	—	—	—	—	—	—	—	—	3	0.0016	100.00	3	0.0016
Murre/Razorbill	1	0.0005	6.25	—	—	—	—	—	—	15	0.0079	93.75	16	0.0084
Atlantic Puffin	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Auk species unknown	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Bonaparte's Gull	23	0.0121	53.49	6	0.0031	13.95	7	0.0037	16.28	7	0.0037	16.28	43	0.0225
Laughing Gull	175	0.0917	42.89	66	0.0346	16.18	107	0.0561	26.23	60	0.0314	14.71	408	0.2138
Ring-billed Gull	4	0.0021	57.14	2	0.0010	28.57	1	0.0005	14.29	—	—	—	7	0.0037
Herring Gull	84	0.0440	26.25	29	0.0152	9.06	58	0.0304	18.13	149	0.0781	46.56	320	0.1677
Lesser Black-backed Gull	—	—	—	—	—	—	—	—	—	1	0.0005	100.00	1	0.0005
Great Black-backed Gull	14	0.0073	32.56	2	0.0010	4.65	12	0.0063	27.91	15	0.0079	34.88	43	0.0225
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	104	0.0545	100.00	104	0.0545
Gull species unknown	1	0.0005	10.00	—	—	—	—	—	—	9	0.0047	90.00	10	0.0052
Tern species unknown	7	0.0037	87.50	—	—	—	1	0.0005	12.50	—	—	—	8	0.0042
Forster's Tern	469	0.2458	67.29	97	0.0508	13.92	113	0.0592	16.21	18	0.0094	2.58	697	0.3653
Commic/Forster's Tern	50	0.0262	42.74	8	0.0042	6.84	15	0.0079	12.82	44	0.0231	37.61	117	0.0613
Season Total	**1,940**	**1.0167**	**20.30**	**570**	**0.2987**	**5.96**	**723**	**0.3789**	**7.56**	**6,325**	**3.3147**	**66.17**	**9,558**	**5.0090**

Table C–35. Avian flight activity (per km^2) in the February 2018 through February 2020 surveys for each species in Area A51

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Red Phalarope	—	—	—	—	—	—	—	—	—	2	0.8475	100	2	0.8475
Bonaparte's Gull	—	—	—	—	—	—	1	0.4237	100	—	—	—	1	0.4237
Season Total	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**0.4237**	**33.33**	**2**	**0.8475**	**66.67**	**3**	**1.2712**
2019 September														
Great Shearwater	1	0.4237	100	—	—	—	—	—	—	—	—	—	1	0.4237
Royal/Caspian Tern	—	—	—	1	0.4237	100	—	—	—	—	—	—	1	0.4237
Season Total	**1**	**0.4237**	**50**	**1**	**0.4237**	**50**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**0.8475**
2018 December														
Common Loon	—	—	—	—	—	—	—	—	—	3	1.2712	100	3	1.2712
Northern Gannet	—	—	—	—	—	—	—	—	—	1	0.4237	100	1	0.4237
Herring Gull	—	—	—	—	—	—	1	0.4237	100	—	—	—	1	0.4237
Season Total	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**0.4237**	**20**	**4**	**1.6949**	**80**	**5**	**2.1186**
2019 December														
Common Loon	—	—	—	—	—	—	—	—	—	2	0.8475	100	2	0.8475
Northern Gannet	—	—	—	—	—	—	—	—	—	1	0.4237	100	1	0.4237
Season Total	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**3**	**1.2712**	**100**	**3**	**1.2712**

Table C–36. Avian flight activity (per km^2) in the February 2018 through February 2020 surveys for each species in Area A53

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Northern Gannet	—	—	—	—	—	—	—	—	—	1	0.3846	100	1	0.3846
Red Phalarope	87	33.4615	19.29	4	1.5385	0.89	32	12.3077	7.1	328	126.1539	72.73	451	173.4615
Bonaparte's Gull	—	—	—	—	—	—	1	0.3846	100	—	—	—	1	0.3846
Season Total	**87**	**33.4615**	**19.21**	**4**	**1.5385**	**0.88**	**33**	**12.6923**	**7.28**	**329**	**126.5385**	**72.63**	**453**	**174.2308**
2020 February														
Red Phalarope	1	0.3846	4.55	—	—	—	—	—	—	21	8.0769	95.45	22	8.4615
Season Total	**1**	**0.3846**	**4.55**	**—**	**—**	**—**	**—**	**—**	**—**	**21**	**8.0769**	**95.45**	**22**	**8.4615**
2019 September														
Cory's Shearwater	1	0.3846	50	—	—	—	—	—	—	1	0.3846	50	2	0.7692
Audubon's Shearwater	3	1.1538	50	—	—	—	—	—	—	3	1.1538	50	6	2.3077
Shearwater species unknown-Large	1	0.3846	50	—	—	—	—	—	—	1	0.3846	50	2	0.7692
Shearwater species unknown-Small	—	—	—	—	—	—	—	—	—	1	0.3846	100	1	0.3846
Bridled Tern	1	0.3846	100	—	—	—	—	—	—	—	—	—	1	0.3846
Common Tern	5	1.9231	83.33	—	—	—	1	0.3846	16.67	—	—	—	6	2.3077
Commic/Forster's Tern	12	4.6154	48	4	1.5385	16	9	3.4615	36	—	—	—	25	9.6154
Season Total	**23**	**8.8462**	**53.49**	**4**	**1.5385**	**9.3**	**10**	**3.8462**	**23.26**	**6**	**2.3077**	**13.95**	**43**	**16.5385**
2018 December														
Common Loon	—	—	—	—	—	—	—	—	—	2	0.7692	100	2	0.7692
Season Total	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**0.7692**	**100**	**2**	**0.7692**
2019 December														
Red-throated Loon	—	—	—	—	—	—	—	—	—	2	0.7722	100	2	0.7722
Season Total	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**0.7722**	**100**	**2**	**0.7722**

Table C–37. Avian flight activity (per km^2) in the February 2018 through February 2020 surveys for each species in the Charleston Call Area (CCA)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Red-throated Loon	—	—	—	—	—	—	—	—	—	1	0.033	100	1	0.033
Common Loon	—	—	—	—	—	—	—	—	—	6	0.1982	100	6	0.1982
Northern Gannet	—	—	—	—	—	—	—	—	—	1	0.033	100	1	0.033
Red Phalarope	21	0.6935	7.17	6	0.1982	2.05	23	0.7596	7.85	243	8.0251	82.94	293	9.6764
Lesser Black-backed Gull	—	—	—	—	—	—	—	—	—	1	0.033	100	1	0.033
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	1	0.033	100	1	0.033
Season Total	**21**	**0.6935**	**6.93**	**6**	**0.1982**	**1.98**	**23**	**0.7596**	**7.59**	**253**	**8.3553**	**83.5**	**303**	**10.0066**
2020 February														
Red-throated Loon	—	—	—	—	—	—	—	—	—	6	0.1982	100	6	0.1982
Common Loon	—	—	—	—	—	—	—	—	—	17	0.5614	100	17	0.5614
Loon species unknown	—	—	—	—	—	—	—	—	—	4	0.1321	100	4	0.1321
Manx Shearwater	1	0.033	100	—	—	—	—	—	—	—	—	—	1	0.033
Red Phalarope	27	0.8917	3.63	21	0.6935	2.82	49	1.6182	6.59	647	21.3672	86.96	744	24.5707
Bonaparte's Gull	7	0.2312	63.64	1	0.033	9.09	3	0.0991	27.27	—	—	—	11	0.3633
Gull species unknown - Small	2	0.0661	50	—	—	—	—	—	—	2	0.0661	50	4	0.1321
Season Total	**37**	**1.2219**	**4.7**	**22**	**0.7266**	**2.8**	**52**	**1.7173**	**6.61**	**676**	**22.325**	**85.9**	**787**	**25.9908**
2018 May/June														
Sterna Tern species unknown	1	0.033	100	—	—	—	—	—	—	—	—	—	1	0.033
Season Total	**1**	**0.033**	**100**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**0.033**
2019 May														
Dovekie	—	—	—	—	—	—	—	—	—	1	0.033	100	1	0.033
Sandwich Tern	—	—	—	1	0.033	100	—	—	—	—	—	—	1	0.033
Commic/Forster's Tern	1	0.033	33.33	2	0.0661	66.67	—	—	—	—	—	—	3	0.0991
Season Total	**1**	**0.033**	**20**	**3**	**0.0991**	**60**	**—**	**—**	**—**	**1**	**0.033**	**20**	**5**	**0.1651**

(continued)

Table C–37. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 October														
Great Shearwater	1	0.033	100	—	—	—	—	—	—	—	—	—	1	0.033
Royal Tern	—	—	—	—	—	—	1	0.033	100	—	—	—	1	0.033
Sandwich Tern	1	0.033	50	—	—	—	1	0.033	50	—	—	—	2	0.0661
Commic/Forster's Tern	1	0.033	50	1	0.033	50	—	—	—	—	—	—	2	0.0661
Season Total	**3**	**0.0991**	**50**	**1**	**0.033**	**16.67**	**2**	**0.0661**	**33.33**	**—**	**—**	**—**	**6**	**0.1982**
2019 September														
Cory's Shearwater	3	0.0991	100	—	—	—	—	—	—	—	—	—	3	0.0991
Shearwater species unknown-Large	1	0.033	50	—	—	—	—	—	—	1	0.033	50	2	0.0661
Shearwater species unknown-Small	10	0.3303	32.26	—	—	—	—	—	—	21	0.6935	67.74	31	1.0238
Sooty Tern	1	0.033	100	—	—	—	—	—	—	—	—	—	1	0.033
Black Tern	1	0.033	50	—	—	—	1	0.033	50	—	—	—	2	0.0661
Common Tern	24	0.7926	88.89	1	0.033	3.7	2	0.0661	7.41	—	—	—	27	0.8917
Commic/Forster's Tern	18	0.5945	90	—	—	—	2	0.0661	10	—	—	—	20	0.6605
Season Total	**58**	**1.9155**	**67.44**	**1**	**0.033**	**1.16**	**5**	**0.1651**	**5.81**	**22**	**0.7266**	**25.58**	**86**	**2.8402**
2018 December														
Common Loon	—	—	—	—	—	—	—	—	—	10	0.3288	100	10	0.3288
Northern Gannet	—	—	—	—	—	—	—	—	—	3	0.0987	100	3	0.0987
Season Total	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**13**	**0.4275**	**100**	**13**	**0.4275**
2019 December														
Red-throated Loon	—	—	—	—	—	—	—	—	—	1	0.033	100	1	0.033
Common Loon	1	0.033	5	—	—	—	—	—	—	19	0.6275	95	20	0.6605
Loon species unknown	—	—	—	—	—	—	—	—	—	3	0.0991	100	3	0.0991
Northern Gannet	1	0.033	100	—	—	—	—	—	—	—	—	—	1	0.033
Red Phalarope	40	1.321	37.74	7	0.2312	6.6	1	0.033	0.94	58	1.9155	54.72	106	3.5007
Red/Red-necked Phalarope	3	0.0991	18.75	—	—	—	—	—	—	13	0.4293	81.25	16	0.5284
Season Total	**45**	**1.4861**	**30.61**	**7**	**0.2312**	**4.76**	**1**	**0.033**	**0.68**	**94**	**3.1044**	**63.95**	**147**	**4.8547**

Table C–38. Avian flight activity (per km^2) in the February 2018 through February 2020 surveys for each species in the Kitty Hawk (KH) Area

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Red-throated Loon	—	—	—	—	—	—	—	—	—	4	0.0543	100	4	0.0543
Common Loon	—	—	—	—	—	—	—	—	—	62	0.8424	100	62	0.8424
Northern Fulmar	—	—	—	1	0.0136	33.33	1	0.0136	33.33	1	0.0136	33.33	3	0.0408
Northern Gannet	4	0.0543	8.16	1	0.0136	2.04	41	0.5571	83.67	3	0.0408	6.12	49	0.6658
Great Skua	—	—	—	—	—	—	1	0.0136	100	—	—	—	1	0.0136
Razorbill	—	—	—	—	—	—	—	—	—	11	0.1495	100	11	0.1495
Murre/Razorbill	—	—	—	—	—	—	—	—	—	1	0.0136	100	1	0.0136
Atlantic Puffin	—	—	—	—	—	—	—	—	—	5	0.0679	100	5	0.0679
Black-legged Kittiwake	1	0.0136	20	—	—	—	2	0.0272	40	2	0.0272	40	5	0.0679
Bonaparte's Gull	—	—	—	—	—	—	1	0.0136	100	—	—	—	1	0.0136
Great Black-backed Gull	—	—	—	—	—	—	1	0.0136	16.67	5	0.0679	83.33	6	0.0815
Season Total	**5**	**0.0679**	**3.38**	**2**	**0.0272**	**1.35**	**47**	**0.6386**	**31.76**	**94**	**1.2772**	**63.51**	**148**	**2.0109**
2020 February														
Red-throated Loon	—	—	—	—	—	—	—	—	—	1	0.0136	100	1	0.0136
Common Loon	—	—	—	—	—	—	—	—	—	39	0.5313	100	39	0.5313
Loon species unknown	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Northern Fulmar	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Manx Shearwater	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Northern Gannet	5	0.0681	45.45	—	—	—	—	—	—	6	0.0817	54.55	11	0.1499
Red Phalarope	—	—	—	—	—	—	—	—	—	3	0.0409	100	3	0.0409
Razorbill	—	—	—	—	—	—	—	—	—	153	2.0845	100	153	2.0845
Atlantic Puffin	—	—	—	—	—	—	—	—	—	22	0.2997	100	22	0.2997
Auk species unknown	2	0.0272	100	—	—	—	—	—	—	—	—	—	2	0.0272
Black-legged Kittiwake	2	0.0272	50	1	0.0136	25	—	—	—	1	0.0136	25	4	0.0545
Bonaparte's Gull	2	0.0272	33.33	2	0.0272	33.33	2	0.0272	33.33	—	—	—	6	0.0817
Herring Gull	2	0.0272	28.57	—	—	—	1	0.0136	14.29	4	0.0545	57.14	7	0.0954

(continued)

Table C–38. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Lesser Black-backed Gull	—	—	—	—	—	—	—	—	—	1	0.0136	100	1	0.0136
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	16	0.218	100	16	0.218
Season Total	**16**	**0.218**	**5.97**	**3**	**0.0409**	**1.12**	**3**	**0.0409**	**1.12**	**246**	**3.3515**	**91.79**	**268**	**3.6512**
2019 May														
Common Loon	—	—	—	—	—	—	—	—	—	8	0.1087	100	8	0.1087
Trindade Petrel	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Season Total	**1**	**0.0136**	**11.11**	**—**	**—**	**—**	**—**	**—**	**—**	**8**	**0.1087**	**88.89**	**9**	**0.1223**
2018 October														
Cory's Shearwater	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Northern Gannet	1	0.0136	33.33	—	—	—	—	—	—	2	0.0272	66.67	3	0.0409
Season Total	**2**	**0.0272**	**50**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**0.0272**	**50**	**4**	**0.0545**
2019 September														
Black-capped Petrel	—	—	—	—	—	—	—	—	—	1	0.0136	100	1	0.0136
Cory's Shearwater	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Great Shearwater	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Audubon's Shearwater	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Herring Gull	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Sooty/Bridled Tern	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Black Tern	—	—	—	—	—	—	1	0.0136	100	—	—	—	1	0.0136
Season Total	**5**	**0.0679**	**71.43**	**—**	**—**	**—**	**1**	**0.0136**	**14.29**	**1**	**0.0136**	**14.29**	**7**	**0.0951**
2018 December														
Red-throated Loon	—	—	—	—	—	—	—	—	—	4	0.0545	100	4	0.0545
Common Loon	—	—	—	—	—	—	—	—	—	69	0.9399	100	69	0.9399
Cory's Shearwater	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Sooty Shearwater	4	0.0545	100	—	—	—	—	—	—	—	—	—	4	0.0545
Manx Shearwater	142	1.9343	49.13	—	—	—	3	0.0409	1.04	144	1.9616	49.83	289	3.9368
Northern Gannet	2	0.0272	22.22	—	—	—	—	—	—	7	0.0954	77.78	9	0.1226
Red-necked Phalarope	—	—	—	—	—	—	—	—	—	5	0.0681	100	5	0.0681

(continued)

Table C–38. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Red Phalarope	14	0.1907	8.33	3	0.0409	1.79	1	0.0136	0.6	150	2.0433	89.29	168	2.2885
Red/Red-necked Phalarope	—	—	—	—	—	—	—	—	—	65	0.8854	100	65	0.8854
Razorbill	2	0.0272	12.5	—	—	—	—	—	—	14	0.1907	87.5	16	0.218
Murre/Razorbill	1	0.0136	25	—	—	—	—	—	—	3	0.0409	75	4	0.0545
Black-legged Kittiwake	309	4.2092	56.28	86	1.1715	15.66	79	1.0761	14.39	75	1.0217	13.66	549	7.4785
Bonaparte's Gull	573	7.8055	53.01	217	2.956	20.07	147	2.0025	13.6	144	1.9616	13.32	1,081	14.7255
Laughing Gull	—	—	—	—	—	—	—	—	—	7	0.0954	100	7	0.0954
Ring-billed Gull	—	—	—	—	—	—	—	—	—	15	0.2043	100	15	0.2043
Herring Gull	4	0.0545	28.57	1	0.0136	7.14	—	—	—	9	0.1226	64.29	14	0.1907
Great Black-backed Gull	5	0.0681	20.83	2	0.0272	8.33	2	0.0272	8.33	15	0.2043	62.5	24	0.3269
Gull species unknown - Large	—	—	—	—	—	—	—	—	—	3	0.0409	100	3	0.0409
Gull species unknown - Small	10	0.1362	0.96	—	—	—	—	—	—	1,030	14.0308	99.04	1,040	14.167
Commic/Forster's Tern	1	0.0136	100	—	—	—	—	—	—	—	—	—	1	0.0136
Season Total	**1,068**	**14.5484**	**31.71**	**309**	**4.2092**	**9.17**	**232**	**3.1603**	**6.89**	**1,759**	**23.9613**	**52.23**	**3,368**	**45.8793**
2019 December														
Red-throated Loon	—	—	—	—	—	—	1	0.0136	100	—	—	—	1	0.0136
Common Loon	—	—	—	—	—	—	1	0.0136	25	3	0.0408	75	4	0.0544
Northern Gannet	1	0.0136	33.33	—	—	—	—	—	—	2	0.0272	66.67	3	0.0408
Red/Red-necked Phalarope	1	0.0136	14.29	1	0.0136	14.29	—	—	—	5	0.068	71.43	7	0.0951
Black-legged Kittiwake	—	—	—	—	—	—	1	0.0136	100	—	—	—	1	0.0136
Bonaparte's Gull	16	0.2175	14.68	9	0.1223	8.26	7	0.0951	6.42	77	1.0465	70.64	109	1.4814
Herring Gull	9	0.1223	39.13	5	0.068	21.74	1	0.0136	4.35	8	0.1087	34.78	23	0.3126
Great Black-backed Gull	4	0.0544	17.39	4	0.0544	17.39	1	0.0136	4.35	14	0.1903	60.87	23	0.3126
Gull species unknown - Large	—	—	—	—	—	—	—	—	—	1	0.0136	100	1	0.0136
Gull species unknown - Small	2	0.0272	28.57	—	—	—	—	—	—	5	0.068	71.43	7	0.0951
Season Total	**33**	**0.4485**	**18.44**	**19**	**0.2582**	**10.61**	**12**	**0.1631**	**6.7**	**115**	**1.5629**	**64.25**	**179**	**2.4327**

Table C–39. Avian flight activity (per km^2) in the February 2018 through February 2020 surveys for each species in the Wilmington West (WW) Area

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Black Scoter	2	0.0566	50	—	—	—	—	—	—	2	0.0566	50	4	0.1133
Long-tailed Duck	—	—	—	—	—	—	—	—	—	1	0.0283	100	1	0.0283
Red-throated Loon	—	—	—	—	—	—	—	—	—	3	0.0849	100	3	0.0849
Common Loon	—	—	—	—	—	—	—	—	—	81	2.2933	100	81	2.2933
Manx Shearwater	—	—	—	—	—	—	—	—	—	1	0.0283	100	1	0.0283
Northern Gannet	1	0.0283	0.78	—	—	—	—	—	—	127	3.5957	99.22	128	3.624
Red Phalarope	1	0.0283	4.17	—	—	—	—	—	—	23	0.6512	95.83	24	0.6795
Razorbill	16	0.453	10.74	—	—	—	—	—	—	133	3.7656	89.26	149	4.2186
Murre/Razorbill	—	—	—	—	—	—	—	—	—	7	0.1982	100	7	0.1982
Bonaparte's Gull	13	0.3681	5.75	8	0.2265	3.54	11	0.3114	4.87	194	5.4926	85.84	226	6.3986
Herring Gull	—	—	—	—	—	—	1	0.0283	100	—	—	—	1	0.0283
Gull species unknown - Large	—	—	—	—	—	—	—	—	—	1	0.0283	100	1	0.0283
Forster's Tern	3	0.0849	42.86	1	0.0283	14.29	—	—	—	3	0.0849	42.86	7	0.1982
Season Total	**36**	**1.0193**	**5.69**	**9**	**0.2548**	**1.42**	**12**	**0.3398**	**1.9**	**576**	**16.308**	**91**	**633**	**17.9219**
2020 February														
Black Scoter	2	0.0568	100	—	—	—	—	—	—	—	—	—	2	0.0568
Red-throated Loon	—	—	—	—	—	—	—	—	—	4	0.1135	100	4	0.1135
Common Loon	1	0.0284	0.42	—	—	—	—	—	—	235	6.6705	99.58	236	6.6988
Petrel species unknown	—	—	—	—	—	—	—	—	—	1	0.0284	100	1	0.0284
Northern Gannet	3	0.0852	6.38	4	0.1135	8.51	4	0.1135	8.51	36	1.0219	76.6	47	1.3341
Cormorant species unknown	—	—	—	—	—	—	—	—	—	2	0.0568	100	2	0.0568
Red Phalarope	90	2.5546	9.87	36	1.0219	3.95	103	2.9236	11.29	683	19.3869	74.89	912	25.887
Razorbill	21	0.5961	6.67	3	0.0852	0.95	1	0.0284	0.32	290	8.2316	92.06	315	8.9412
Murre/Razorbill	—	—	—	—	—	—	—	—	—	3	0.0852	100	3	0.0852
Bonaparte's Gull	178	5.0525	16.14	79	2.2424	7.16	106	3.0088	9.61	740	21.0048	67.09	1,103	31.3085
Herring Gull	1	0.0284	6.67	1	0.0284	6.67	8	0.2271	53.33	5	0.1419	33.33	15	0.4258

(continued)

Table C–39. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Great Black-backed Gull	—	—	—	—	—	—	1	0.0284	100	—	—	—	1	0.0284
Gull species unknown - Small	5	0.1419	100	—	—	—	—	—	—	—	—	—	5	0.1419
Gull species unknown	2	0.0568	100	—	—	—	—	—	—	—	—	—	2	0.0568
Tern species unknown	2	0.0568	100	—	—	—	—	—	—	—	—	—	2	0.0568
Forster's Tern	18	0.5109	81.82	—	—	—	4	0.1135	18.18	—	—	—	22	0.6245
Season Total	**323**	**9.1683**	**12.09**	**123**	**3.4913**	**4.6**	**227**	**6.4434**	**8.5**	**1,999**	**56.7414**	**74.81**	**2,672**	**75.8445**
2019 May														
Passerine species unknown	24	0.682	100	—	—	—	—	—	—	—	—	—	24	0.682
Season Total	**24**	**0.682**	**100**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**24**	**0.682**
2018 October														
Royal Tern	4	0.1135	100	—	—	—	—	—	—	—	—	—	4	0.1135
Commic/Forster's Tern	2	0.0568	50	1	0.0284	25	1	0.0284	25	—	—	—	4	0.1135
Season Total	**6**	**0.1703**	**75**	**1**	**0.0284**	**12.5**	**1**	**0.0284**	**12.5**	**—**	**—**	**—**	**8**	**0.2271**
2019 September														
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	1	0.024	100	1	0.024
Royal Tern	4	0.0962	33.33	3	0.0721	25	5	0.1202	41.67	—	—	—	12	0.2885
Royal/Caspian Tern	4	0.0962	80	—	—	—	—	—	—	1	0.024	20	5	0.1202
Sandwich Tern	1	0.024	100	—	—	—	—	—	—	—	—	—	1	0.024
Thalasseus Tern unid.	1	0.024	100	—	—	—	—	—	—	—	—	—	1	0.024
Tern species unknown	1	0.024	100	—	—	—	—	—	—	—	—	—	1	0.024
Season Total	**11**	**0.2644**	**52.38**	**3**	**0.0721**	**14.29**	**5**	**0.1202**	**23.81**	**2**	**0.0481**	**9.52**	**21**	**0.5048**
2018 December														
Duck species unknown	2	0.0568	100	—	—	—	—	—	—	—	—	—	2	0.0568
Red-throated Loon	—	—	—	—	—	—	—	—	—	1	0.0284	100	1	0.0284
Common Loon	3	0.0852	3.95	—	—	—	—	—	—	73	2.0721	96.05	76	2.1573
Northern Gannet	61	1.7315	37.89	2	0.0568	1.24	2	0.0568	1.24	96	2.725	59.63	161	4.57
Red Phalarope	6	0.1703	6	2	0.0568	2	—	—	—	92	2.6114	92	100	2.8385
Skua species unknown	1	0.0284	100	—	—	—	—	—	—	—	—	—	1	0.0284

(continued)

Table C–39. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Bonaparte's Gull	3	0.0852	100	—	—	—	—	—	—	—	—	—	3	0.0852
Laughing Gull	8	0.2271	100	—	—	—	—	—	—	—	—	—	8	0.2271
Herring Gull	1	0.0284	50	—	—	—	—	—	—	1	0.0284	50	2	0.0568
Gull species unknown - Small	1	0.0284	100	—	—	—	—	—	—	—	—	—	1	0.0284
Forster's Tern	19	0.5393	95	1	0.0284	5	—	—	—	—	—	—	20	0.5677
Commic/Forster's Tern	18	0.5109	100	—	—	—	—	—	—	—	—	—	18	0.5109
Season Total	**123**	**3.4913**	**31.3**	**5**	**0.1419**	**1.27**	**2**	**0.0568**	**0.51**	**263**	**7.4652**	**66.92**	**393**	**11.1553**
2019 December														
Common Loon	—	—	—	—	—	—	—	—	—	34	0.9197	100	34	0.9197
Northern Gannet	41	1.109	32.28	19	0.5139	14.96	6	0.1623	4.72	61	1.65	48.03	127	3.4352
Red-necked Phalarope	—	—	—	—	—	—	—	—	—	2	0.0541	100	2	0.0541
Red Phalarope	39	1.0549	12.54	6	0.1623	1.93	1	0.027	0.32	265	7.168	85.21	311	8.4122
Red/Red-necked Phalarope	65	1.7582	29.68	3	0.0811	1.37	6	0.1623	2.74	145	3.9221	66.21	219	5.9237
Murre/Razorbill	—	—	—	—	—	—	—	—	—	3	0.0811	100	3	0.0811
Black-legged Kittiwake	—	—	—	—	—	—	1	0.027	100	—	—	—	1	0.027
Bonaparte's Gull	3	0.0811	60	—	—	—	1	0.027	20	1	0.027	20	5	0.1352
Laughing Gull	—	—	—	—	—	—	1	0.027	100	—	—	—	1	0.027
Herring Gull	7	0.1893	25.93	4	0.1082	14.81	1	0.027	3.7	15	0.4057	55.56	27	0.7303
Tern species unknown	1	0.027	100	—	—	—	—	—	—	—	—	—	1	0.027
Forster's Tern	31	0.8385	72.09	7	0.1893	16.28	5	0.1352	11.63	—	—	—	43	1.1631
Season Total	**187**	**5.0582**	**24.16**	**39**	**1.0549**	**5.04**	**22**	**0.5951**	**2.84**	**526**	**14.2278**	**67.96**	**774**	**20.9359**

Table C–40. Avian flight activity (per km^2) in the February 2018 through February 2020 surveys for each species in the Wilmington East (WE) Area

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Red-throated Loon	—	—	—	—	—	—	—	—	—	6	0.0766	100	6	0.0766
Common Loon	—	—	—	—	—	—	—	—	—	78	0.9955	100	78	0.9955
Loon species unknown	—	—	—	—	—	—	—	—	—	1	0.0128	100	1	0.0128
Manx Shearwater	—	—	—	—	—	—	—	—	—	7	0.0893	100	7	0.0893
Northern Gannet	2	0.0255	6.06	4	0.0511	12.12	—	—	—	27	0.3446	81.82	33	0.4212
Red Phalarope	94	1.1997	18.4	21	0.268	4.11	9	0.1149	1.76	387	4.9394	75.73	511	6.522
Razorbill	1	0.0128	0.39	—	—	—	—	—	—	257	3.2802	99.61	258	3.2929
Bonaparte's Gull	305	3.8928	39.3	84	1.0721	10.82	49	0.6254	6.31	338	4.314	43.56	776	9.9043
Ring-billed Gull	—	—	—	—	—	—	1	0.0128	100	—	—	—	1	0.0128
Herring Gull	2	0.0255	12.5	1	0.0128	6.25	1	0.0128	6.25	12	0.1532	75	16	0.2042
Lesser Black-backed Gull	—	—	—	—	—	—	—	—	—	1	0.0128	100	1	0.0128
Forster's Tern	28	0.3574	60.87	6	0.0766	13.04	1	0.0128	2.17	11	0.1404	23.91	46	0.5871
Season Total	**432**	**5.5137**	**24.91**	**116**	**1.4805**	**6.69**	**61**	**0.7786**	**3.52**	**1,125**	**14.3586**	**64.88**	**1,734**	**22.1315**
2020 February														
Red-throated Loon	—	—	—	—	—	—	—	—	—	3	0.0384	100	3	0.0384
Common Loon	—	—	—	1	0.0128	3.13	—	—	—	31	0.3967	96.88	32	0.4095
Northern Gannet	3	0.0384	37.5	3	0.0384	37.5	—	—	—	2	0.0256	25	8	0.1024
Red Phalarope	1,380	17.6606	22.82	501	6.4116	8.29	470	6.0148	7.77	3,696	47.2997	61.12	6,047	77.3867
Razorbill	4	0.0512	57.14	—	—	—	—	—	—	3	0.0384	42.86	7	0.0896
Bonaparte's Gull	224	2.8666	51.14	71	0.9086	16.21	54	0.6911	12.33	89	1.139	20.32	438	5.6053
Gull species unknown - Small	5	0.064	45.45	—	—	—	—	—	—	6	0.0768	54.55	11	0.1408
Forster's Tern	6	0.0768	85.71	1	0.0128	14.29	—	—	—	—	—	—	7	0.0896
Sterna Tern species unknown	—	—	—	—	—	—	1	0.0128	100	—	—	—	1	0.0128
Season Total	**1,622**	**20.7576**	**24.75**	**577**	**7.3842**	**8.8**	**525**	**6.7187**	**8.01**	**3,830**	**49.0146**	**58.44**	**6,554**	**83.8751**

(continued)

Table C–40. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2019 May														
Common Tern	—	—	—	—	—	—	1	0.0128	100	—	—	—	1	0.0128
Commic/Forster's Tern	1	0.0128	16.67	1	0.0128	16.67	2	0.0255	33.33	2	0.0255	33.33	6	0.0766
Season Total	**1**	**0.0128**	**14.29**	**1**	**0.0128**	**14.29**	**3**	**0.0383**	**42.86**	**2**	**0.0255**	**28.57**	**7**	**0.0893**
2018 October														
Cory's Shearwater	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Bridled Tern	1	0.0128	50	1	0.0128	50	—	—	—	—	—	—	2	0.0256
Royal Tern	2	0.0256	25	1	0.0128	12.5	1	0.0128	12.5	4	0.0512	50	8	0.1024
Tern species unknown	1	0.0128	50	—	—	—	—	—	—	1	0.0128	50	2	0.0256
Common Tern	4	0.0512	100	—	—	—	—	—	—	—	—	—	4	0.0512
Commic/Forster's Tern	—	—	—	1	0.0128	100	—	—	—	—	—	—	1	0.0128
Season Total	**9**	**0.1152**	**50**	**3**	**0.0384**	**16.67**	**1**	**0.0128**	**5.56**	**5**	**0.064**	**27.78**	**18**	**0.2304**
2019 September														
Black-capped Petrel	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Cory's Shearwater	34	0.434	77.27	1	0.0128	2.27	1	0.0128	2.27	8	0.1021	18.18	44	0.5616
Great Shearwater	4	0.0511	33.33	—	—	—	—	—	—	8	0.1021	66.67	12	0.1532
Audubon's Shearwater	15	0.1914	88.24	—	—	—	1	0.0128	5.88	1	0.0128	5.88	17	0.217
Shearwater species unknown-Large	—	—	—	—	—	—	—	—	—	1	0.0128	100	1	0.0128
Shearwater species unknown	3	0.0383	100	—	—	—	—	—	—	—	—	—	3	0.0383
Sooty Tern	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Bridled Tern	7	0.0893	100	—	—	—	—	—	—	—	—	—	7	0.0893
Sooty/Bridled Tern	6	0.0766	100	—	—	—	—	—	—	—	—	—	6	0.0766
Gull-billed Tern	—	—	—	—	—	—	1	0.0128	100	—	—	—	1	0.0128
Black Tern	3	0.0383	75	—	—	—	1	0.0128	25	—	—	—	4	0.0511
Royal Tern	6	0.0766	30	3	0.0383	15	8	0.1021	40	3	0.0383	15	20	0.2553
Tern species unknown	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Common Tern	15	0.1914	75	2	0.0255	10	3	0.0383	15	—	—	—	20	0.2553
Commic/Forster's Tern	5	0.0638	100	—	—	—	—	—	—	—	—	—	5	0.0638

(continued)

Table C–40. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Passerine species unknown	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Season Total	**102**	**1.3019**	**70.83**	**6**	**0.0766**	**4.17**	**15**	**0.1914**	**10.42**	**21**	**0.268**	**14.58**	**144**	**1.8379**
2018 December														
Common Loon	2	0.0256	7.69	—	—	—	1	0.0128	3.85	23	0.2946	88.46	26	0.333
Northern Gannet	134	1.7162	58.77	25	0.3202	10.96	16	0.2049	7.02	53	0.6788	23.25	228	2.9201
Laughing Gull	7	0.0897	87.5	1	0.0128	12.5	—	—	—	—	—	—	8	0.1025
Ring-billed Gull	—	—	—	—	—	—	1	0.0128	100	—	—	—	1	0.0128
Herring Gull	—	—	—	—	—	—	1	0.0128	100	—	—	—	1	0.0128
Lesser Black-backed Gull	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Season Total	**144**	**1.8443**	**54.34**	**26**	**0.333**	**9.81**	**19**	**0.2433**	**7.17**	**76**	**0.9734**	**28.68**	**265**	**3.394**
2019 December														
Common Loon	—	—	—	—	—	—	—	—	—	13	0.1659	100	13	0.1659
Manx Shearwater	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Northern Gannet	16	0.2042	35.56	7	0.0893	15.56	8	0.1021	17.78	14	0.1787	31.11	45	0.5743
Red-necked Phalarope	—	—	—	—	—	—	—	—	—	3	0.0383	100	3	0.0383
Red Phalarope	239	3.0504	23.03	17	0.217	1.64	5	0.0638	0.48	777	9.917	74.86	1,038	13.2482
Red/Red-necked Phalarope	3	0.0383	21.43	—	—	—	2	0.0255	14.29	9	0.1149	64.29	14	0.1787
Bonaparte's Gull	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Herring Gull	8	0.1021	19.51	3	0.0383	7.32	6	0.0766	14.63	24	0.3063	58.54	41	0.5233
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	3	0.0383	100	3	0.0383
Tern species unknown	1	0.0128	100	—	—	—	—	—	—	—	—	—	1	0.0128
Forster's Tern	35	0.4467	89.74	3	0.0383	7.69	1	0.0128	2.56	—	—	—	39	0.4978
Sterna Tern species unknown	6	0.0766	40	1	0.0128	6.67	—	—	—	8	0.1021	53.33	15	0.1914
Season Total	**310**	**3.9566**	**25.54**	**31**	**0.3957**	**2.55**	**22**	**0.2808**	**1.81**	**851**	**10.8615**	**70.1**	**1,214**	**15.4946**

Table C–41. Avian flight activity (per km^2) in the February 2018 through February 2020 surveys for each species in the Grand Strand Call Area (GSCA; counts include part of WW)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
2018 February														
Red-throated Loon	—	—	—	—	—	—	—	—	—	11	0.0553	100	11	0.0553
Common Loon	—	—	—	—	—	—	—	—	—	302	1.5195	100	302	1.5195
Loon species unknown	—	—	—	—	—	—	—	—	—	4	0.0201	100	4	0.0201
Northern Gannet	36	0.1811	12.54	13	0.0654	4.53	5	0.0252	1.74	233	1.1723	81.18	287	1.444
Red Phalarope	28	0.1409	2.14	8	0.0403	0.61	9	0.0453	0.69	1,265	6.3648	96.56	1,310	6.5912
Red/Red-necked Phalarope	2	0.0101	20	—	—	—	—	—	—	8	0.0403	80	10	0.0503
Razorbill	6	0.0302	11.11	—	—	—	—	—	—	48	0.2415	88.89	54	0.2717
Murre/Razorbill	—	—	—	—	—	—	—	—	—	1	0.005	100	1	0.005
Bonaparte's Gull	37	0.1862	28.91	12	0.0604	9.38	19	0.0956	14.84	60	0.3019	46.88	128	0.644
Herring Gull	—	—	—	—	—	—	—	—	—	2	0.0101	100	2	0.0101
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	1	0.005	100	1	0.005
Forster's Tern	18	0.0906	90	2	0.0101	10	—	—	—	—	—	—	20	0.1006
Season Total	**127**	**0.639**	**5.96**	**35**	**0.1761**	**1.64**	**33**	**0.166**	**1.55**	**1,935**	**9.7358**	**90.85**	**2,130**	**10.717**
2020 February														
Black Scoter	—	—	—	—	—	—	—	—	—	3	0.0151	100	3	0.0151
Scoter unid.	—	—	—	—	—	—	—	—	—	4	0.0202	100	4	0.0202
Duck species unknown	1	0.005	100	—	—	—	—	—	—	—	—	—	1	0.005
Red-throated Loon	—	—	—	—	—	—	—	—	—	18	0.0907	100	18	0.0907
Common Loon	—	—	—	—	—	—	—	—	—	285	1.4358	100	285	1.4358
Manx Shearwater	—	—	—	—	—	—	—	—	—	3	0.0151	100	3	0.0151
Northern Gannet	45	0.2267	7.68	18	0.0907	3.07	42	0.2116	7.17	481	2.4233	82.08	586	2.9523
Red Phalarope	114	0.5743	55.34	—	—	—	—	—	—	92	0.4635	44.66	206	1.0378
Common/Thick-billed Murre	—	—	—	—	—	—	—	—	—	1	0.005	100	1	0.005
Razorbill	68	0.3426	24.29	—	—	—	—	—	—	212	1.0681	75.71	280	1.4107
Murre/Razorbill	—	—	—	—	—	—	—	—	—	1	0.005	100	1	0.005
Bonaparte's Gull	275	1.3855	26.24	164	0.8262	15.65	240	1.2091	22.9	369	1.859	35.21	1,048	5.2799

(continued)

Table C–41. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Little Gull	—	—	—	—	—	—	1	0.005	100	—	—	—	1	0.005
Herring Gull	1	0.005	3.23	2	0.0101	6.45	8	0.0403	25.81	20	0.1008	64.52	31	0.1562
Lesser Black-backed Gull	1	0.005	100	—	—	—	—	—	—	—	—	—	1	0.005
Great Black-backed Gull	1	0.005	100	—	—	—	—	—	—	—	—	—	1	0.005
Gull species unknown - Small	5	0.0252	17.24	—	—	—	—	—	—	24	0.1209	82.76	29	0.1461
Gull species unknown	1	0.005	50	—	—	—	—	—	—	1	0.005	50	2	0.0101
Forster's Tern	4	0.0202	50	1	0.005	12.5	3	0.0151	37.5	—	—	—	8	0.0403
Sterna Tern species unknown	—	—	—	—	—	—	1	0.005	100	—	—	—	1	0.005
Season Total	**516**	**2.5996**	**20.56**	**185**	**0.932**	**7.37**	**295**	**1.4862**	**11.75**	**1,514**	**7.6276**	**60.32**	**2,510**	**12.6455**
2018 May/June														
Cory's Shearwater	—	—	—	—	—	—	1	0.0049	100	—	—	—	1	0.0049
Shearwater species unknown-Large	—	—	—	—	—	—	—	—	—	1	0.0049	100	1	0.0049
Royal Tern	—	—	—	—	—	—	1	0.0049	100	—	—	—	1	0.0049
Sterna Tern species unknown	1	0.0049	100	—	—	—	—	—	—	—	—	—	1	0.0049
Season Total	**1**	**0.0049**	**25**	**—**	**—**	**—**	**2**	**0.0099**	**50**	**1**	**0.0049**	**25**	**4**	**0.0198**
2019 May														
Common Loon	—	—	—	—	—	—	—	—	—	1	0.0045	100	1	0.0045
Shorebird species unknown	2	0.0091	100	—	—	—	—	—	—	—	—	—	2	0.0091
Dovekie	—	—	—	—	—	—	—	—	—	7	0.0317	100	7	0.0317
Royal Tern	1	0.0045	12.5	2	0.0091	25	5	0.0226	62.5	—	—	—	8	0.0362
Commic/Forster's Tern	1	0.0045	100	—	—	—	—	—	—	—	—	—	1	0.0045
Passerine species unknown	24	0.1087	100	—	—	—	—	—	—	—	—	—	24	0.1087
Season Total	**28**	**0.1268**	**65.12**	**2**	**0.0091**	**4.65**	**5**	**0.0226**	**11.63**	**8**	**0.0362**	**18.6**	**43**	**0.1947**
2018 October														
Common Loon	—	—	—	—	—	—	—	—	—	36	0.1599	100	36	0.1599
Cory's Shearwater	1	0.0044	50	1	0.0044	50	—	—	—	—	—	—	2	0.0089
Great Shearwater	—	—	—	—	—	—	—	—	—	1	0.0044	100	1	0.0044
Red Phalarope	—	—	—	—	—	—	—	—	—	5	0.0222	100	5	0.0222

(continued)

Table C–41. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Parasitic Jaeger	—	—	—	—	—	—	1	0.0044	100	—	—	—	1	0.0044
Black-legged Kittiwake	1	0.0044	100	—	—	—	—	—	—	—	—	—	1	0.0044
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	5	0.0222	100	5	0.0222
Bridled Tern	1	0.0044	100	—	—	—	—	—	—	—	—	—	1	0.0044
Caspian Tern	1	0.0044	100	—	—	—	—	—	—	—	—	—	1	0.0044
Royal Tern	18	0.0799	78.26	1	0.0044	4.35	4	0.0178	17.39	—	—	—	23	0.1021
Royal/Caspian Tern	17	0.0755	77.27	1	0.0044	4.55	4	0.0178	18.18	—	—	—	22	0.0977
Sandwich Tern	3	0.0133	75	1	0.0044	25	—	—	—	—	—	—	4	0.0178
Tern species unknown	20	0.0888	31.25	—	—	—	1	0.0044	1.56	43	0.191	67.19	64	0.2842
Common Tern	45	0.1998	78.95	7	0.0311	12.28	5	0.0222	8.77	—	—	—	57	0.2531
Forster's Tern	61	0.2709	79.22	9	0.04	11.69	7	0.0311	9.09	—	—	—	77	0.3419
Commic/Forster's Tern	205	0.9104	72.7	11	0.0488	3.9	16	0.0711	5.67	50	0.222	17.73	282	1.2523
Sterna Tern species unknown	4	0.0178	100	—	—	—	—	—	—	—	—	—	4	0.0178
Season Total	**377**	**1.6742**	**64.33**	**31**	**0.1377**	**5.29**	**38**	**0.1688**	**6.48**	**140**	**0.6217**	**23.89**	**586**	**2.6024**
2019 September														
Royal Tern	22	0.1111	44	16	0.0808	32	12	0.0606	24	—	—	—	50	0.2525
Royal/Caspian Tern	3	0.0152	100	—	—	—	—	—	—	—	—	—	3	0.0152
Sandwich Tern	1	0.0051	25	—	—	—	3	0.0152	75	—	—	—	4	0.0202
Thalasseus Tern unid.	1	0.0051	100	—	—	—	—	—	—	—	—	—	1	0.0051
Tern species unknown	—	—	—	1	0.0051	33.33	2	0.0101	66.67	—	—	—	3	0.0152
Common Tern	—	—	—	1	0.0051	100	—	—	—	—	—	—	1	0.0051
Forster's Tern	1	0.0051	100	—	—	—	—	—	—	—	—	—	1	0.0051
Commic/Forster's Tern	8	0.0404	80	—	—	—	2	0.0101	20	—	—	—	10	0.0505
Season Total	**36**	**0.1818**	**49.32**	**18**	**0.0909**	**24.66**	**19**	**0.096**	**26.03**	**—**	**—**	**—**	**73**	**0.3687**
2018 December														
Lesser Scaup	4	0.0192	100	—	—	—	—	—	—	—	—	—	4	0.0192
White-winged Scoter	—	—	—	—	—	—	—	—	—	1	0.0048	100	1	0.0048
Black Scoter	3	0.0144	75	—	—	—	—	—	—	1	0.0048	25	4	0.0192

(continued)

Table C–41. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Duck species unknown	2	0.0096	100	—	—	—	—	—	—	—	—	—	2	0.0096
Red-throated Loon	—	—	—	—	—	—	—	—	—	16	0.0768	100	16	0.0768
Common Loon	1	0.0048	0.59	—	—	—	—	—	—	169	0.8109	99.41	170	0.8157
Loon species unknown	—	—	—	—	—	—	—	—	—	2	0.0096	100	2	0.0096
Northern Gannet	158	0.7582	27.1	2	0.0096	0.34	2	0.0096	0.34	421	2.0202	72.21	583	2.7975
Red-necked Phalarope	—	—	—	—	—	—	—	—	—	2	0.0096	100	2	0.0096
Red Phalarope	22	0.1056	10.48	2	0.0096	0.95	—	—	—	186	0.8925	88.57	210	1.0077
Pomarine Jaeger	1	0.0048	100	—	—	—	—	—	—	—	—	—	1	0.0048
Murre/Razorbill	—	—	—	—	—	—	—	—	—	1	0.0048	100	1	0.0048
Bonaparte's Gull	1	0.0048	10	—	—	—	—	—	—	9	0.0432	90	10	0.048
Laughing Gull	7	0.0336	87.5	—	—	—	—	—	—	1	0.0048	12.5	8	0.0384
Ring-billed Gull	1	0.0048	50	—	—	—	—	—	—	1	0.0048	50	2	0.0096
Herring Gull	8	0.0384	33.33	—	—	—	—	—	—	16	0.0768	66.67	24	0.1152
Gull species unknown - Small	1	0.0048	100	—	—	—	—	—	—	—	—	—	1	0.0048
Tern species unknown	3	0.0144	100	—	—	—	—	—	—	—	—	—	3	0.0144
Forster's Tern	37	0.1775	97.37	1	0.0048	2.63	—	—	—	—	—	—	38	0.1823
Commic/Forster's Tern	5	0.024	100	—	—	—	—	—	—	—	—	—	5	0.024
Season Total	**254**	**1.2188**	**23.37**	**5**	**0.024**	**0.46**	**2**	**0.0096**	**0.18**	**826**	**3.9635**	**75.99**	**1,087**	**5.2159**
2019 December														
Red-throated Loon	—	—	—	—	—	—	—	—	—	2	0.0192	100	2	0.0192
Common Loon	3	0.0288	1.85	—	—	—	—	—	—	159	1.5277	98.15	162	1.5565
Northern Gannet	4	0.0384	23.53	2	0.0192	11.76	7	0.0673	41.18	4	0.0384	23.53	17	0.1633
Red Phalarope	868	8.3397	36.52	53	0.5092	2.23	28	0.269	1.18	1,428	13.7202	60.08	2,377	22.8382
Black-legged Kittiwake	1	0.0096	100	—	—	—	—	—	—	—	—	—	1	0.0096
Bonaparte's Gull	6	0.0576	54.55	3	0.0288	27.27	—	—	—	2	0.0192	18.18	11	0.1057
Herring Gull	—	—	—	—	—	—	—	—	—	4	0.0384	100	4	0.0384
Lesser Black-backed Gull	—	—	—	—	—	—	1	0.0096	100	—	—	—	1	0.0096
Great Black-backed Gull	1	0.0096	100	—	—	—	—	—	—	—	—	—	1	0.0096

(continued)

Table C–41. (Continued)

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)
Gull species unknown - Small	—	—	—	—	—	—	—	—	—	2	0.0192	100	2	0.0192
Forster's Tern	53	0.5092	51.46	11	0.1057	10.68	7	0.0673	6.8	32	0.3075	31.07	103	0.9896
Sterna Tern species unknown	1	0.0096	100	—	—	—	—	—	—	—	—	—	1	0.0096
Season Total	**937**	**9.0027**	**34.94**	**69**	**0.663**	**2.57**	**43**	**0.4131**	**1.6**	**1,633**	**15.6899**	**60.89**	**2,682**	**25.7686**

Table C–42. Density per km^2 of all flying and sitting birds observed by area for the February 2018 survey

Survey Area	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	
TRANSECT (Coverage Varies)													
SASA (6%)	5,816	3.0354	10.29	1,821	0.9504	3.22	4,255	2.2207	7.53	44,646	23.3008	78.97	56,538
A51 (34%)	—	—	—	—	—	—	1	0.4237	33.33	2	0.8475	66.67	3
A53 (34%)	87	33.4615	19.21	4	1.5385	0.88	33	12.6923	7.28	329	126.5385	72.63	453
CCA (11%)	21	0.6935	6.93	6	0.1982	1.98	23	0.7596	7.59	253	8.3553	83.50	303
TOTAL	**5,830**	**2.9877**	**10.24**	**1,828**	**0.9368**	**3.21**	**4,276**	**2.1913**	**7.51**	**45,006**	**23.0645**	**79.04**	**56,940**
GRID (≈10%)													
KH	5	0.0679	3.38	2	0.0272	1.35	47	0.6386	31.76	94	1.2772	63.51	148
WW	36	1.0193	5.69	9	0.2548	1.42	12	0.3398	1.90	576	16.3080	91.00	633
WE	432	5.5137	24.91	116	1.4805	6.69	61	0.7786	3.52	1,125	14.3586	64.88	1,734
GSCA	127	0.6390	5.96	35	0.1761	1.64	33	0.1660	1.55	1,935	9.7358	90.85	2,130
TOTAL	**594**	**1.5388**	**12.84**	**162**	**0.4197**	**3.50**	**153**	**0.3964**	**3.31**	**3,717**	**9.6290**	**80.35**	**4,626**
SURVEY TOTAL	**6,424**	**2.7484**	**10.43**	**1,990**	**0.8514**	**3.23**	**4,429**	**1.8949**	**7.19**	**48,723**	**20.8456**	**79.14**	**61,566**

[1] RSZ = 23–319 m

Table C–43. Density per km^2 of all flying and sitting birds observed by area for the February 2020 survey

Survey Area	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	N	Density (km^2)	%	
TRANSECT (Coverage Varies)													
SASA (6%)	4,383	2.2998	12.00	1,612	0.8458	4.41	3,438	1.8040	9.41	27,092	14.2155	74.17	36,525
A51 (34%)	—	—	—	—	—	—	—	—	—	—	—	—	—
A53 (34%)	1	0.3846	4.55	—	—	0.00	—	—	0.00	21	8.0769	95.45	22
CCA (11%)	37	1.2219	4.70	22	0.7266	2.80	52	1.7173	6.61	676	22.3250	85.90	787
TOTAL	**4,410**	**2.2720**	**11.86**	**1,630**	**0.8398**	**4.39**	**3,483**	**1.7944**	**9.37**	**27,649**	**14.2444**	**74.38**	**37,172**
GRID (≈10%)													
KH	16	0.2180	5.97	3	0.0409	1.12	3	0.0409	1.12	246	3.3515	91.79	268
WW	323	9.1683	12.09	123	3.4913	4.60	227	6.4434	8.50	1,999	56.7414	74.81	2,672
WE	1,622	20.7576	24.75	577	7.3842	8.80	525	6.7187	8.01	3,830	49.0146	58.44	6,554
GSCA	516	2.5996	20.56	185	0.9320	7.37	295	1.4862	11.75	1,514	7.6276	60.32	2,510
TOTAL	**2,420**	**6.2815**	**20.45**	**885**	**2.2971**	**7.48**	**1,046**	**2.7150**	**8.84**	**7,482**	**19.4207**	**63.23**	**11,833**
SURVEY TOTAL	**6,830**	**2.9360**	**13.94**	**2,515**	**1.0811**	**5.13**	**4,529**	**1.9469**	**9.24**	**35,131**	**15.1016**	**71.69**	**49,005**

[1] RSZ = 23–319 m

Table C–44. Density per km² of all flying and sitting birds observed by area for the May/June 2018 survey

Survey Area	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	
TRANSECT (Coverage Varies)													
SASA (6%)	151	0.0871	59.92	24	0.0138	9.52	58	0.0334	23.02	19	0.0110	7.54	252
A51 (34%)	—	—	—	—	—	—	—	—	—	—	—	—	—
A53 (34%)	—	—	—	—	—	—	—	—	—	—	—	—	—
CCA (11%)	1	0.0330	100.00	—	—	0.00	—	—	0.00	—	—	0.00	1
TOTAL	**152**	**0.0859**	**60.08**	**24**	**0.0136**	**9.49**	**58**	**0.0328**	**22.92**	**19**	**0.0107**	**7.51**	**253**
GRID (≈10%)													
KH	—	—	—	—	—	—	—	—	—	—	—	—	—
WW	—	—	—	—	—	—	—	—	—	—	—	—	—
WE	—	—	—	—	—	—	—	—	—	—	—	—	—
GSCA	1	0.0049	25.00	—	—	0.00	2	0.0099	50.00	1	0.0049	25.00	4
TOTAL	**1**	**0.0026**	**25.00**	**—**	**—**	**0.00**	**2**	**0.0051**	**50.00**	**1**	**0.0026**	**25.00**	**4**
SURVEY TOTAL	**153**	**0.0709**	**59.53**	**24**	**0.0111**	**9.34**	**60**	**0.0278**	**23.35**	**20**	**0.0093**	**7.78**	**257**

[1] RSZ = 23–319 m

Table C–45. Density per km² of all flying and sitting birds observed by area for the May 2019 survey

Survey Area	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	
TRANSECT (Coverage Varies)													
SASA (6%)	457	0.2397	65.85	35	0.0184	5.04	105	0.0551	15.13	97	0.0509	13.98	694
A51 (34%)	—	—	—	—	—	—	—	—	—	—	—	—	—
A53 (34%)	—	—	—	—	—	—	—	—	—	—	—	—	—
CCA (11%)	1	0.0330	20.00	3	0.0991	60.00	—	—	0.00	1	0.0330	20.00	5
TOTAL	**457**	**0.2354**	**65.66**	**36**	**0.0185**	**5.17**	**105**	**0.0541**	**15.09**	**98**	**0.0505**	**14.08**	**696**
GRID (≈10%)													
KH	1	0.0136	11.11	—	—	0.00	—	—	0.00	8	0.1090	88.89	9
WW	24	0.6812	100.00	—	—	0.00	—	—	0.00	—	—	0.00	24
WE	1	0.0128	14.29	1	0.0128	14.29	3	0.0384	42.86	2	0.0256	28.57	7
GSCA	28	0.1268	65.12	2	0.0091	4.65	5	0.0226	11.63	8	0.0362	18.60	43
TOTAL	**30**	**0.0736**	**50.85**	**3**	**0.0074**	**5.08**	**8**	**0.0196**	**13.56**	**18**	**0.0442**	**30.51**	**59**
SURVEY TOTAL	**487**	**0.2073**	**64.50**	**39**	**0.0166**	**5.17**	**113**	**0.0481**	**14.97**	**116**	**0.0494**	**15.36**	**755**

[1] RSZ = 23–319 m

Table C–46. Density per km² of all flying and sitting birds observed by area for the October 2018 survey

Survey Area	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	
TRANSECT (Coverage Varies)													
SASA (6%)	778	0.4303	49.81	137	0.0758	8.77	230	0.1272	14.72	417	0.2306	26.70	1,562
A51 (34%)	—	—	—	—	—	—	—	—	—	—	—	—	—
A53 (34%)	—	—	—	—	—	—	—	—	—	—	—	—	—
CCA (11%)	3	0.0991	50.00	1	0.0330	16.67	2	0.0661	33.33	—	—	0.00	6
TOTAL	**780**	**0.4232**	**49.84**	**138**	**0.0749**	**8.82**	**230**	**0.1248**	**14.70**	**417**	**0.2262**	**26.65**	**1,565**
GRID (≈10%)													
KH	2	0.0272	50.00	—	—	0.00	—	—	0.00	2	0.0272	50.00	4
WW	6	0.1705	75.00	1	0.0284	12.50	1	0.0284	12.50	—	—	0.00	8
WE	9	0.1149	50.00	3	0.0383	16.67	1	0.0128	5.56	5	0.0638	27.78	18
GSCA	377	1.6742	64.33	31	0.1377	5.29	38	0.1688	6.48	140	0.6217	23.89	586
TOTAL	**394**	**0.9409**	**63.96**	**35**	**0.0836**	**5.68**	**40**	**0.0955**	**6.49**	**147**	**0.3511**	**23.86**	**616**
SURVEY TOTAL	**1,174**	**0.5190**	**53.83**	**173**	**0.0765**	**7.93**	**270**	**0.1194**	**12.38**	**564**	**0.2493**	**25.86**	**2,181**

[1] RSZ = 23–319 m

Table C–47. Density per km² of all flying and sitting birds observed by area for the September 2019 survey

Survey Area	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	
TRANSECT (Coverage Varies)													
SASA (6%)	1,296	0.6762	64.83	187	0.0976	9.35	383	0.1998	19.16	133	0.0694	6.65	1,999
A51 (34%)	1	0.4237	50.00	1	0.4237	50.00	—	—	—	—	—	—	2
A53 (34%)	23	8.8462	53.49	4	1.5385	9.30	10	3.8462	23.26	6	2.3077	13.95	43
CCA (11%)	58	1.9155	67.44	1	0.0330	1.16	5	0.1651	5.81	22	0.7266	25.58	86
TOTAL	**1,361**	**0.6973**	**64.50**	**191**	**0.0979**	**9.05**	**397**	**0.2034**	**18.82**	**161**	**0.0825**	**7.63**	**2,110**
GRID (≈10%)													
KH	5	0.0681	71.43	—	—	0.00	1	0.0136	14.29	1	0.0136	14.29	7
WW	11	0.3122	52.38	3	0.0852	14.29	5	0.1419	23.81	2	0.0568	9.52	21
WE	102	1.3064	70.83	6	0.0768	4.17	15	0.1921	10.42	21	0.2690	14.58	144
GSCA	36	0.1818	49.32	18	0.0909	24.66	19	0.0960	26.03	—	—	0.00	73
TOTAL	**151**	**0.3925**	**62.40**	**27**	**0.0702**	**11.16**	**40**	**0.1040**	**16.53**	**24**	**0.0624**	**9.92**	**242**
SURVEY TOTAL	**1,512**	**0.6471**	**64.29**	**218**	**0.0933**	**9.27**	**437**	**0.1870**	**18.58**	**185**	**0.0792**	**7.87**	**2,352**

[1] RSZ = 23–319 m

Table C–48. Density per km² of all flying and sitting birds observed by area for the December 2018 survey

Survey Area	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	
TRANSECT (Coverage Varies)													
SASA (6%)	1,929	1.0072	15.35	421	0.2198	3.35	615	0.3211	4.89	9,601	5.0132	76.40	12,566
A51 (34%)	—	—	—	—	—	—	1	0.4237	20.00	4	1.6949	80.00	5
A53 (34%)	—	—	—	—	—	—	—	—	—	2	0.7692	100.00	2
CCA (11%)	—	—	—	—	—	—	—	—	—	13	0.4275	100.00	13
TOTAL	**1,929**	**0.9890**	**15.34**	**421**	**0.2158**	**3.35**	**615**	**0.3153**	**4.89**	**9,607**	**4.9254**	**76.42**	**12,572**
GRID (≈10%)													
KH	1,068	14.5109	31.71	309	4.1984	9.17	232	3.1522	6.89	1,759	23.8995	52.23	3,368
WW	123	2.9567	31.30	5	0.1202	1.27	2	0.0481	0.51	263	6.3221	66.92	393
WE	144	1.8379	54.34	26	0.3318	9.81	19	0.2425	7.17	76	0.9700	28.68	265
GSCA	254	1.2188	23.37	5	0.0240	0.46	2	0.0096	0.18	826	3.9635	75.99	1,087
TOTAL	**1,580**	**3.9768**	**31.18**	**340**	**0.8558**	**6.71**	**253**	**0.6368**	**4.99**	**2,894**	**7.2842**	**57.11**	**5,067**
SURVEY TOTAL	**3,509**	**1.4946**	**19.89**	**761**	**0.3241**	**4.31**	**868**	**0.3697**	**4.92**	**12,501**	**5.3245**	**70.87**	**17,639**

[1] RSZ = 23–319 m

Table C–49. Density per km² of all flying and sitting birds observed by area for the December 2019 survey

Survey Area	Flight Height Unknown			Flying outside RSZ[1]			Flying within RSZ[1]			Sitting			Total Number
	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	N	Density (km²)	%	
TRANSECT (Coverage Varies)													
SASA (6%)	1,940	1.0167	20.30	570	0.2987	5.96	723	0.3789	7.56	6,325	3.3147	66.17	9,558
A51 (34%)	—	—	—	—	—	—	—	—	—	3	1.2712	100.00	3
A53 (34%)	—	—	—	—	—	—	—	—	—	2	0.7692	100.00	2
CCA (11%)	45	1.4861	30.61	7	0.2312	4.76	1	0.0330	0.68	94	3.1044	63.95	147
TOTAL	**1,944**	**1.0003**	**20.20**	**570**	**0.2933**	**5.92**	**723**	**0.3720**	**7.51**	**6,385**	**3.2855**	**66.36**	**9,622**
GRID (≈10%)													
KH	33	0.4493	18.44	19	0.2587	10.61	12	0.1634	6.70	115	1.5657	64.25	179
WW	187	12.0335	24.16	39	2.5097	5.04	22	1.4157	2.84	526	33.8481	67.96	774
WE	310	3.9677	25.54	31	0.3968	2.55	22	0.2816	1.81	851	10.8921	70.10	1,214
GSCA	937	9.0027	34.94	69	0.6630	2.57	43	0.4131	1.60	1,633	15.6899	60.89	2,682
TOTAL	**1,441**	**5.3134**	**30.68**	**149**	**0.5494**	**3.17**	**92**	**0.3392**	**1.96**	**3,015**	**11.1173**	**64.19**	**4,697**
SURVEY TOTAL	**3,385**	**1.5285**	**23.64**	**719**	**0.3247**	**5.02**	**815**	**0.3680**	**5.69**	**9,400**	**4.2446**	**65.65**	**14,319**

[1] RSZ = 23–319 m

C.7 Flight Heights for Flying Birds Observed during the February 2018 through February 2020 Surveys

Table C–50. Flight heights for flying birds observed during the February 2018 through February 2020 surveys for each species for all areas combined

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Black Scoter	1	31.3	31.3	31.3		15.65
Red-breasted Merganser	3	12.4	69.0	27.6	29.29	40.1242
Duck species unknown	2	54.1	63.8	59	6.90	85.0277
Red-throated Loon	35	0.5	85.1	32.3	24.76	29.9409
Common Loon	3	37.6	67.7	39.6	16.81	29.742
Northern Fulmar	20	0.4	71.6	27.9	18.95	38.0121
Northern Gannet	761	0.2	117.9	34.4	27.18	35.3474
Cormorant species unknown	1	40.8	40.8	40.8		25.7195
Red Phalarope	978	0.2	82.8	38.8	21.39	24.8727
Red/Red-necked Phalarope	134	0.0	74.3	24.1	20.77	40.744
Great Skua	1	54.4	54.4	54.4		42.3748
Parasitic Jaeger	1	46.9	46.9	46.9		43.31
Razorbill	27	0.2	66.7	16	14.48	36.9299
Black-legged Kittiwake	4	46.2	83.7	58.1	17.30	45.152
Bonaparte's Gull	4,168	0.0	154.3	41.3	36.94	31.1939
Ring-billed Gull	6	51.6	142.6	90.9	39.38	32.4151
Herring Gull	92	0.5	118.5	44.6	28.78	63.4762
Great Black-backed Gull	7	16.9	107.3	64	37.32	36.2016
Gull species unknown - Small	11	1.9	137.7	39.7	43.53	35.7049
Forster's Tern	164	0.6	71.0	27	19.45	27.9296
2020 February						
Greater Scaup	11	11.8	47.1	25.3	12.65	31.429
Red-throated Loon	5	13.2	49.5	42	15.56	34.8075
Common Loon	1	0.1	0.1	0.1		10.0838
Manx Shearwater	5	2.0	40.6	19.4	16.46	69.062
Northern Gannet	550	0.1	111.3	26.8	26.25	36.8328
Cormorant species unknown	3	10.1	79.3	22	37.00	29.9768
Red Phalarope	2,131	0.1	97.9	31.9	26.20	43.3955
Parasitic Jaeger	1	29.2	29.2	29.2		113.216
Razorbill	60	0.1	44.4	16.2	11.96	60.4382
Murre/Razorbill	1	29.0	29.0	29		37.823
Black-legged Kittiwake	26	0.3	117.5	47.4	36.55	46.0233
Bonaparte's Gull	3,850	0.0	170.0	35.7	33.81	35.0373

(continued)

Table C–50. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
Little Gull	1	25.7	25.7	25.7		
Laughing Gull	2	68.9	139.1	104	49.62	29.7638
Ring-billed Gull	2	14.6	33.4	24	13.26	32.2193
Herring Gull	191	0.1	211.0	38.9	43.73	68.3118
Lesser Black-backed Gull	3	18.1	124.9	29.9	58.57	31.2274
Great Black-backed Gull	7	7.8	77.0	28.7	26.40	42.3495
Gull species unknown - Small	3	3.0	51.7	3.9	27.83	89.8129
Forster's Tern	129	0.0	94.6	27.8	24.87	27.5087
Commic/Forster's Tern	60	1.6	63.6	34.1	18.12	51.9121
Sterna Tern species unknown	2	26.8	56.3	41.6	20.82	54.5305
2018 May/June						
Cory's Shearwater	3	0.7	26.2	6.2	13.43	37.1927
Great Shearwater	1	6.1	6.1	6.1		35.4732
Laughing Gull	17	3.0	77.7	25.7	22.84	30.3413
Caspian Tern	5	27.0	39.4	28.6	6.16	39.4677
Black Tern	7	0.4	40.2	12.1	15.13	37.6388
Royal Tern	36	2.8	58.6	36.5	12.56	29.7906
Sandwich Tern	9	1.1	47.1	26.6	15.87	48.1029
Sterna Tern species unknown	6	9.4	42.4	34.1	14.38	55.8708
2019 May						
Cory's Shearwater	1	13.7	13.7	13.7		33.2584
Black-bellied Plover	5	32.6	45.5	42.1	4.90	21.0966
Ruddy Turnstone	2	33.8	86.6	60.2	37.39	11.9104
Shorebird species unknown	20	0.5	44.9	26.7	11.88	260.448
Red/Red-necked Phalarope	1	2.1	2.1	2.1		53.0865
Laughing Gull	8	7.3	84.7	56.6	23.04	29.8498
Herring Gull	2	74.1	95.1	84.6	14.80	60.7574
Gull-billed Tern	1	73.3	73.3	73.3		34.7186
Caspian Tern	4	42.4	128.2	90.1	36.14	33.3373
Black Tern	1	26.4	26.4	26.4		45.1841
Royal Tern	63	1.8	83.7	45.1	22.60	28.1936
Royal/Caspian Tern	7	11.1	72.8	36.9	21.17	27.9475
Sandwich Tern	2	21.2	27.1	24.2	4.20	42.622
Tern species unknown	3	26.3	39.1	26.7	7.26	117.808
Common Tern	15	5.9	47.0	26.8	14.36	44.401
Commic/Forster's Tern	17	4.1	65.2	40.2	20.14	50.9742
2018 October						
Common Loon	2	17.7	47.9	32.8	21.29	18.4949
Black-capped Petrel	1	73.9	73.9	73.9		27.3988

(continued)

Table C–50. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
Cory's Shearwater	7	1.6	32.1	12	10.95	42.0996
Northern Gannet	15	11.7	128.2	81.8	39.32	35.2519
Double-crested Cormorant	6	13.6	39.4	29.5	9.94	32.4712
Brown Pelican	1	63.4	63.4	63.4		33.0369
Great Blue Heron	13	60.8	295.7	123.3	96.03	21.3546
Great Egret	1	252.7	252.7	252.7		23.8329
Green Heron	1	42.9	42.9	42.9		28.7761
Peregrine Falcon	1	52.7	52.7	52.7		28.3045
Dunlin	3	44.1	52.8	47.1	4.41	29.0324
Shorebird species unknown	7	20.9	56.0	34.3	10.95	243.641
Red Phalarope	7	3.8	63.7	28.7	25.31	33.203
Parasitic Jaeger	1	73.7	73.7	73.7		90.1892
Bonaparte's Gull	4	64.3	145.7	105.9	36.44	32.3336
Laughing Gull	79	0.0	175.7	43.8	44.61	28.6743
Ring-billed Gull	2	67.2	158.8	113	64.80	22.7409
Herring Gull	19	3.1	134.3	29.8	39.19	64.9486
Lesser Black-backed Gull	1	1.2	1.2	1.2		28.3311
Great Black-backed Gull	5	3.3	79.6	14.8	35.70	41.1858
Gull species unknown - Small	3	2.7	75.7	59.6	38.35	79.9417
Bridled Tern	1	8.5	8.5	8.5		32.9304
Gull-billed Tern	6	12.2	78.1	43.7	24.64	42.0609
Caspian Tern	4	17.5	47.4	35.9	12.39	32.5213
Royal Tern	31	0.2	35.7	23.7	10.79	33.5096
Royal/Caspian Tern	31	1.6	49.9	31.1	14.33	26.114
Sandwich Tern	13	1.1	38.4	16.6	12.63	49.5636
Tern species unknown	28	1.3	53.3	25.8	15.23	122.256
Common Tern	21	0.4	27.0	13.6	9.79	40.3714
Commic Tern	1	18.3	18.3	18.3		
Forster's Tern	20	0.9	54.6	20.4	15.98	31.8913
Commic/Forster's Tern	104	0.2	52.2	25.8	14.96	52.9181
Sterna Tern species unknown	4	6.5	39.2	23.7	14.05	
2019 September						
Black-capped Petrel	1	37.0	37.0	37		14.5893
Cory's Shearwater	11	4.2	49.9	17.4	16.96	41.8382
Audubon's Shearwater	4	15.5	56.6	32.6	19.83	21.0641
Shearwater species unknown	1	102.0	102.0	102		
Great Blue Heron	1	188.4	188.4	188.4		27.3126
Red Phalarope	5	2.0	40.1	23.1	13.77	32.4184
Skua species unknown	1	13.8	13.8	13.8		

(continued)

Table C–50. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
Laughing Gull	8	18.0	79.7	54.7	20.75	27.6848
Least Tern	3	1.0	36.2	15.2	17.72	29.5791
Gull-billed Tern	1	68.7	68.7	68.7		45.7881
Caspian Tern	1	9.2	9.2	9.2		37.7096
Black Tern	118	0.8	120.1	43.2	34.62	39.5708
Royal Tern	123	0.8	79.5	29.6	21.17	30.764
Royal/Caspian Tern	2	10.4	17.2	13.8	4.84	31.6135
Sandwich Tern	36	0.5	82.6	43	24.96	48.3012
Tern species unknown	4	21.4	71.4	49.1	21.17	116.282
Common Tern	201	0.2	126.4	39	30.62	41.0727
Forster's Tern	4	6.2	30.9	25	11.57	29.7585
Commic/Forster's Tern	128	0.2	113.5	39.8	28.39	52.4927
Sterna Tern species unknown	2	12.6	34.6	23.6	15.55	55.8491
2018 December						
Black Scoter	12	1.8	42.5	26.4	13.34	30.8736
Red-breasted Merganser	4	36.6	61.9	59.6	12.01	27.6625
Red-throated Loon	6	8.5	28.7	23.9	7.88	25.1951
Common Loon	4	8.4	28.5	27.5	9.76	27.1027
Manx Shearwater	3	23.8	43.8	34	10.02	63.3475
Northern Gannet	453	0.1	136.8	25.1	27.82	32.8114
Double-crested Cormorant	2	23.5	50.2	36.9	18.90	23.7545
Cormorant species unknown	1	8.2	8.2	8.2		22.3918
Red Phalarope	8	1.8	47.2	19.1	14.38	21.4904
Razorbill	10	6.0	28.9	18.3	7.35	50.9283
Atlantic Puffin	1	27.5	27.5	27.5		66.1673
Black-legged Kittiwake	168	0.1	102.5	22.4	18.10	43.6838
Bonaparte's Gull	449	0.0	76.3	20.4	19.29	32.3489
Laughing Gull	94	0.2	86.2	33.7	25.64	28.5479
Ring-billed Gull	25	7.1	84.3	29.7	21.42	25.2308
Herring Gull	213	0.0	210.4	40.3	39.11	59.3531
Lesser Black-backed Gull	6	6.0	40.7	7.6	13.65	32.4898
Great Black-backed Gull	41	0.1	243.3	39.3	61.92	35.7769
Gull species unknown - Small	4	8.6	84.5	54.1	31.29	69.5949
Royal Tern	1	55.0	55.0	55		24.3944
Tern species unknown	1	11.8	11.8	11.8		113.688
Common Tern	1	11.3	11.3	11.3		45.8689
Forster's Tern	106	0.1	51.8	22.4	14.53	28.8222
Commic/Forster's Tern	16	0.6	53.0	20.9	15.83	46.8834

(continued)

Table C–50. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
2019 December						
Greater Scaup	3	37.4	53.9	40.1	8.84	24.752
White-winged Scoter	1	11.2	11.2	11.2		39.8281
Black Scoter	9	1.3	49.7	31.5	18.23	40.9992
Red-breasted Merganser	2	25.3	43.4	34.4	12.77	39.9703
Red-throated Loon	8	6.6	38.8	21.3	10.73	35.3647
Common Loon	7	0.7	53.7	30.4	18.86	17.4963
Loon species unknown	1	2.5	2.5	2.5		85.9124
Manx Shearwater	1	0.7	0.7	0.7		80.5622
Northern Gannet	588	0.0	76.7	23.6	19.40	35.8815
Cormorant species unknown	1	66.3	66.3	66.3		23.631
Red Phalarope	241	0.1	62.0	19.5	17.52	28.678
Red/Red-necked Phalarope	75	0.5	59.1	30.5	17.06	44.5968
Great Skua	1	0.4	0.4	0.4		37.2033
Black-legged Kittiwake	2	23.7	66.6	45.1	30.29	40.7791
Bonaparte's Gull	33	0.0	57.2	21.8	16.17	38.7364
Laughing Gull	174	1.4	106.3	35.7	26.81	31.9291
Ring-billed Gull	3	10.5	54.8	20.8	23.18	23.6868
Herring Gull	107	1.9	93.3	32.7	26.08	68.1718
Lesser Black-backed Gull	1	87.0	87.0	87		38.1206
Great Black-backed Gull	19	11.2	72.5	36.6	19.88	41.0358
Tern species unknown	1	30.3	30.3	30.3		121.273
Forster's Tern	232	0.1	60.5	23.3	16.81	31.0669
Commic/Forster's Tern	23	2.4	60.2	28.6	16.03	55.5102
Sterna Tern species unknown	1	9.4	9.4	9.4		53.9695
All Surveys						
Greater Scaup	14	11.8	53.9	32.9	13.10	24.752-31.429
White-winged Scoter	1	11.2	11.2	11.2		39.8281
Black Scoter	22	1.3	49.7	29.6	14.88	15.65-40.9992
Red-breasted Merganser	9	12.4	69.0	43.4	19.71	27.6625-40.1242
Duck species unknown	2	54.1	63.8	59	6.90	85.0277
Red-throated Loon	54	0.5	85.1	27.8	22.06	25.1951-35.3647
Common Loon	17	0.1	67.7	28.5	18.62	10.0838-29.742
Loon species unknown	1	2.5	2.5	2.5		85.9124
Northern Fulmar	20	0.4	71.6	27.9	18.95	38.0121
Black-capped Petrel	2	37.0	73.9	55.5	26.08	14.5893-27.3988
Cory's Shearwater	22	0.7	49.9	13.5	14.38	33.2584-42.0996
Great Shearwater	1	6.1	6.1	6.1		35.4732
Manx Shearwater	9	0.7	43.8	23.8	16.58	63.3475-80.5622

(continued)

Table C–50. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
Audubon's Shearwater	4	15.5	56.6	32.6	19.83	21.0641
Shearwater species unknown	1	102.0	102.0	102		
Northern Gannet	2,367	0.0	136.8	27.5	26.02	32.8114-36.8328
Double-crested Cormorant	8	13.6	50.2	29.5	11.62	23.7545-32.4712
Cormorant species unknown	6	8.2	79.3	31.4	29.78	22.3918-29.9768
Brown Pelican	1	63.4	63.4	63.4		33.0369
Great Blue Heron	14	60.8	295.7	155.8	92.37	21.3546-27.3126
Great Egret	1	252.7	252.7	252.7		23.8329
Green Heron	1	42.9	42.9	42.9		28.7761
Peregrine Falcon	1	52.7	52.7	52.7		28.3045
Black-bellied Plover	5	32.6	45.5	42.1	4.90	21.0966
Ruddy Turnstone	2	33.8	86.6	60.2	37.39	11.9104
Dunlin	3	44.1	52.8	47.1	4.41	29.0324
Shorebird species unknown	27	0.5	56.0	28	12.01	243.641-260.448
Red Phalarope	3,370	0.1	97.9	32.5	24.57	21.4904-43.3955
Red/Red-necked Phalarope	210	0.0	74.3	26.6	19.52	40.744-53.0865
Great Skua	2	0.4	54.4	27.4	38.20	37.2033-42.3748
Parasitic Jaeger	3	29.2	73.7	46.9	22.40	43.31-113.216
Skua species unknown	1	13.8	13.8	13.8		
Razorbill	97	0.1	66.7	16.4	12.24	36.9299-60.4382
Murre/Razorbill	1	29.0	29.0	29		37.823
Atlantic Puffin	1	27.5	27.5	27.5		66.1673
Black-legged Kittiwake	200	0.1	117.5	24.1	23.03	40.7791-46.0233
Bonaparte's Gull	8,504	0.0	170.0	37.2	35.25	31.1939-38.7364
Little Gull	1	25.7	25.7	25.7		
Laughing Gull	382	0.0	175.7	36.4	32.11	27.6848-31.9291
Ring-billed Gull	38	7.1	158.8	34.3	37.71	22.7409-32.4151
Herring Gull	624	0.0	211.0	39.1	37.57	59.3531-68.3118
Lesser Black-backed Gull	11	1.2	124.9	16.4	39.58	28.3311-38.1206
Great Black-backed Gull	79	0.1	243.3	38.8	49.22	35.7769-42.3495
Gull species unknown - Small	21	1.9	137.7	42.5	37.57	35.7049-89.8129
Bridled Tern	1	8.5	8.5	8.5		32.9304
Least Tern	3	1.0	36.2	15.2	17.72	29.5791
Gull-billed Tern	8	12.2	78.1	49.9	24.92	34.7186-45.7881
Caspian Tern	14	9.2	128.2	37.9	33.18	32.5213-39.4677
Black Tern	126	0.4	120.1	42	34.60	37.6388-45.1841
Royal Tern	254	0.2	83.7	32.1	20.59	24.3944-33.5096
Royal/Caspian Tern	40	1.6	72.8	30.2	15.83	26.114-31.6135
Sandwich Tern	60	0.5	82.6	33.6	24.22	42.622-49.5636

(continued)

Table C–50. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
Tern species unknown	37	1.3	71.4	26.7	16.56	113.688-122.256
Common Tern	238	0.2	126.4	33.3	29.88	40.3714-45.8689
Commic Tern	1	18.3	18.3	18.3		
Forster's Tern	655	0.0	94.6	24.8	19.33	27.5087-31.8913
Commic/Forster's Tern	348	0.2	113.5	31.2	22.68	46.8834-55.5102
Sterna Tern species unknown	15	6.5	56.3	28.9	14.94	53.9695-55.8708

Table C–51. Flight heights for flying birds observed during the February 2018 through February 2020 surveys for each species in the South Atlantic Survey Area (SASA; counts include all of A51, part of A53, and part of CCA)

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Black Scoter	1	31.3	31.3	31.3		15.65
Red-breasted Merganser	3	12.4	69.0	27.6	29.29	40.1242
Duck species unknown	2	54.1	63.8	59.0	6.90	85.0277
Red-throated Loon	35	0.5	85.1	32.3	24.76	29.9409
Common Loon	3	37.6	67.7	39.6	16.81	29.742
Northern Fulmar	18	0.4	71.6	28.4	19.99	38.0121
Northern Gannet	697	0.2	117.9	33.6	26.88	35.3474
Cormorant species unknown	1	40.8	40.8	40.8		25.7195
Red Phalarope	903	0.2	82.8	39.8	21.42	24.8727
Red/Red-necked Phalarope	134	0.0	74.3	24.1	20.77	40.744
Parasitic Jaeger	1	46.9	46.9	46.9		43.31
Razorbill	27	0.2	66.7	16.0	14.48	36.9299
Black-legged Kittiwake	2	46.2	49.5	47.8	2.37	45.152
Bonaparte's Gull	3,984	0.0	154.3	43.1	37.18	31.1939
Ring-billed Gull	5	51.6	142.6	85.4	44.02	32.4151
Herring Gull	89	0.5	118.5	47.3	29.06	63.4762
Great Black-backed Gull	6	16.9	100.8	51.4	34.23	36.2016
Gull species unknown - Small	11	1.9	137.7	39.7	43.53	35.7049
Forster's Tern	154	0.6	71.0	27.3	19.56	27.9296
2020 February						
Greater Scaup	11	11.8	47.1	25.3	12.65	31.429
Red-throated Loon	5	13.2	49.5	42.0	15.56	34.8075
Manx Shearwater	5	2.0	40.6	19.4	16.46	69.062
Northern Gannet	480	0.1	111.3	25.6	27.12	36.8328
Cormorant species unknown	3	10.1	79.3	22.0	37.00	29.9768
Red Phalarope	961	0.3	97.9	44.4	27.39	43.3955

(continued)

Table C–51. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
Parasitic Jaeger	1	29.2	29.2	29.2		113.216
Razorbill	56	0.1	44.4	16.4	12.15	60.4382
Murre/Razorbill	1	29.0	29.0	29.0		37.823
Black-legged Kittiwake	25	0.3	117.5	53.6	36.69	46.0233
Bonaparte's Gull	3,135	0.0	170.0	38.6	34.92	35.0373
Laughing Gull	2	68.9	139.1	104.0	49.62	29.7638
Ring-billed Gull	2	14.6	33.4	24.0	13.26	32.2193
Herring Gull	171	0.1	211.0	36.0	40.55	68.3118
Lesser Black-backed Gull	3	18.1	124.9	29.9	58.57	31.2274
Great Black-backed Gull	6	7.8	63.4	25.8	22.50	42.3495
Gull species unknown - Small	3	3.0	51.7	3.9	27.83	89.8129
Forster's Tern	120	0.0	94.6	27.7	25.19	27.5087
Commic/Forster's Tern	60	1.6	63.6	34.1	18.12	51.9121
2018 May/June						
Cory's Shearwater	2	0.7	6.2	3.4	3.85	37.1927
Great Shearwater	1	6.1	6.1	6.1		35.4732
Laughing Gull	17	3.0	77.7	25.7	22.84	30.3413
Caspian Tern	5	27.0	39.4	28.6	6.16	39.4677
Black Tern	7	0.4	40.2	12.1	15.13	37.6388
Royal Tern	35	2.8	55.9	36.3	12.15	29.7906
Sandwich Tern	9	1.1	47.1	26.6	15.87	48.1029
Sterna Tern species unknown	6	9.4	42.4	34.1	14.38	55.8708
2019 May						
Cory's Shearwater	1	13.7	13.7	13.7		33.2584
Black-bellied Plover	5	32.6	45.5	42.1	4.90	21.0966
Ruddy Turnstone	2	33.8	86.6	60.2	37.39	11.9104
Shorebird species unknown	20	0.5	44.9	26.7	11.88	260.448
Red/Red-necked Phalarope	1	2.1	2.1	2.1		53.0865
Laughing Gull	8	7.3	84.7	56.6	23.04	29.8498
Herring Gull	2	74.1	95.1	84.6	14.80	60.7574
Gull-billed Tern	1	73.3	73.3	73.3		34.7186
Caspian Tern	4	42.4	128.2	90.1	36.14	33.3373
Black Tern	1	26.4	26.4	26.4		45.1841
Royal Tern	56	1.8	83.7	48.3	23.01	28.1936
Royal/Caspian Tern	7	11.1	72.8	36.9	21.17	27.9475
Sandwich Tern	2	21.2	27.1	24.2	4.20	42.622
Tern species unknown	3	26.3	39.1	26.7	7.26	117.808
Common Tern	14	5.9	47.0	26.6	14.44	44.401
Commic/Forster's Tern	13	4.1	65.2	40.2	20.57	50.9742

(continued)

Table C–51. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
2018 October						
Common Loon	2	17.7	47.9	32.8	21.29	18.4949
Black-capped Petrel	1	73.9	73.9	73.9		27.3988
Cory's Shearwater	6	1.6	32.1	9.5	11.53	42.0996
Northern Gannet	15	11.7	128.2	81.8	39.32	35.2519
Double-crested Cormorant	6	13.6	39.4	29.5	9.94	32.4712
Brown Pelican	1	63.4	63.4	63.4		33.0369
Great Blue Heron	13	60.8	295.7	123.3	96.03	21.3546
Great Egret	1	252.7	252.7	252.7		23.8329
Green Heron	1	42.9	42.9	42.9		28.7761
Peregrine Falcon	1	52.7	52.7	52.7		28.3045
Dunlin	3	44.1	52.8	47.1	4.41	29.0324
Shorebird species unknown	7	20.9	56.0	34.3	10.95	243.641
Red Phalarope	7	3.8	63.7	28.7	25.31	33.203
Bonaparte's Gull	4	64.3	145.7	105.9	36.44	32.3336
Laughing Gull	79	0.0	175.7	43.8	44.61	28.6743
Ring-billed Gull	2	67.2	158.8	113.0	64.80	22.7409
Herring Gull	19	3.1	134.3	29.8	39.19	64.9486
Lesser Black-backed Gull	1	1.2	1.2	1.2		28.3311
Great Black-backed Gull	5	3.3	79.6	14.8	35.70	41.1858
Gull species unknown - Small	3	2.7	75.7	59.6	38.35	79.9417
Gull-billed Tern	6	12.2	78.1	43.7	24.64	42.0609
Caspian Tern	4	17.5	47.4	35.9	12.39	32.5213
Royal Tern	24	0.2	35.7	23.1	10.83	33.5096
Royal/Caspian Tern	26	1.6	49.9	30.2	14.64	26.114
Sandwich Tern	12	1.1	38.4	16.9	12.84	49.5636
Tern species unknown	27	1.3	53.3	25.1	15.51	122.256
Common Tern	9	0.4	24.0	7.4	8.86	40.3714
Commic Tern	1	18.3	18.3	18.3		
Forster's Tern	4	1.3	47.7	6.1	22.07	31.8913
Commic/Forster's Tern	73	1.0	52.2	26.3	14.74	52.9181
Sterna Tern species unknown	4	6.5	39.2	23.7	14.05	
2019 September						
Black-capped Petrel	1	37.0	37.0	37.0		14.5893
Cory's Shearwater	9	4.2	49.9	17.4	18.02	41.8382
Audubon's Shearwater	3	15.5	45.3	19.9	16.10	21.0641
Shearwater species unknown	1	102.0	102.0	102.0		
Great Blue Heron	1	188.4	188.4	188.4		27.3126
Red Phalarope	5	2.0	40.1	23.1	13.77	32.4184

(continued)

Table C–51. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
Skua species unknown	1	13.8	13.8	13.8		
Laughing Gull	8	18.0	79.7	54.7	20.75	27.6848
Least Tern	3	1.0	36.2	15.2	17.72	29.5791
Caspian Tern	1	9.2	9.2	9.2		37.7096
Black Tern	115	0.8	120.1	43.1	34.97	39.5708
Royal Tern	76	0.8	79.5	34.2	21.79	30.764
Royal/Caspian Tern	2	10.4	17.2	13.8	4.84	31.6135
Sandwich Tern	33	0.5	82.6	41.9	24.76	48.3012
Tern species unknown	1	71.4	71.4	71.4		116.282
Common Tern	193	0.2	126.4	39.1	30.40	41.0727
Forster's Tern	4	6.2	30.9	25.0	11.57	29.7585
Commic/Forster's Tern	111	0.2	113.5	39.2	29.69	52.4927
Sterna Tern species unknown	2	12.6	34.6	23.6	15.55	55.8491
2018 December						
Black Scoter	12	1.8	42.5	26.4	13.34	30.8736
Red-breasted Merganser	4	36.6	61.9	59.6	12.01	27.6625
Red-throated Loon	6	8.5	28.7	23.9	7.88	25.1951
Common Loon	3	8.4	28.5	28.4	11.56	27.1027
Northern Gannet	408	0.1	136.8	25.8	28.70	32.8114
Double-crested Cormorant	2	23.5	50.2	36.9	18.90	23.7545
Cormorant species unknown	1	8.2	8.2	8.2		22.3918
Red Phalarope	2	14.4	47.2	30.8	23.22	21.4904
Razorbill	10	6.0	28.9	18.3	7.35	50.9283
Atlantic Puffin	1	27.5	27.5	27.5		66.1673
Black-legged Kittiwake	3	4.7	32.4	21.5	13.95	43.6838
Bonaparte's Gull	85	0.0	69.9	28.3	19.78	32.3489
Laughing Gull	93	0.2	86.2	33.8	25.53	28.5479
Ring-billed Gull	24	7.1	84.3	28.9	19.97	25.2308
Herring Gull	211	0.0	210.4	40.6	39.21	59.3531
Lesser Black-backed Gull	6	6.0	40.7	7.6	13.65	32.4898
Great Black-backed Gull	37	0.1	243.3	43.2	64.17	35.7769
Gull species unknown - Small	4	8.6	84.5	54.1	31.29	69.5949
Royal Tern	1	55.0	55.0	55.0		24.3944
Tern species unknown	1	11.8	11.8	11.8		113.688
Common Tern	1	11.3	11.3	11.3		45.8689
Forster's Tern	105	0.1	51.8	22.5	14.59	28.8222
Commic/Forster's Tern	16	0.6	53.0	20.9	15.83	46.8834

(continued)

Table C–51. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
2019 December						
Greater Scaup	3	37.4	53.9	40.1	8.84	24.752
White-winged Scoter	1	11.2	11.2	11.2		39.8281
Black Scoter	9	1.3	49.7	31.5	18.23	40.9992
Red-breasted Merganser	2	25.3	43.4	34.4	12.77	39.9703
Red-throated Loon	7	6.6	38.8	18.5	11.39	35.3647
Common Loon	6	0.7	53.7	31.7	20.53	17.4963
Loon species unknown	1	2.5	2.5	2.5		85.9124
Manx Shearwater	1	0.7	0.7	0.7		80.5622
Northern Gannet	542	0.0	76.7	24.2	19.69	35.8815
Cormorant species unknown	1	66.3	66.3	66.3		23.631
Red Phalarope	132	0.5	62.0	24.8	17.68	28.678
Red/Red-necked Phalarope	63	0.7	59.1	30.9	16.93	44.5968
Great Skua	1	0.4	0.4	0.4		37.2033
Bonaparte's Gull	13	4.7	57.2	26.8	18.53	38.7364
Laughing Gull	173	1.4	106.3	35.6	26.84	31.9291
Ring-billed Gull	3	10.5	54.8	20.8	23.18	23.6868
Herring Gull	87	1.9	93.3	37.2	26.39	68.1718
Great Black-backed Gull	14	16.5	72.5	42.0	17.98	41.0358
Tern species unknown	1	30.3	30.3	30.3		121.273
Forster's Tern	210	0.1	60.5	23.8	16.98	31.0669
Commic/Forster's Tern	23	2.4	60.2	28.6	16.03	55.5102
All Surveys						
Greater Scaup	14	11.8	53.9	32.9	13.10	24.752-31.429
White-winged Scoter	1	11.2	11.2	11.2		39.8281
Black Scoter	22	1.3	49.7	29.6	14.88	15.65-40.9992
Red-breasted Merganser	9	12.4	69.0	43.4	19.71	27.6625-40.1242
Duck species unknown	2	54.1	63.8	59.0	6.90	85.0277
Red-throated Loon	53	0.5	85.1	28.1	22.25	25.1951-35.3647
Common Loon	14	0.7	67.7	31.7	18.59	17.4963-29.742
Loon species unknown	1	2.5	2.5	2.5		85.9124
Northern Fulmar	18	0.4	71.6	28.4	19.99	38.0121
Black-capped Petrel	2	37.0	73.9	55.5	26.08	14.5893-27.3988
Cory's Shearwater	18	0.7	49.9	10.2	15.07	33.2584-42.0996
Great Shearwater	1	6.1	6.1	6.1		35.4732
Manx Shearwater	6	0.7	40.6	11.8	16.52	69.062-80.5622
Audubon's Shearwater	3	15.5	45.3	19.9	16.10	21.0641
Shearwater species unknown	1	102.0	102.0	102.0		
Northern Gannet	2,142	0.0	136.8	27.6	26.29	32.8114-36.8328

(continued)

Table C–51. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
Double-crested Cormorant	8	13.6	50.2	29.5	11.62	23.7545-32.4712
Cormorant species unknown	6	8.2	79.3	31.4	29.78	22.3918-29.9768
Brown Pelican	1	63.4	63.4	63.4		33.0369
Great Blue Heron	14	60.8	295.7	155.8	92.37	21.3546-27.3126
Great Egret	1	252.7	252.7	252.7		23.8329
Green Heron	1	42.9	42.9	42.9		28.7761
Peregrine Falcon	1	52.7	52.7	52.7		28.3045
Black-bellied Plover	5	32.6	45.5	42.1	4.90	21.0966
Ruddy Turnstone	2	33.8	86.6	60.2	37.39	11.9104
Dunlin	3	44.1	52.8	47.1	4.41	29.0324
Shorebird species unknown	27	0.5	56.0	28.0	12.01	243.641-260.448
Red Phalarope	2,010	0.2	97.9	40.7	24.76	21.4904-43.3955
Red/Red-necked Phalarope	198	0.0	74.3	26.3	19.63	40.744-53.0865
Great Skua	1	0.4	0.4	0.4		37.2033
Parasitic Jaeger	2	29.2	46.9	38.0	12.46	43.31-113.216
Skua species unknown	1	13.8	13.8	13.8		
Razorbill	93	0.1	66.7	16.4	12.37	36.9299-60.4382
Murre/Razorbill	1	29.0	29.0	29.0		37.823
Atlantic Puffin	1	27.5	27.5	27.5		66.1673
Black-legged Kittiwake	30	0.3	117.5	43.7	34.74	43.6838-46.0233
Bonaparte's Gull	7,221	0.0	170.0	40.5	36.20	31.1939-38.7364
Laughing Gull	380	0.0	175.7	36.4	32.12	27.6848-31.9291
Ring-billed Gull	36	7.1	158.8	33.5	37.48	22.7409-32.4151
Herring Gull	579	0.0	211.0	38.9	36.60	59.3531-68.3118
Lesser Black-backed Gull	10	1.2	124.9	12.7	36.92	28.3311-32.4898
Great Black-backed Gull	68	0.1	243.3	39.5	51.19	35.7769-42.3495
Gull species unknown - Small	21	1.9	137.7	42.5	37.57	35.7049-89.8129
Least Tern	3	1.0	36.2	15.2	17.72	29.5791
Gull-billed Tern	7	12.2	78.1	44.5	25.49	34.7186-42.0609
Caspian Tern	14	9.2	128.2	37.9	33.18	32.5213-39.4677
Black Tern	123	0.4	120.1	41.7	34.91	37.6388-45.1841
Royal Tern	192	0.2	83.7	34.3	20.81	24.3944-33.5096
Royal/Caspian Tern	35	1.6	72.8	29.3	16.25	26.114-31.6135
Sandwich Tern	56	0.5	82.6	30.3	23.50	42.622-49.5636
Tern species unknown	33	1.3	71.4	26.7	16.55	113.688-122.256
Common Tern	217	0.2	126.4	36.0	30.00	40.3714-45.8689
Commic Tern	1	18.3	18.3	18.3		
Forster's Tern	597	0.0	94.6	25.2	19.52	27.5087-31.8913
Commic/Forster's Tern	296	0.2	113.5	31.9	23.39	46.8834-55.5102
Sterna Tern species unknown	12	6.5	42.4	29.9	13.29	55.8491-55.8708

Table C–52. Flight heights for flying birds observed during the February 2018 through February 2020 surveys for each species in Area A51

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Bonaparte's Gull	1	50.4	50.4	50.4		31.1939
2019 September						
Royal/Caspian Tern	1	17.2	17.2	17.2		31.6135
2018 December						
Herring Gull	1	75.1	75.1	75.1		59.3531
All Surveys						
Bonaparte's Gull	1	50.4	50.4	50.4		31.1939
Herring Gull	1	75.1	75.1	75.1		59.3531
Royal/Caspian Tern	1	17.2	17.2	17.2		31.6135

Table C–53. Flight heights for flying birds observed during the February 2018 through December 2018 surveys for each species in Area A53

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Red Phalarope	36	4.1	74.4	59.1	18.90	24.8727
Bonaparte's Gull	1	52.0	52.0	52.0		31.1939
2019 September						
Common Tern	1	63.9	63.9	63.9		41.0727
Commic/Forster's Tern	13	7.0	65.9	40.5	18.59	52.4927
All Surveys						
Red Phalarope	36	4.1	74.4	59.1	18.90	24.8727
Bonaparte's Gull	1	52.0	52.0	52.0		31.1939
Common Tern	1	63.9	63.9	63.9		41.0727
Commic/Forster's Tern	13	7.0	65.9	40.5	18.59	52.4927

Table C–54. Flight heights for flying birds observed during the February 2018 through February 2020 surveys for each species in the Charleston Call Area (CCA)

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Red Phalarope	29	6.8	72.4	45.0	19.69	24.8727
2020 February						
Red Phalarope	70	1.0	97.0	38.3	26.40	43.3955
Bonaparte's Gull	4	22.1	31.0	27.6	3.90	35.0373
2019 May						
Sandwich Tern	1	21.2	21.2	21.2		42.622
Commic/Forster's Tern	2	4.1	7.3	5.7	2.26	50.9742
2018 October						
Royal Tern	1	25.6	25.6	25.6		33.5096
Sandwich Tern	1	36.1	36.1	36.1		49.5636
Commic/Forster's Tern	1	7.5	7.5	7.5		52.9181
2019 September						
Black Tern	1	73.3	73.3	73.3		39.5708
Common Tern	3	5.7	56.9	36.2	25.75	41.0727
Commic/Forster's Tern	2	24.2	51.4	37.8	19.20	52.4927
2019 December						
Red Phalarope	8	1.5	31.3	18.1	8.84	28.678
All Surveys						
Red Phalarope	107	1.0	97.0	38.2	24.65	24.8727-43.3955
Bonaparte's Gull	4	22.1	31.0	27.6	3.90	35.0373
Black Tern	1	73.3	73.3	73.3		39.5708
Royal Tern	1	25.6	25.6	25.6		33.5096
Sandwich Tern	2	21.2	36.1	28.6	10.50	42.622-49.5636
Common Tern	3	5.7	56.9	36.2	25.75	41.0727
Commic/Forster's Tern	5	4.1	51.4	7.5	19.79	50.9742-52.9181

Table C–55. Flight heights for flying birds observed during the February 2018 through February 2020 surveys for each species in the Kitty Hawk (KH) Area

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Northern Fulmar	2	20.9	28.4	24.7	5.30	38.0121
Northern Gannet	42	22.3	105.4	59.8	20.84	35.3474
Great Skua	1	54.4	54.4	54.4		42.3748
Black-legged Kittiwake	2	66.6	83.7	75.2	12.12	45.152
Bonaparte's Gull	1	61.4	61.4	61.4		31.1939
Great Black-backed Gull	1	107.3	107.3	107.3		36.2016
2020 February						
Black-legged Kittiwake	1	14.9	14.9	14.9		46.0233
Bonaparte's Gull	4	15.1	38.2	23.8	9.94	35.0373
Herring Gull	1	56.4	56.4	56.4		68.3118
2019 September						
Black Tern	1	34.0	34.0	34.0		39.5708
2018 December						
Manx Shearwater	3	23.8	43.8	34.0	10.02	63.3475
Red Phalarope	4	1.8	37.3	19.7	14.56	21.4904
Black-legged Kittiwake	165	0.1	102.5	22.5	18.18	43.6838
Bonaparte's Gull	364	0.1	76.3	19.2	19.05	32.3489
Herring Gull	1	14.1	14.1	14.1		59.3531
Great Black-backed Gull	4	18.5	87.3	28.6	32.09	35.7769
2019 December						
Red-throated Loon	1	25.7	25.7	25.7		35.3647
Common Loon	1	25.5	25.5	25.5		17.4963
Red/Red-necked Phalarope	1	13.3	13.3	13.3		44.5968
Black-legged Kittiwake	1	66.6	66.6	66.6		40.7791
Bonaparte's Gull	16	0.0	54.1	19.0	13.84	38.7364
Herring Gull	6	5.0	60.4	16.2	19.79	68.1718
Great Black-backed Gull	5	11.2	47.8	14.1	15.24	41.0358
All Surveys						
Red-throated Loon	1	25.7	25.7	25.7		35.3647
Common Loon	1	25.5	25.5	25.5		17.4963
Northern Fulmar	2	20.9	28.4	24.7	5.30	38.0121
Manx Shearwater	3	23.8	43.8	34.0	10.02	63.3475
Northern Gannet	42	22.3	105.4	59.8	20.84	35.3474
Red Phalarope	4	1.8	37.3	19.7	14.56	21.4904
Red/Red-necked Phalarope	1	13.3	13.3	13.3		44.5968
Great Skua	1	54.4	54.4	54.4		42.3748
Black-legged Kittiwake	169	0.1	102.5	22.7	19.05	40.7791-46.0233
Bonaparte's Gull	385	0.0	76.3	19.3	18.84	31.1939-38.7364
Herring Gull	8	5.0	60.4	16.2	21.22	59.3531-68.3118
Great Black-backed Gull	10	11.2	107.3	19.8	33.80	35.7769-41.0358
Black Tern	1	34.0	34.0	34.0		39.5708

Table C–56. Flight heights for flying birds observed during the February 2018 through February 2020 surveys for each species in the Wilmington West (WW) Area

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Bonaparte's Gull	19	3.7	61.0	25.3	16.84	31.1939
Herring Gull	1	41.4	41.4	41.4		63.4762
Forster's Tern	1	6.4	6.4	6.4		27.9296
2020 February						
Northern Gannet	8	2.1	56.9	24.5	18.25	36.8328
Red Phalarope	139	2.1	97.7	46.2	25.86	43.3955
Razorbill	4	7.3	25.6	9.8	8.43	60.4382
Bonaparte's Gull	185	0.2	139.9	25.7	25.42	35.0373
Herring Gull	9	12.7	190.7	102.7	56.76	68.3118
Great Black-backed Gull	1	77.0	77.0	77.0		42.3495
Forster's Tern	4	30.0	76.0	46.8	22.53	27.5087
2018 October						
Commic/Forster's Tern	2	12.9	38.2	25.6	17.84	52.9181
2019 September						
Royal Tern	8	1.1	50.2	27.2	17.91	30.764
2018 December						
Northern Gannet	4	3.5	26.8	19.4	11.45	32.8114
Red Phalarope	2	12.4	20.3	16.3	5.60	21.4904
Forster's Tern	1	18.8	18.8	18.8		28.8222
2019 December						
Northern Gannet	25	0.1	38.7	14.8	10.30	35.8815
Red Phalarope	7	2.6	23.3	9.5	7.24	28.678
Red/Red-necked Phalarope	9	0.5	57.6	27.0	18.84	44.5968
Black-legged Kittiwake	1	23.7	23.7	23.7		40.7791
Bonaparte's Gull	1	43.3	43.3	43.3		38.7364
Laughing Gull	1	58.6	58.6	58.6		31.9291
Herring Gull	5	8.3	42.0	17.5	13.61	68.1718
Forster's Tern	12	2.7	40.0	18.7	13.19	31.0669
All Surveys						
Northern Gannet	37	0.1	56.9	16.5	13.30	32.8114-36.8328
Red Phalarope	148	2.1	97.7	41.9	26.27	21.4904-43.3955
Red/Red-necked Phalarope	9	0.5	57.6	27.0	18.84	44.5968
Razorbill	4	7.3	25.6	9.8	8.43	60.4382
Black-legged Kittiwake	1	23.7	23.7	23.7		40.7791
Bonaparte's Gull	205	0.2	139.9	25.7	24.69	31.1939-38.7364
Laughing Gull	1	58.6	58.6	58.6		31.9291
Herring Gull	15	8.3	190.7	42.0	57.94	63.4762-68.3118
Great Black-backed Gull	1	77.0	77.0	77.0		42.3495
Royal Tern	8	1.1	50.2	27.2	17.91	30.764
Forster's Tern	18	2.7	76.0	22.0	19.80	27.5087-31.0669
Commic/Forster's Tern	2	12.9	38.2	25.6	17.84	52.9181

Table C–57. Flight heights for flying birds observed during the February 2018 through February 2020 surveys for each species in the Wilmington East (WE) Area

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Northern Gannet	4	2.1	19.0	8.1	7.07	35.3474
Red Phalarope	30	2.8	60.0	18.4	13.80	24.8727
Bonaparte's Gull	133	0.9	69.0	17.1	16.04	31.1939
Ring-billed Gull	1	96.5	96.5	96.5		32.4151
Herring Gull	2	18.0	39.1	28.6	14.92	63.4762
Forster's Tern	7	1.2	27.3	17.1	8.44	27.9296
2020 February						
Common Loon	1	0.1	0.1	0.1		10.0838
Northern Gannet	3	7.8	10.5	9.8	1.37	36.8328
Red Phalarope	971	0.1	97.7	22.0	21.04	43.3955
Bonaparte's Gull	125	0.1	108.5	18.7	23.70	35.0373
Forster's Tern	1	12.7	12.7	12.7		27.5087
Sterna Tern species unknown	1	26.8	26.8	26.8		54.5305
2019 May						
Common Tern	1	39.1	39.1	39.1		44.401
Commic/Forster's Tern	3	21.2	54.9	40.2	16.86	50.9742
2018 October						
Bridled Tern	1	8.5	8.5	8.5		32.9304
Royal Tern	2	10.8	33.3	22.0	15.94	33.5096
Commic/Forster's Tern	1	10.7	10.7	10.7		52.9181
2019 September						
Cory's Shearwater	2	13.3	36.1	24.7	16.08	41.8382
Audubon's Shearwater	1	56.6	56.6	56.6		21.0641
Gull-billed Tern	1	68.7	68.7	68.7		45.7881
Black Tern	1	60.2	60.2	60.2		39.5708
Royal Tern	11	8.6	43.8	29.7	10.02	30.764
Common Tern	5	4.4	118.8	23.5	46.89	41.0727
2018 December						
Common Loon	1	26.7	26.7	26.7		27.1027
Northern Gannet	41	2.7	57.1	17.3	12.97	32.8114
Laughing Gull	1	2.4	2.4	2.4		28.5479
Ring-billed Gull	1	77.0	77.0	77.0		25.2308
Herring Gull	1	36.0	36.0	36.0		59.3531
2019 December						
Northern Gannet	15	2.2	54.9	23.3	16.06	35.8815
Red Phalarope	22	1.2	46.9	15.4	11.75	28.678
Red/Red-necked Phalarope	2	42.5	50.9	46.7	5.93	44.5968
Herring Gull	9	6.4	86.8	43.0	26.61	68.1718
Forster's Tern	4	1.9	39.4	10.2	17.49	31.0669
Sterna Tern species unknown	1	9.4	9.4	9.4		53.9695

(continued)

Table C–57. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
All Surveys						
Common Loon	2	0.1	26.7	13.4	18.85	10.0838-27.1027
Cory's Shearwater	2	13.3	36.1	24.7	16.08	41.8382
Audubon's Shearwater	1	56.6	56.6	56.6		21.0641
Northern Gannet	63	2.1	57.1	16.1	13.55	32.8114-36.8328
Red Phalarope	1,023	0.1	97.7	21.2	20.78	24.8727-43.3955
Red/Red-necked Phalarope	2	42.5	50.9	46.7	5.93	44.5968
Bonaparte's Gull	258	0.1	108.5	17.7	20.21	31.1939-35.0373
Laughing Gull	1	2.4	2.4	2.4		28.5479
Ring-billed Gull	2	77.0	96.5	86.7	13.77	25.2308-32.4151
Herring Gull	12	6.4	86.8	37.6	23.90	59.3531-68.1718
Bridled Tern	1	8.5	8.5	8.5		32.9304
Gull-billed Tern	1	68.7	68.7	68.7		45.7881
Black Tern	1	60.2	60.2	60.2		39.5708
Royal Tern	13	8.6	43.8	29.7	10.45	30.764-33.5096
Common Tern	6	4.4	118.8	31.3	41.97	41.0727-44.401
Forster's Tern	12	1.2	39.4	15.1	11.10	27.5087-31.0669
Commic/Forster's Tern	4	10.7	54.9	30.7	19.64	50.9742-52.9181
Sterna Tern species unknown	2	9.4	26.8	18.1	12.34	53.9695-54.5305

Table C–58. Flight heights for flying birds observed during the February 2018 through February 2020 surveys for each species in the Grand Strand Call Area (GSCA; counts include part of WW)

Species	N	Min	Max	Median	Std Dev	Error
2018 February						
Northern Gannet	18	0.2	45.2	12.7	13.08	35.3474
Red Phalarope	17	7.1	61.4	27.9	16.83	24.8727
Bonaparte's Gull	31	3.5	91.2	27.0	21.26	31.1939
Forster's Tern	2	6.6	13.7	10.2	5.00	27.9296
2020 February						
Northern Gannet	60	2.4	69.4	33.1	19.19	36.8328
Bonaparte's Gull	404	0.1	117.1	29.7	26.47	35.0373
Little Gull	1	25.7	25.7	25.7		
Herring Gull	10	14.3	165.0	65.1	54.35	68.3118
Forster's Tern	4	13.5	44.1	25.9	12.64	27.5087
Sterna Tern species unknown	1	56.3	56.3	56.3		54.5305
2018 May/June						
Cory's Shearwater	1	26.2	26.2	26.2		37.1927
Royal Tern	1	58.6	58.6	58.6		29.7906
2019 May						
Royal Tern	7	9.1	55.1	35.6	17.24	28.1936

(continued)

Table C–58. (Continued)

Species	N	Min	Max	Median	Std Dev	Error
2018 October						
Cory's Shearwater	1	21.7	21.7	21.7		42.0996
Parasitic Jaeger	1	73.7	73.7	73.7		90.1892
Royal Tern	5	6.2	33.8	25.7	10.98	33.5096
Royal/Caspian Tern	5	7.6	43.8	35.3	14.04	26.114
Sandwich Tern	1	6.0	6.0	6.0		49.5636
Tern species unknown	1	26.5	26.5	26.5		122.256
Common Tern	12	0.8	27.0	17.6	9.49	40.3714
Forster's Tern	16	0.9	54.6	21.3	14.91	31.8913
Commic/Forster's Tern	27	0.2	51.8	25.7	15.68	52.9181
2019 September						
Royal Tern	28	1.3	72.0	17.6	21.47	30.764
Sandwich Tern	3	33.9	81.7	68.7	24.73	48.3012
Tern species unknown	3	21.4	55.7	42.5	17.28	116.282
Common Tern	1	14.1	14.1	14.1		41.0727
Commic/Forster's Tern	2	24.1	51.2	37.7	19.20	52.4927
2018 December						
Northern Gannet	4	3.5	26.8	19.4	11.45	32.8114
Red Phalarope	2	12.4	20.3	16.3	5.60	21.4904
Forster's Tern	1	18.8	18.8	18.8		28.8222
2019 December						
Northern Gannet	9	11.8	43.0	31.3	10.09	35.8815
Red Phalarope	81	0.1	61.3	10.7	17.02	28.678
Bonaparte's Gull	3	4.6	21.2	12.4	8.29	38.7364
Lesser Black-backed Gull	1	87.0	87.0	87.0		38.1206
Forster's Tern	18	1.1	40.0	14.8	12.62	31.0669
All Surveys						
Cory's Shearwater	2	21.7	26.2	24.0	3.19	37.1927-42.0996
Northern Gannet	91	0.2	69.4	27.7	19.33	32.8114-36.8328
Red Phalarope	100	0.1	61.4	15.5	17.36	21.4904-28.678
Parasitic Jaeger	1	73.7	73.7	73.7		90.1892
Bonaparte's Gull	438	0.1	117.1	29.0	26.10	31.1939-38.7364
Little Gull	1	25.7	25.7	25.7		
Herring Gull	10	14.3	165.0	65.1	54.35	68.3118
Lesser Black-backed Gull	1	87.0	87.0	87.0		38.1206
Royal Tern	41	1.3	72.0	23.6	20.11	28.1936-33.5096
Royal/Caspian Tern	5	7.6	43.8	35.3	14.04	26.114
Sandwich Tern	4	6.0	81.7	51.3	34.27	48.3012-49.5636
Tern species unknown	4	21.4	55.7	34.5	15.61	116.282-122.256
Common Tern	13	0.8	27.0	15.6	9.12	40.3714-41.0727
Forster's Tern	41	0.9	54.6	19.5	13.26	27.5087-31.8913
Commic/Forster's Tern	29	0.2	51.8	25.7	15.96	52.4927-52.9181
Sterna Tern species unknown	1	56.3	56.3	56.3		54.5305

Table C–59. Median flight height (m) for flying birds (with known flight heights) for each species group within each area and mean altitude error* (m) for the February 2018 survey

Species Group	Median Altitude (m)										SURVEY TOTAL	
	TRANSECT (Coverage Varies)					GRID (≈10%)						
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	Median Altitude	Mean Error
Duck	42.7				42.7						42.7	51.0
Loon	35.4				35.4						35.4	29.9
Fulmar	28.4				28.4	24.7				24.7	27.9	38.0
Gannet	33.6				33.6	59.8		8.1	12.7	47.1	34.4	35.3
Cormorant	40.8				40.8						40.8	25.7
Phalarope	38.1		59.1	45.0	38.2			18.4	27.9	19.5	37.4	26.8
Skua	46.9				46.9	54.4				54.4	50.6	42.8
Auk	16.0				16.0						16.0	36.9
Gull	43.1	50.4	52.0		43.1	75.2	28.0	17.4	27.0	20.0	41.5	31.9
Sterna Tern	27.3				27.3		6.4	17.1	10.2	13.4	27.0	27.9

* Mean Altitude Error = the average error for each species in the species group

Table C–60. Median flight height (m) for flying birds (with known flight heights) for each species group within each area and mean altitude error* (m) for the February 2020 survey

Species Group	Median Altitude (m)										SURVEY TOTAL	
	TRANSECT (Coverage Varies)					GRID (≈10%)						
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	Median Altitude	Mean Error
Duck	25.3				25.3						25.3	31.4
Loon	42.0				42.0			0.1		0.1	33.7	22.4
Shearwater	19.4				19.4						19.4	69.1
Gannet	25.6				25.6		24.5	9.8	33.1	31.0	26.8	36.8
Cormorant	22.0				22.0						22.0	30.0
Phalarope	44.4			38.3	44.2		46.2	22.0		23.9	31.9	43.4
Skua	29.2				29.2						29.2	113.2
Auk	16.4				16.4		9.8			9.8	16.4	49.1
Gull	38.4			27.6	38.4	23.8	26.9	18.7	29.9	26.8	35.8	46.8
Sterna Tern	31.2				31.2		46.8	19.8	27.0	30.0	31.0	44.7

* Mean Altitude Error = the average error for each species in the species group

Table C–61. Median flight height (m) for flying birds (with known flight heights) for each species group within each area and mean altitude error* (m) for the May/June 2018 survey

Species Group	Median Altitude (m)										SURVEY TOTAL	
	TRANSECT (Coverage Varies)					GRID (≈10%)						
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	Median Altitude	Mean Error
Shearwater	6.1				6.1				26.2	26.2	6.2	36.8
Gull	25.7				25.7						25.7	30.3
Tern	34.0				34.0				58.6	58.6	34.4	34.5
Sterna Tern	34.1				34.1						34.1	55.9

* Mean Altitude Error = the average error for each species in the species group

Table C–62. Median flight height (m) for flying birds (with known flight heights) for each species group within each area and mean altitude error* (m) for the May 2019 survey

Species Group	Median Altitude (m)										SURVEY TOTAL	
	TRANSECT (Coverage Varies)					GRID (≈10%)						
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	Median Altitude	Mean Error
Shearwater	13.7				13.7						13.7	33.3
Shorebird	30.2				30.2						30.2	97.8
Phalarope	2.1				2.1						2.1	53.1
Gull	63.3				63.3						63.3	45.3
Tern	40.7			21.2	40.7				35.6	39.7	39.1	47.7
Sterna Tern	27.0			5.7	26.9			39.7		35.6	27.9	47.1

* Mean Altitude Error = the average error for each species in the species group

Table C–63. Median flight height (m) for flying birds (with known flight heights) for each species group within each area and mean altitude error* (m) for the October 2018 survey

Species Group	Median Altitude (m)										SURVEY TOTAL	
	TRANSECT (Coverage Varies)					GRID (≈10%)						
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	Median Altitude	Mean Error
Loon	32.8				32.8						32.8	18.5
Petrel	73.9				73.9						73.9	27.4
Shearwater	9.5				9.5				21.7	21.7	12.0	42.1
Gannet	81.8				81.8						81.8	35.3
Cormorant	29.5				29.5						29.5	32.5
Pelican	63.4				63.4						63.4	33.0
Ardeidae	123.3				123.3						123.3	22.0
Raptor	52.7				52.7						52.7	28.3
Shorebird	36.4				36.4						36.4	179.3
Phalarope	28.7				28.7						28.7	33.2
Skua									73.7	73.7	73.7	90.2
Gull	43.7				43.7						43.7	36.7
Tern	24.7			30.8	24.7			10.8	27.8	26.5	25.1	55.5
Sterna Tern	22.0			7.5	21.6		25.6	10.7	23.4	22.4	21.7	48.2

* Mean Altitude Error = the average error for each species in the species group

Table C–64. Median flight height (m) for flying birds (with known flight heights) for each species group within each area and mean altitude error* (m) for the September 2019 survey

Species Group	Median Altitude (m)										SURVEY TOTAL	
	TRANSECT (Coverage Varies)					GRID (≈10%)						
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	Median Altitude	Mean Error
Petrel	37.0				37.0						37.0	14.6
Shearwater	19.9				19.9			36.1		36.1	21.4	31.5
Ardeidae	188.4				188.4						188.4	27.3
Phalarope	23.1				23.1						23.1	32.4
Skua	13.8				13.8						13.8	
Gull	54.7				54.7						54.7	27.7
Tern	39.0	17.2		73.3	39.3	34.0	27.2	29.9	22.5	25.6	34.6	47.5
Sterna Tern	38.6		41.0	36.2	38.6			23.5	24.1	23.8	38.6	44.8

* Mean Altitude Error = the average error for each species in the species group

Table C–65. Median flight height (m) for flying birds (with known flight heights) for each species group within each area and mean altitude error* (m) for the December 2018 survey

Species Group	Median Altitude (m)										SURVEY TOTAL	
	TRANSECT (Coverage Varies)					GRID (≈10%)						
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	Median Altitude	Mean Error
Duck	33.6				33.6						33.6	30.1
Loon	24.2				24.2			26.7		26.7	25.5	26.0
Shearwater						34.0				34.0	34.0	63.3
Gannet	25.8				25.8		19.4	17.3	19.4	17.3	25.1	32.8
Cormorant	23.5				23.5						23.5	23.3
Phalarope	30.8				30.8	19.7	16.3		16.3	19.1	19.1	21.5
Auk	18.6				18.6						18.6	52.3
Gull	34.6	75.1			34.6	20.5		36.0		20.5	25.5	39.8
Tern	33.4				33.4						33.4	69.0
Sterna Tern	22.3				22.3		18.8		18.8	18.8	22.1	31.3

* Mean Altitude Error = the average error for each species in the species group

Table C–66. Median flight height (m) for flying birds (with known flight heights) for each species group within each area and mean altitude error* (m) for the December 2019 survey

Species Group	Median Altitude (m)										SURVEY TOTAL	
	TRANSECT (Coverage Varies)					GRID (≈10%)						
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	Median Altitude	Mean Error
Duck	36.2				36.2						36.2	36.4
Loon	21.3				21.3	25.6				25.6	24.8	46.3
Shearwater	0.7				0.7						0.7	80.6
Gannet	24.2				24.2		14.8	23.3	31.3	17.1	23.6	35.9
Cormorant	66.3				66.3						66.3	23.6
Phalarope	27.2			18.1	27.2	13.3	16.8	16.6	10.7	14.6	22.3	36.6
Skua	0.4				0.4						0.4	37.2
Gull	36.0				36.0	16.4	22.2	43.0	16.8	20.7	32.8	40.4
Tern	30.3				30.3						30.3	121.3
Sterna Tern	24.0				24.0		18.7	9.4	14.8	13.0	23.6	46.8

* Mean Altitude Error = the average error for each species in the species group

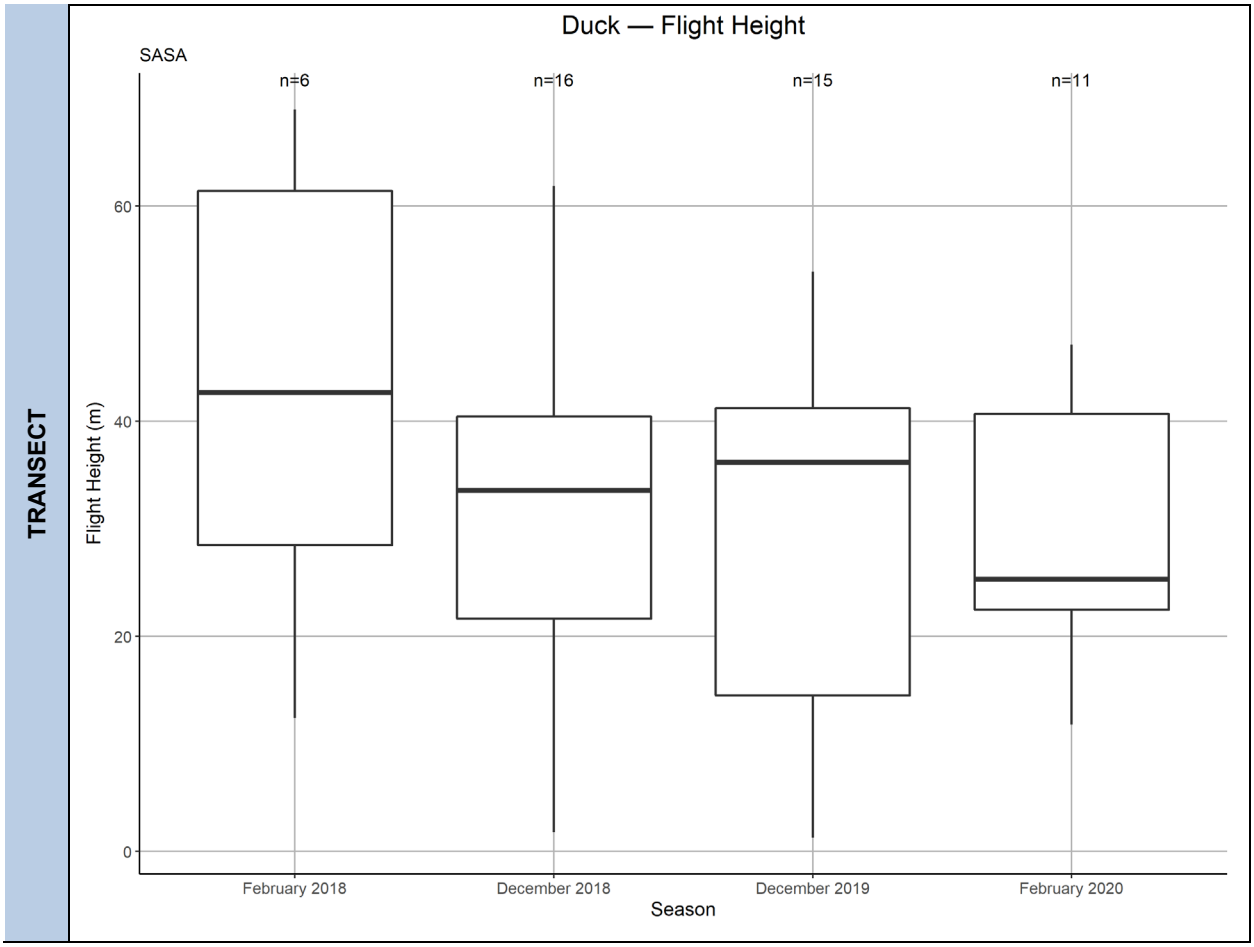


Figure C–278. Distribution of flight heights for ducks during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

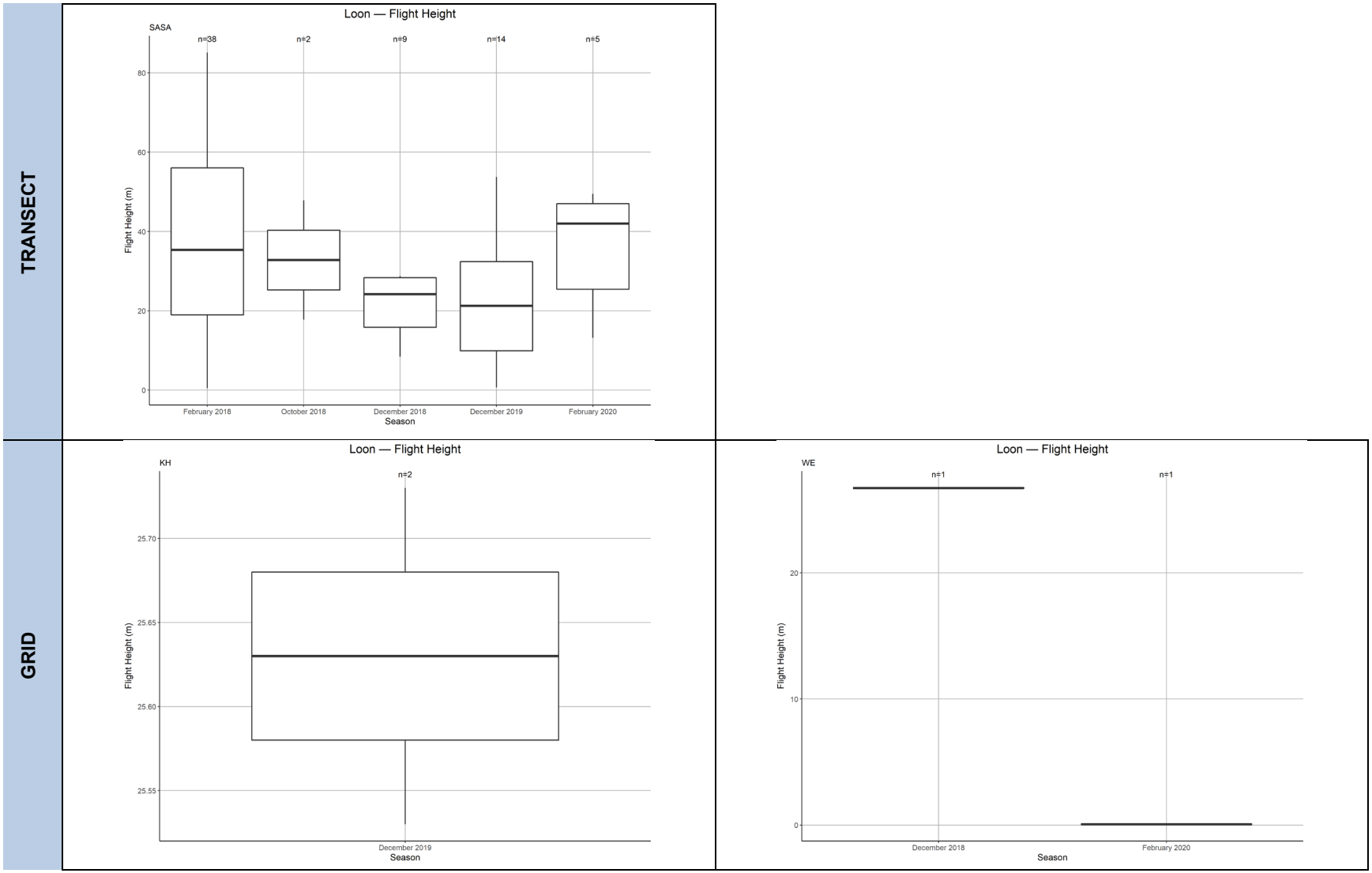


Figure C–279. Distribution of flight heights for loons during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

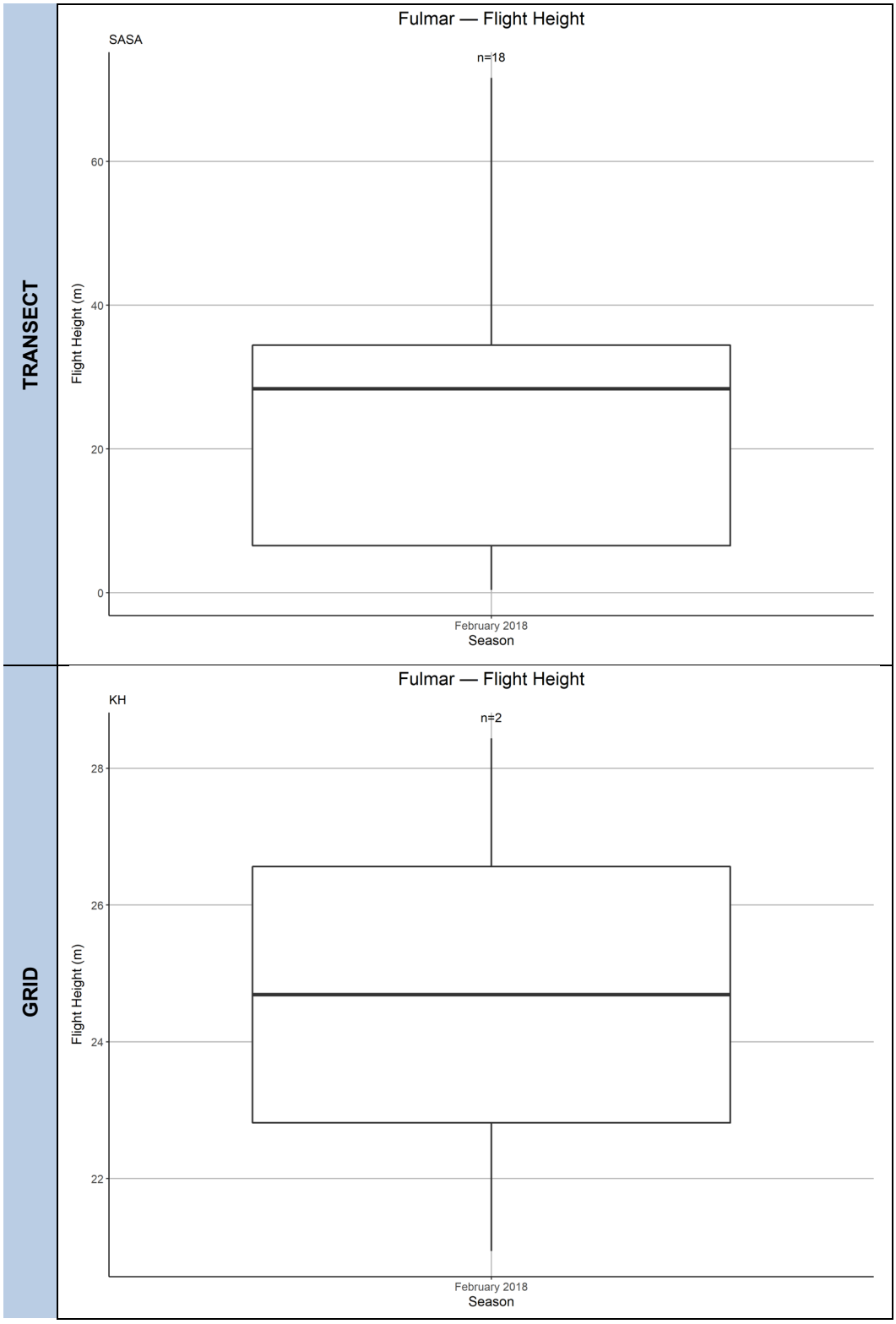


Figure C–280. Distribution of flight heights for fulmars during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

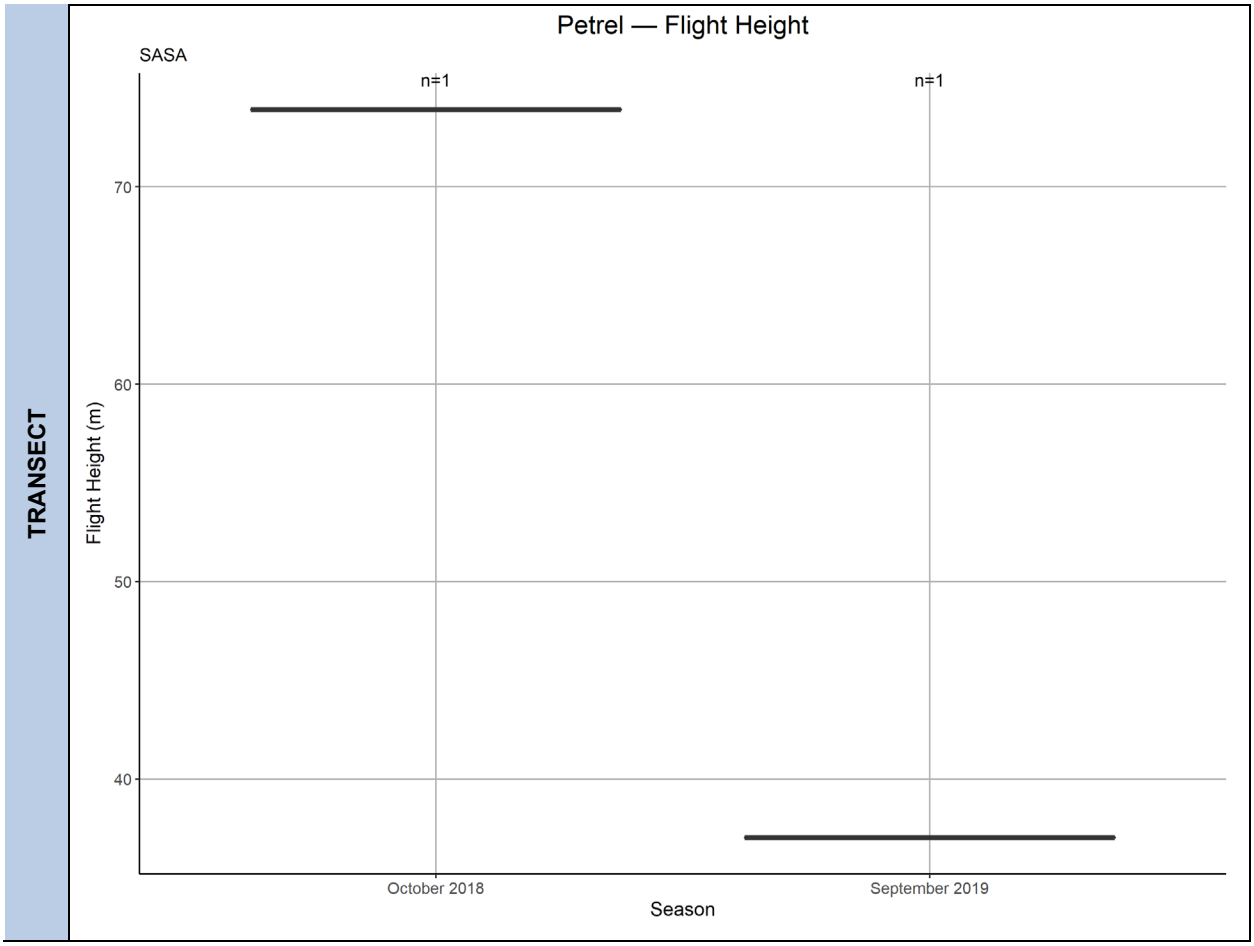
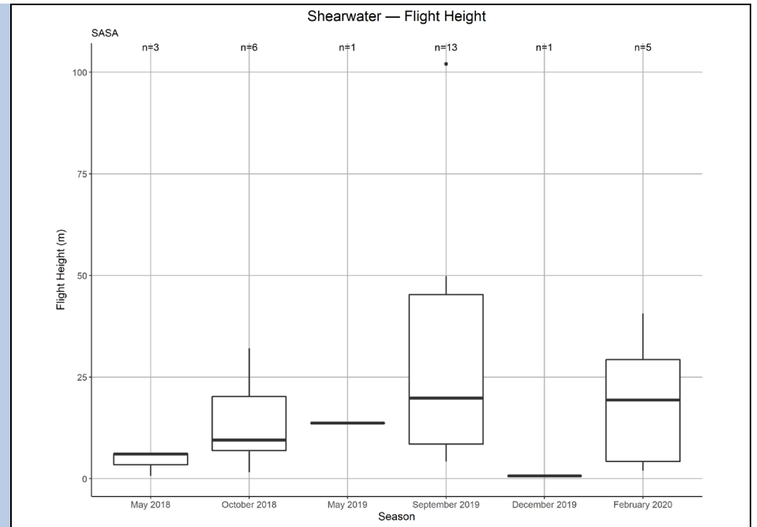
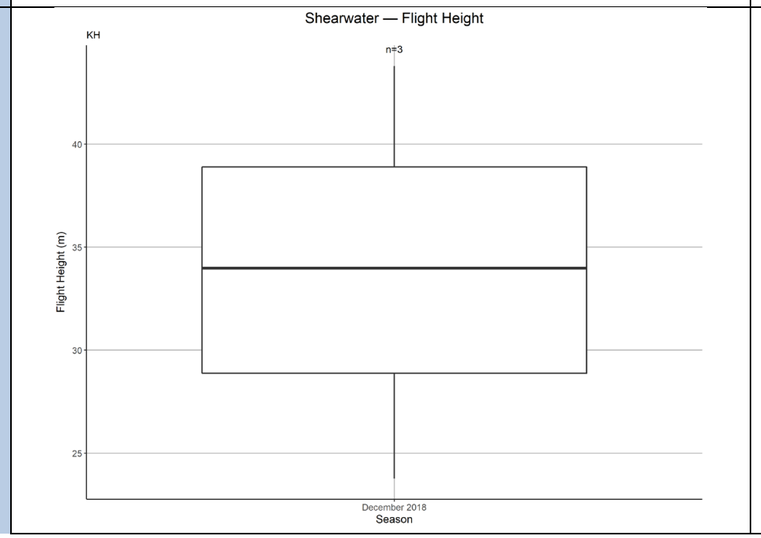


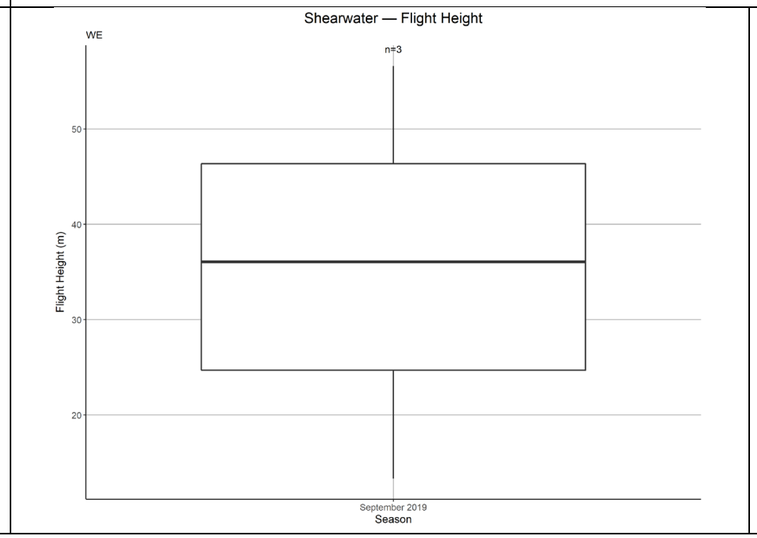
Figure C–281. Distribution of flight heights for petrels during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

TRANSECT



GRID





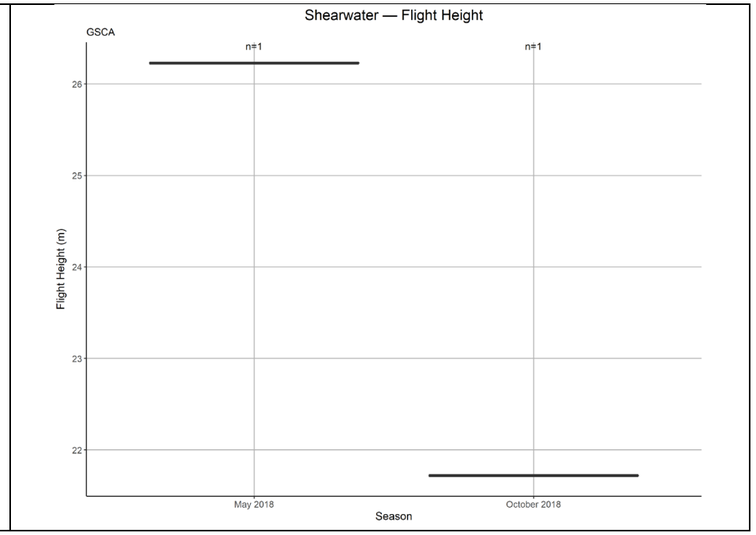


Figure C–282. Distribution of flight heights for shearwaters during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

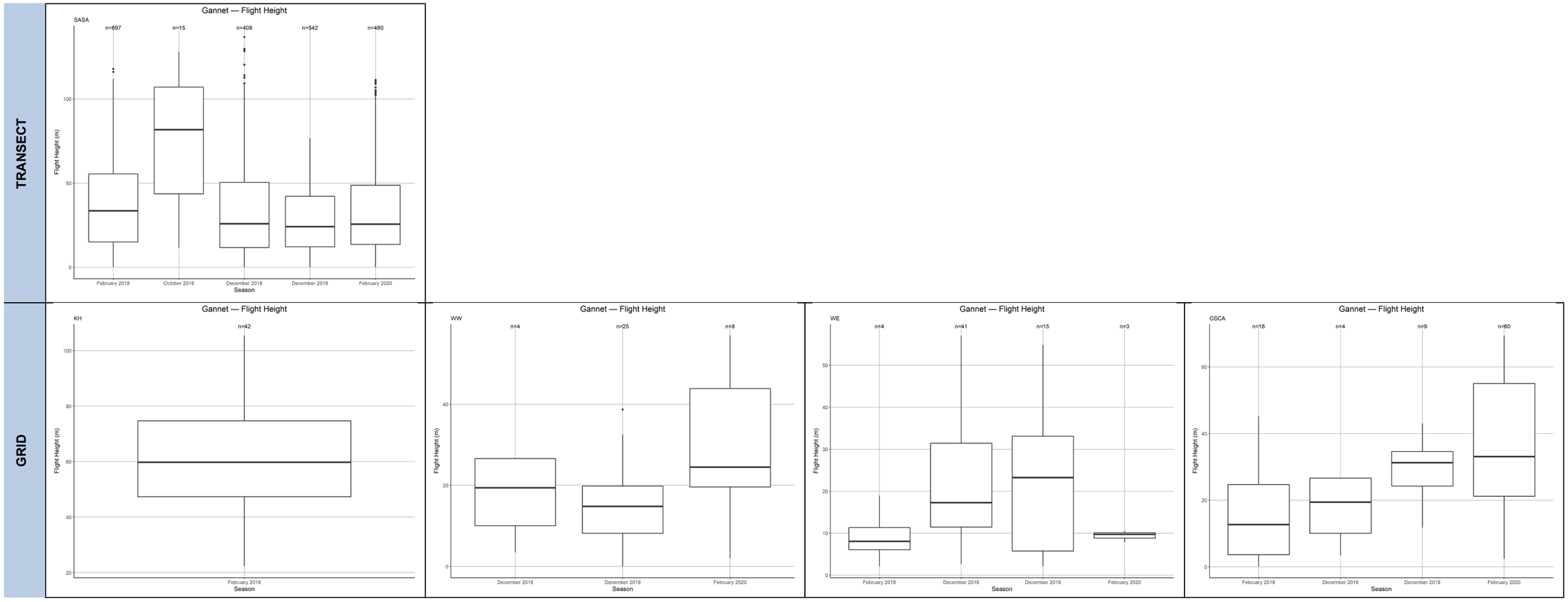


Figure C–283. Distribution of flight heights for gannets during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

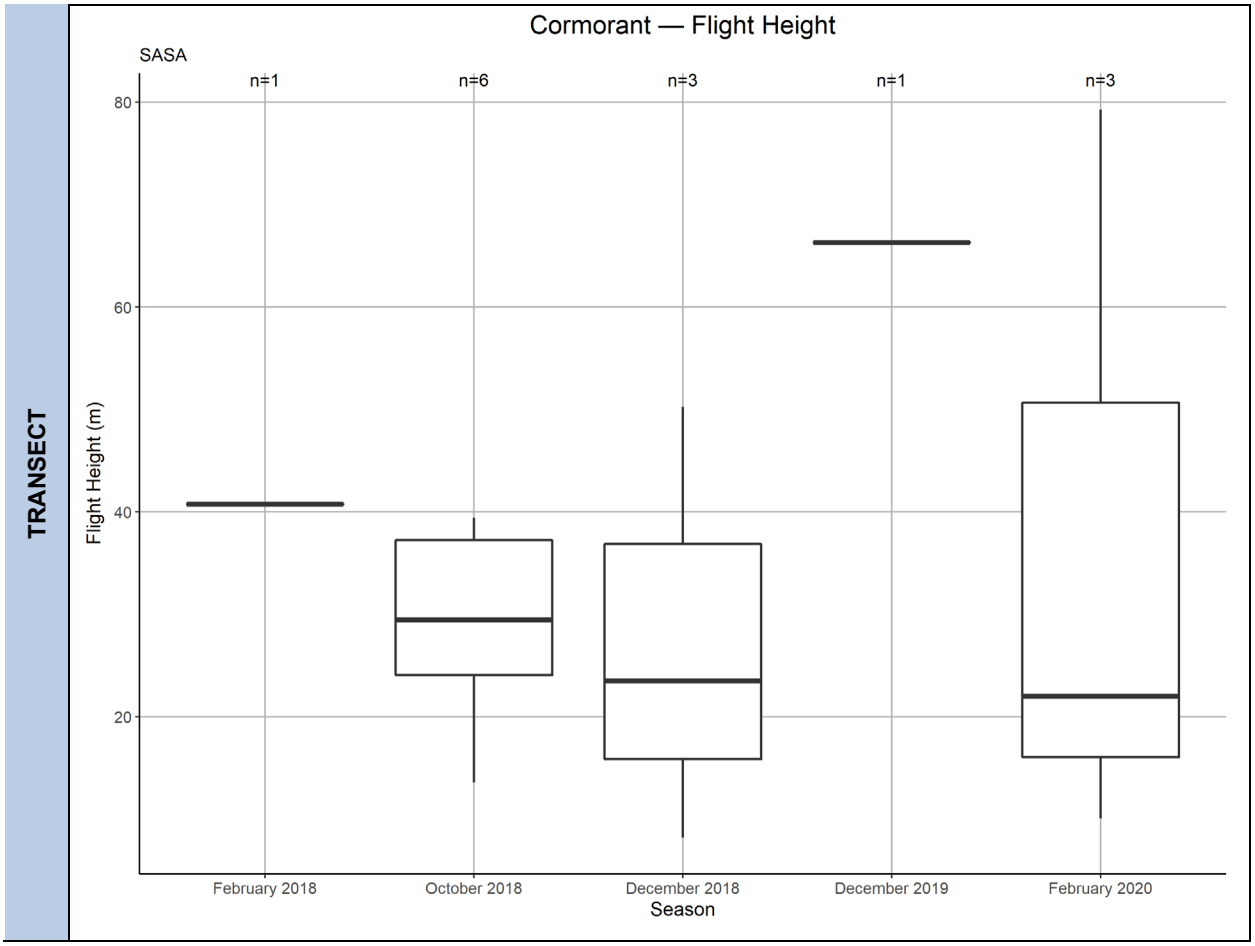


Figure C–284. Distribution of flight heights for cormorants during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

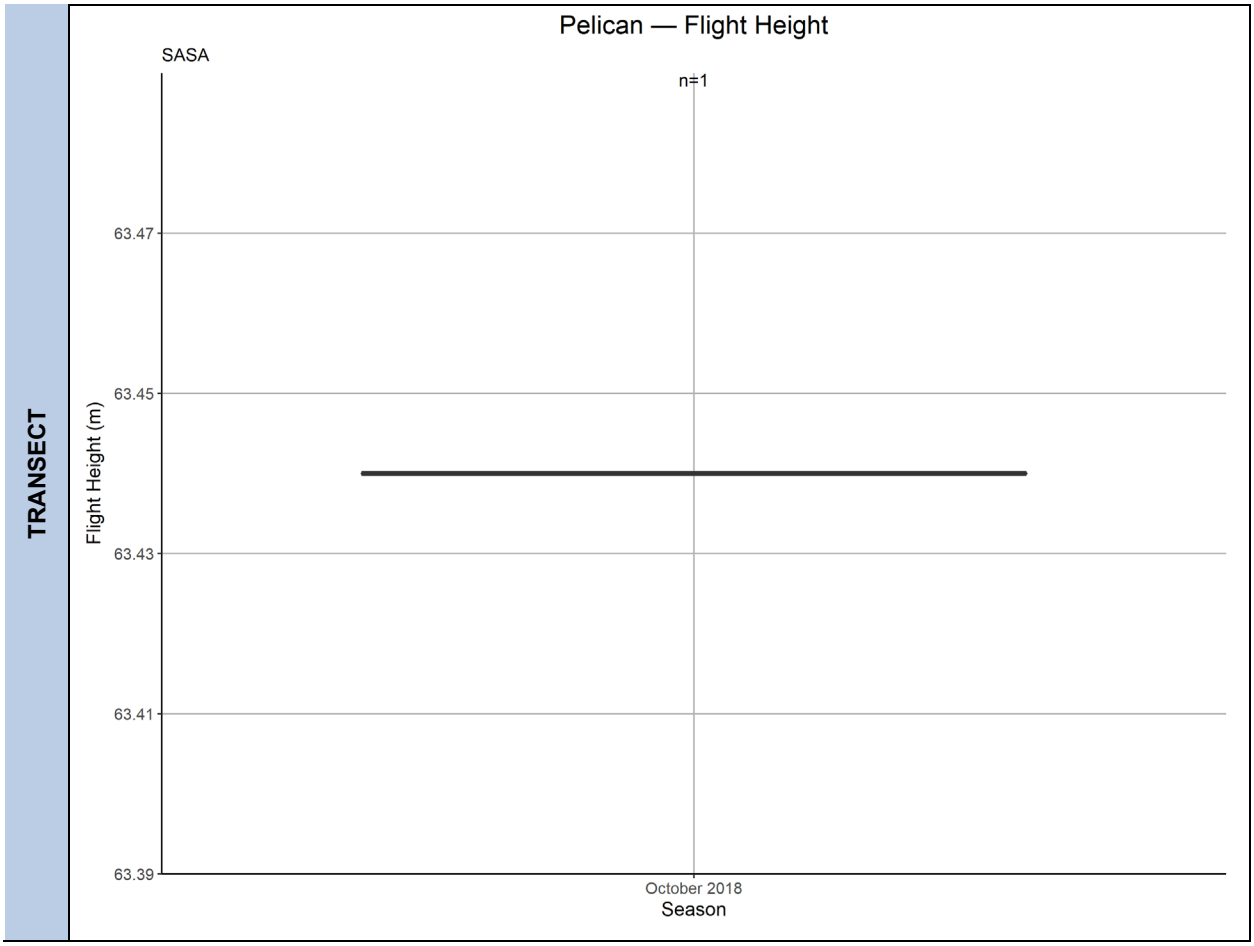


Figure C–285. Distribution of flight heights for pelicans during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

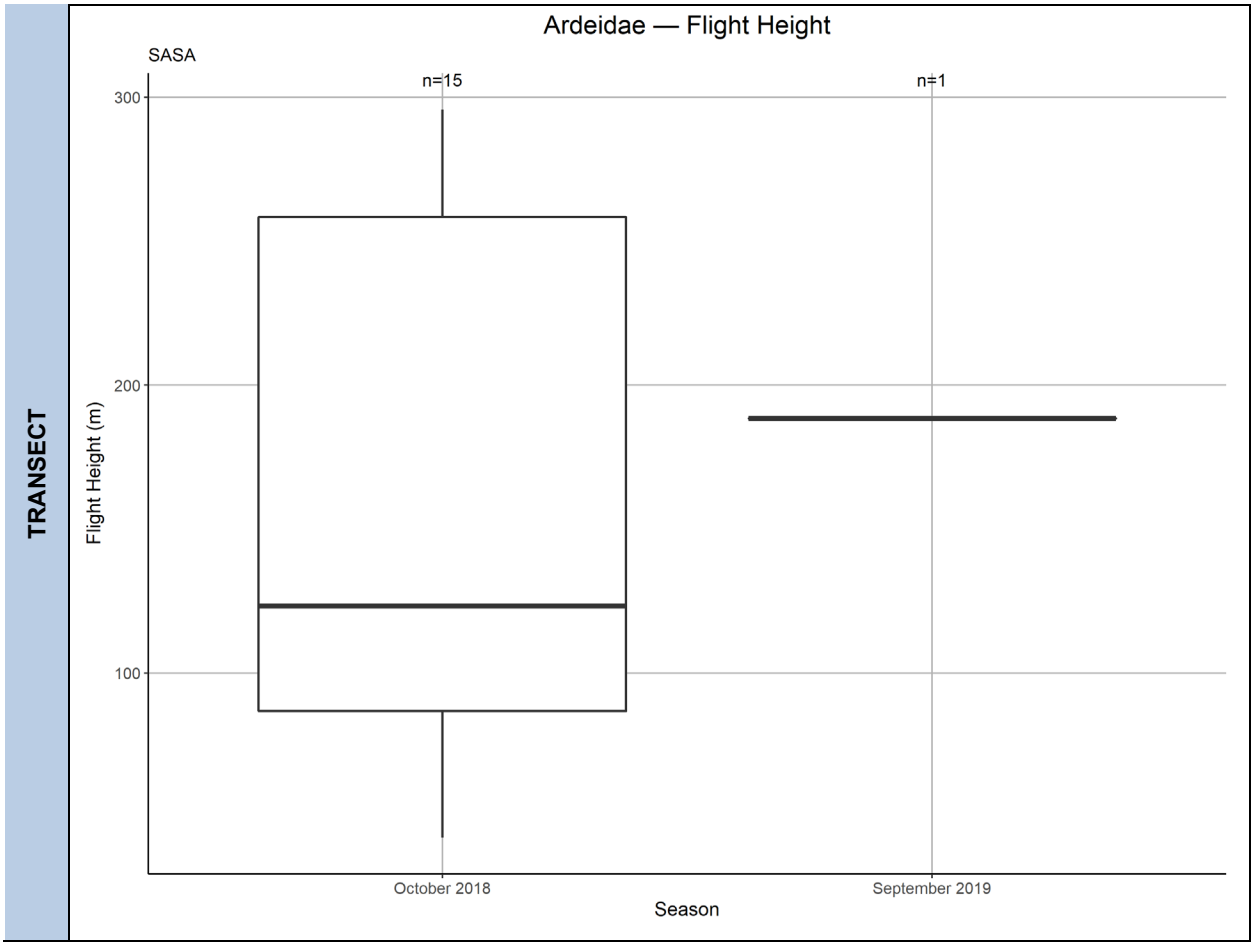


Figure C–286. Distribution of flight heights for Ardeidae during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

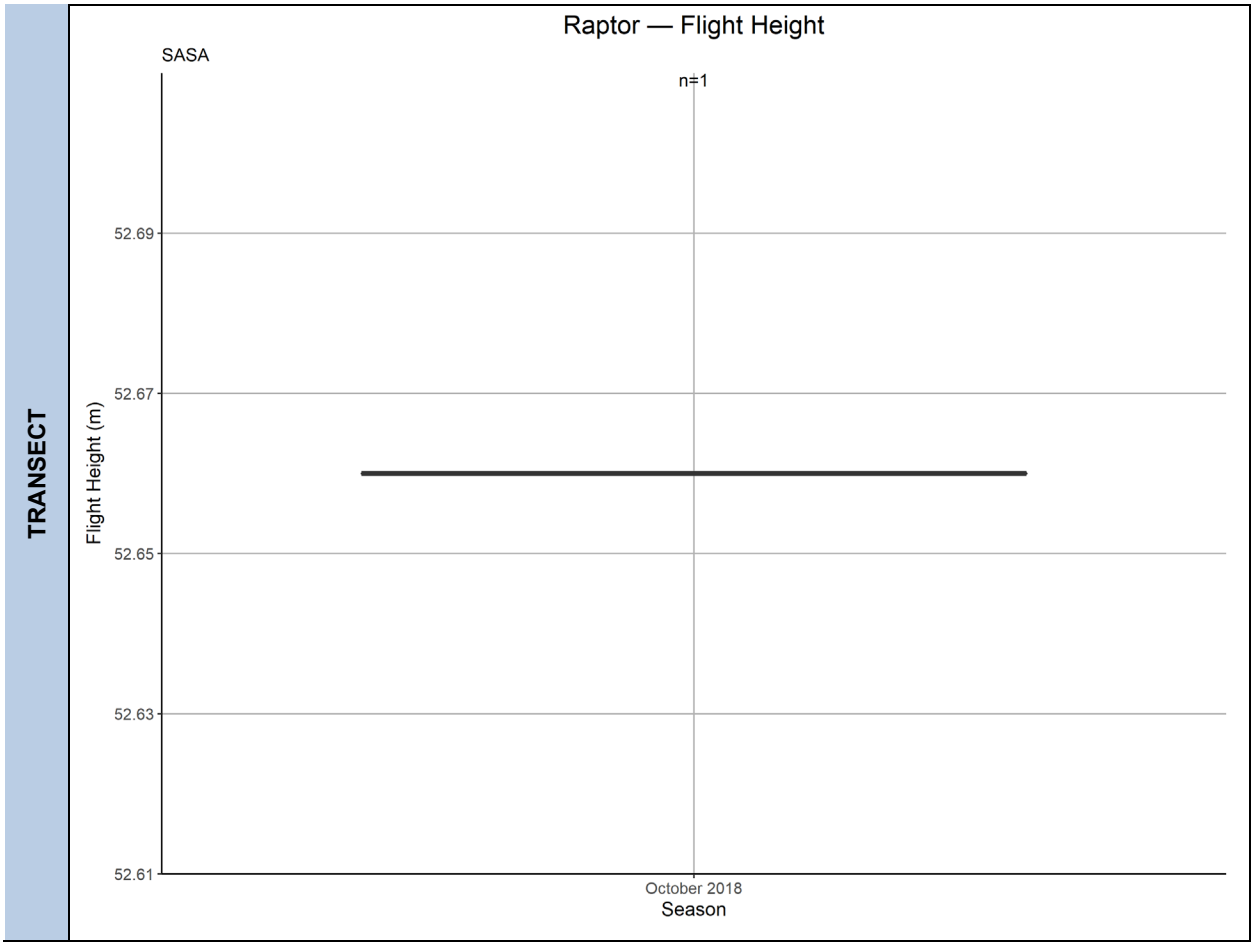


Figure C–287. Distribution of flight heights for raptors during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

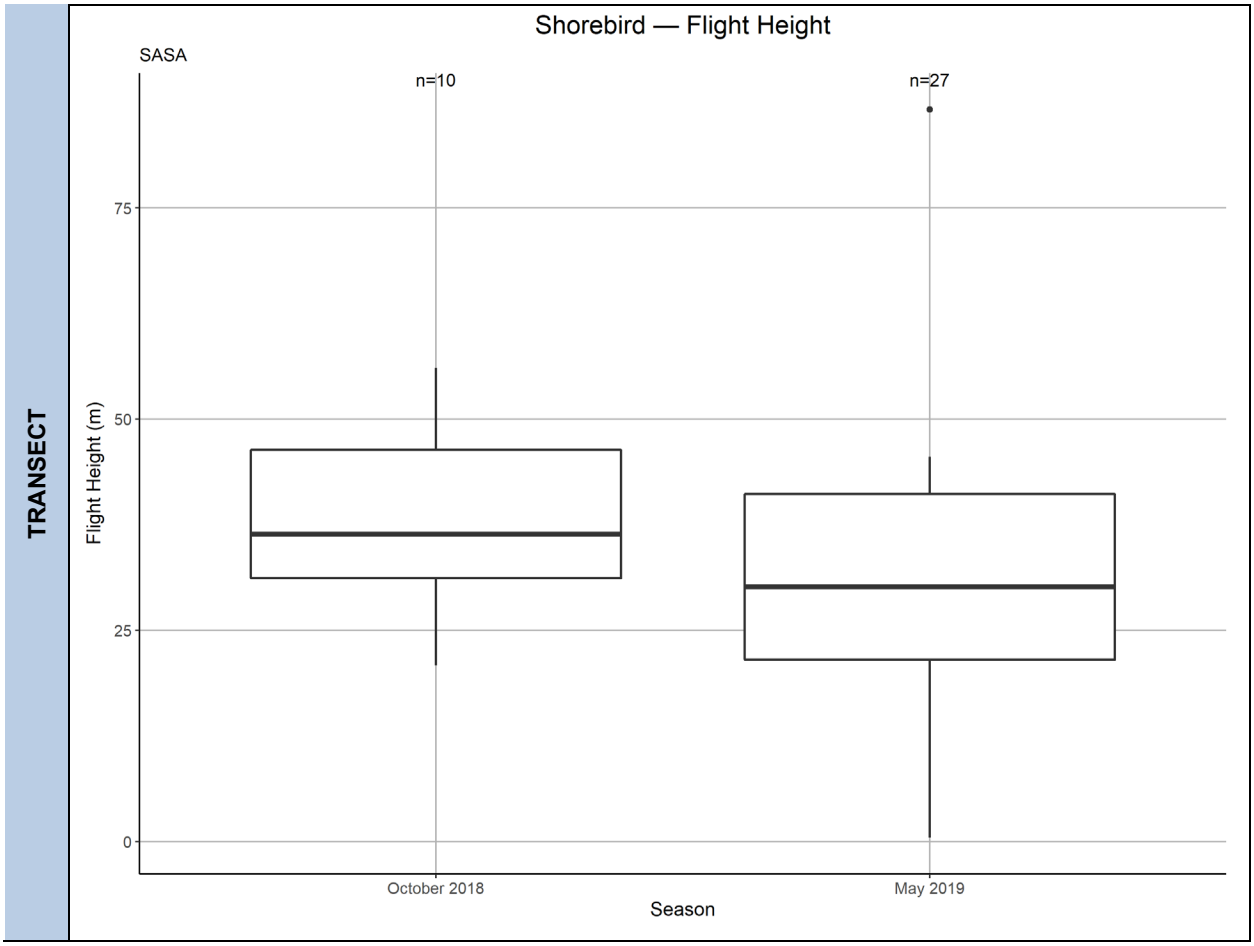


Figure C–288. Distribution of flight heights for shorebirds during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

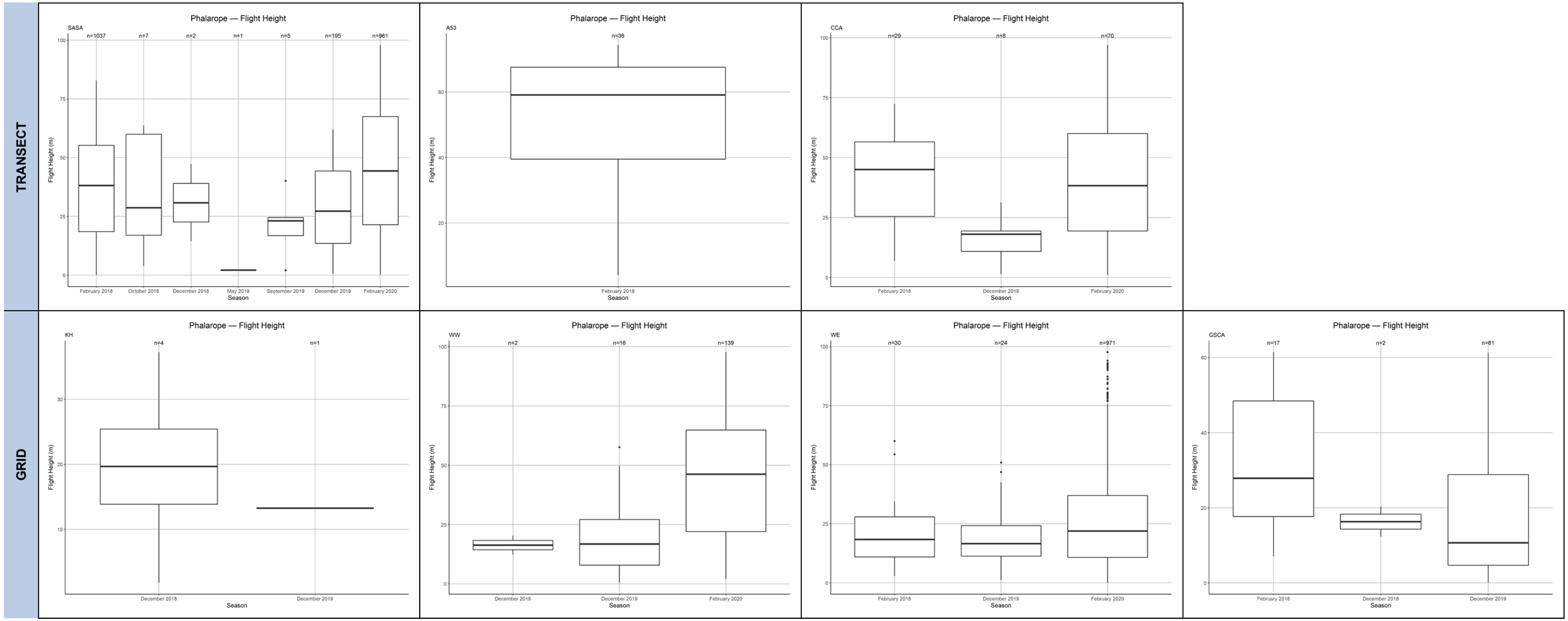


Figure C–289. Distribution of flight heights for phalaropes during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

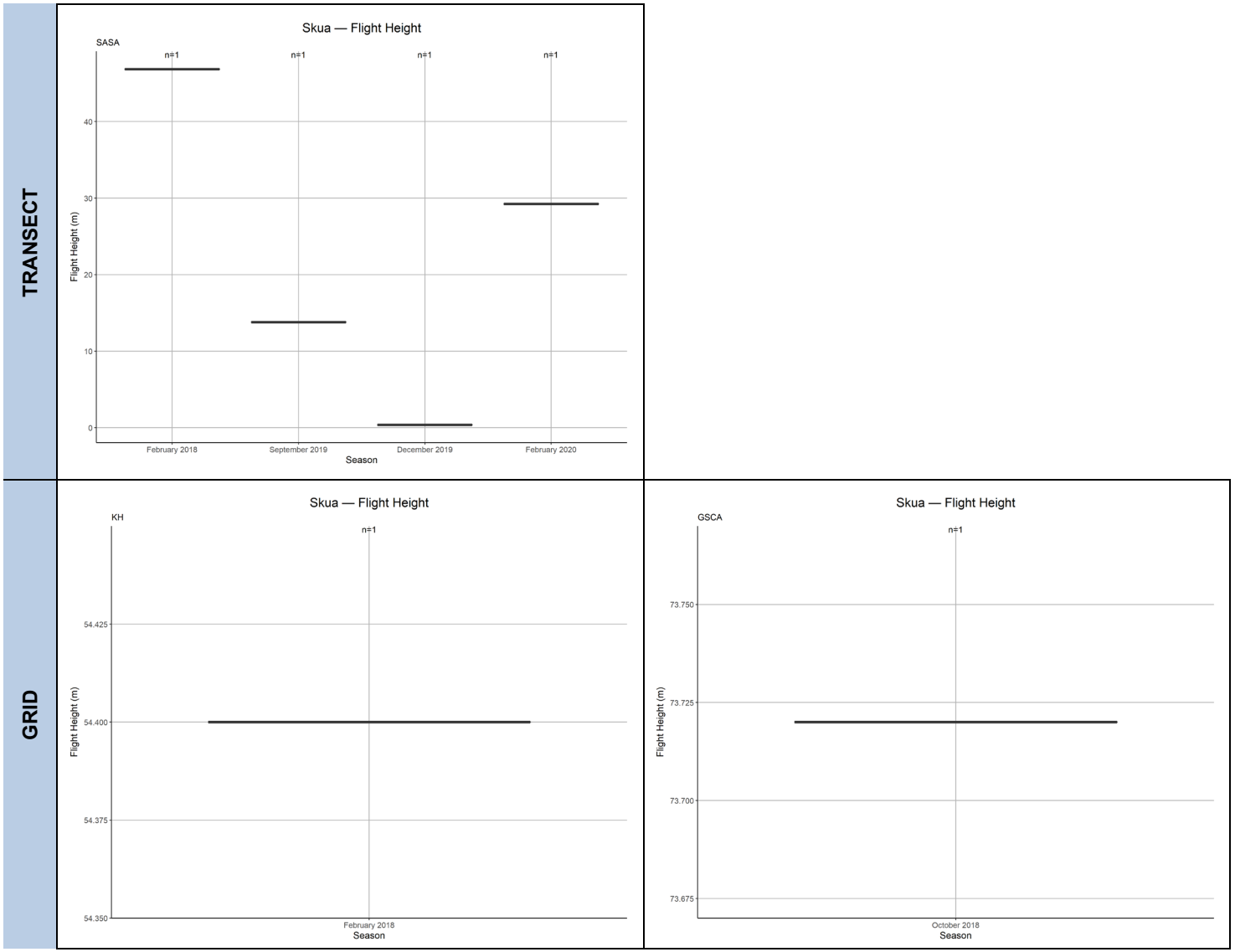


Figure C–290. Distribution of flight heights for skuas during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

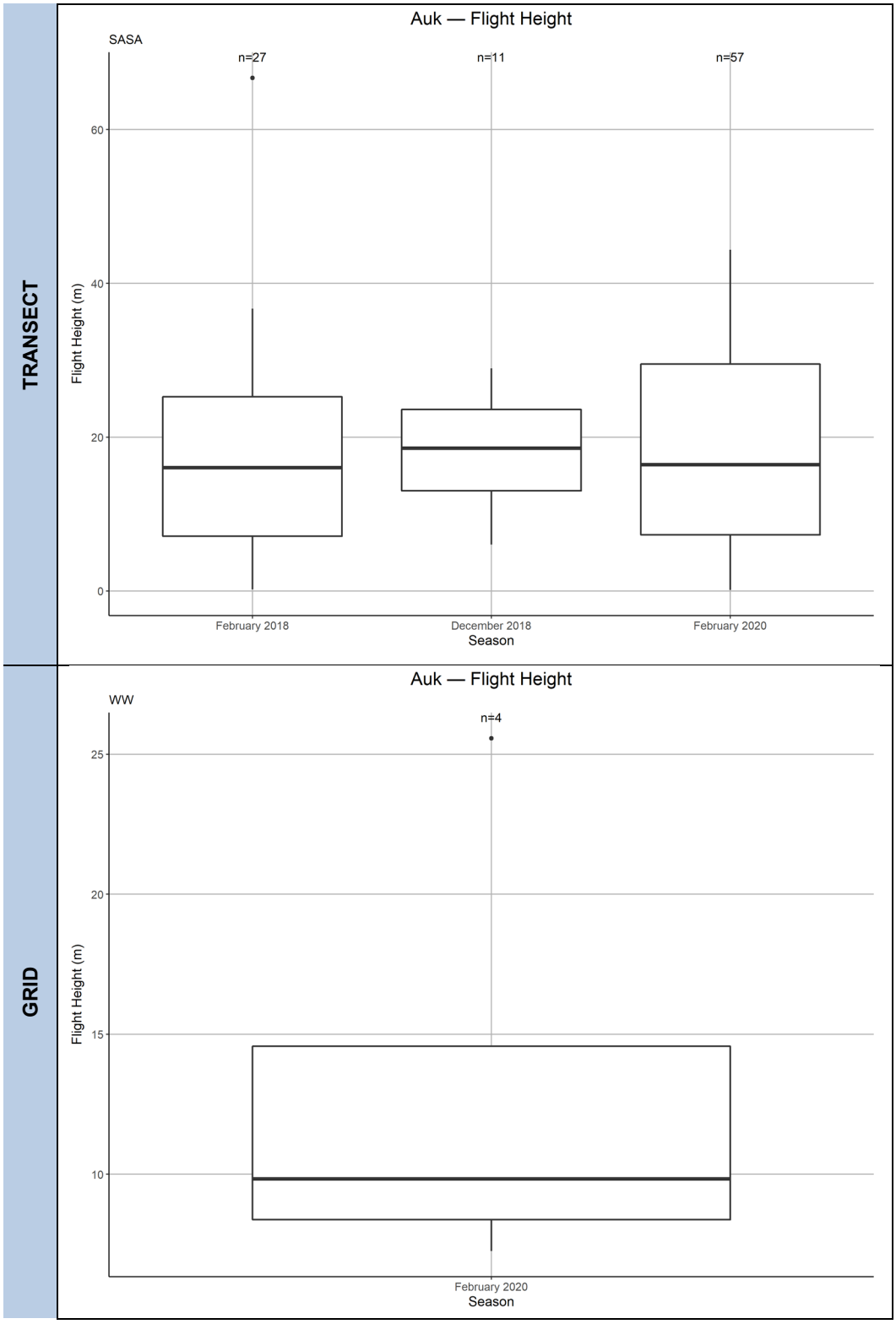


Figure C–291. Distribution of flight heights for auks during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

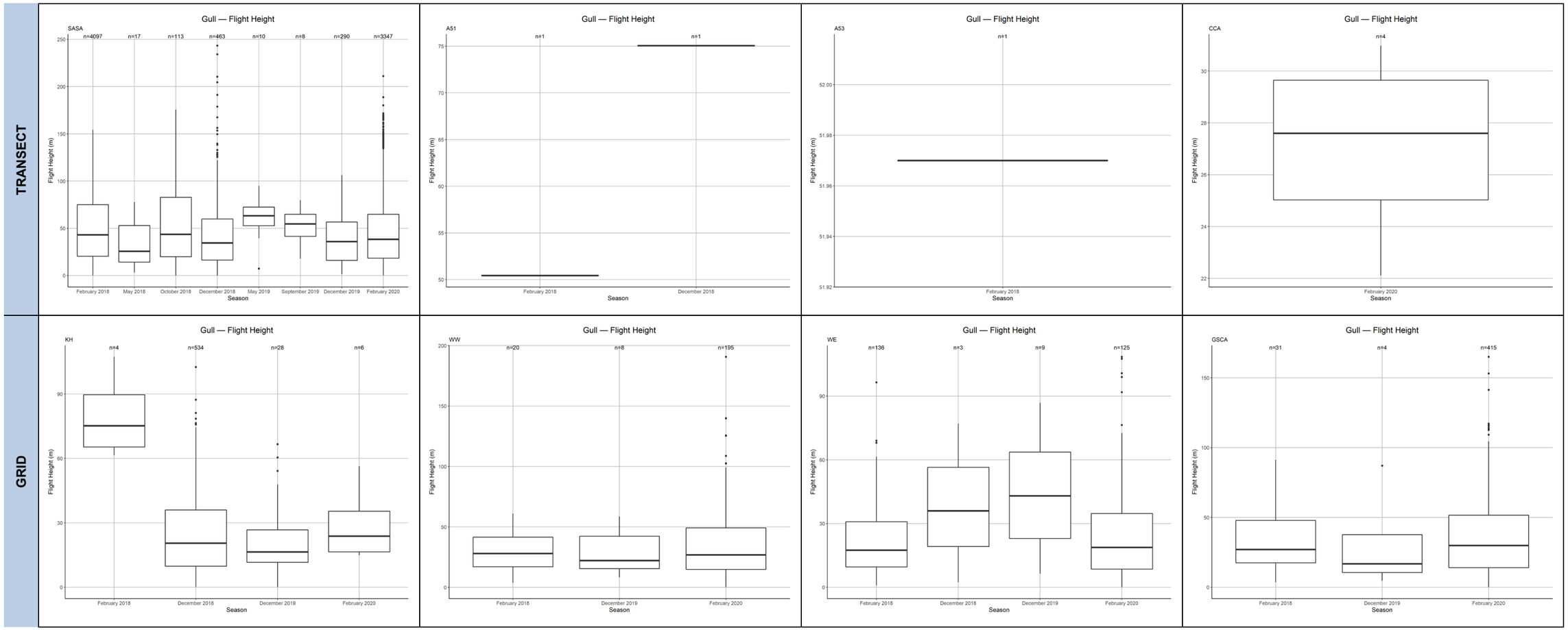


Figure C–292. Distribution of flight heights for gulls during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

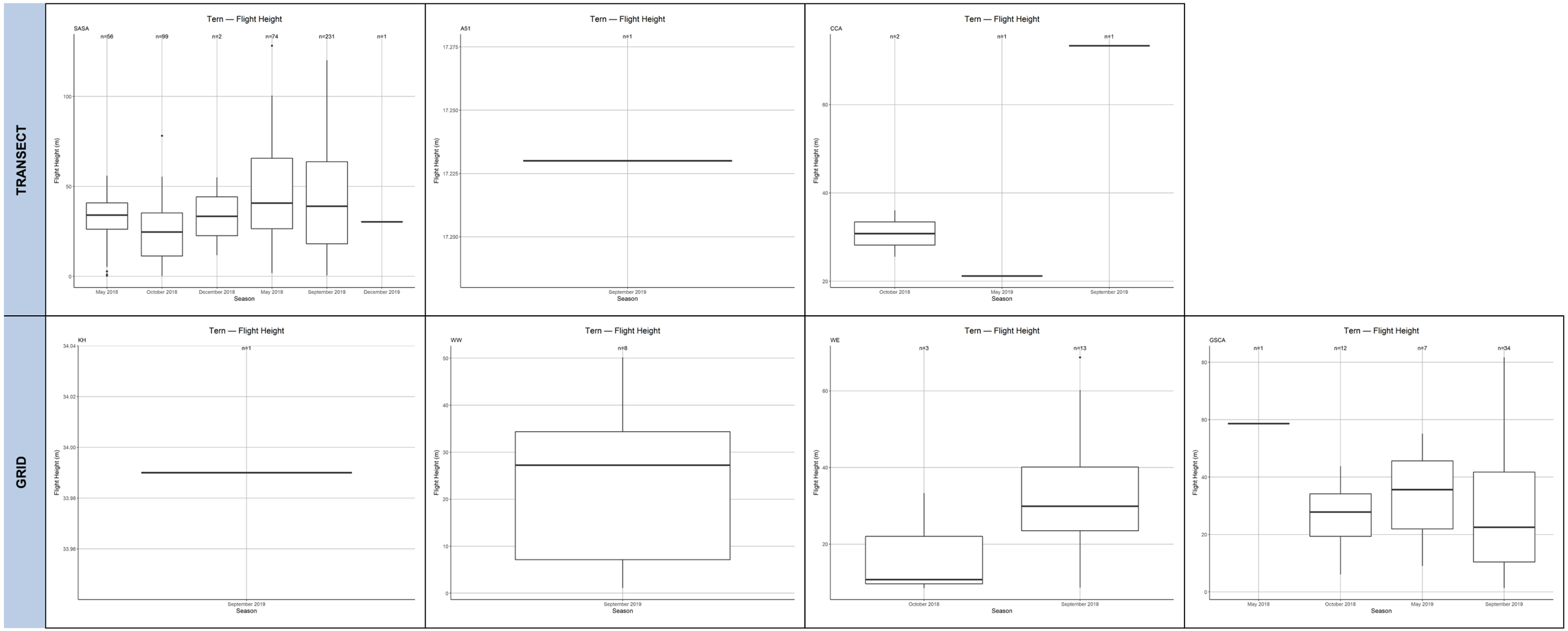


Figure C–293. Distribution of flight heights for terns during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

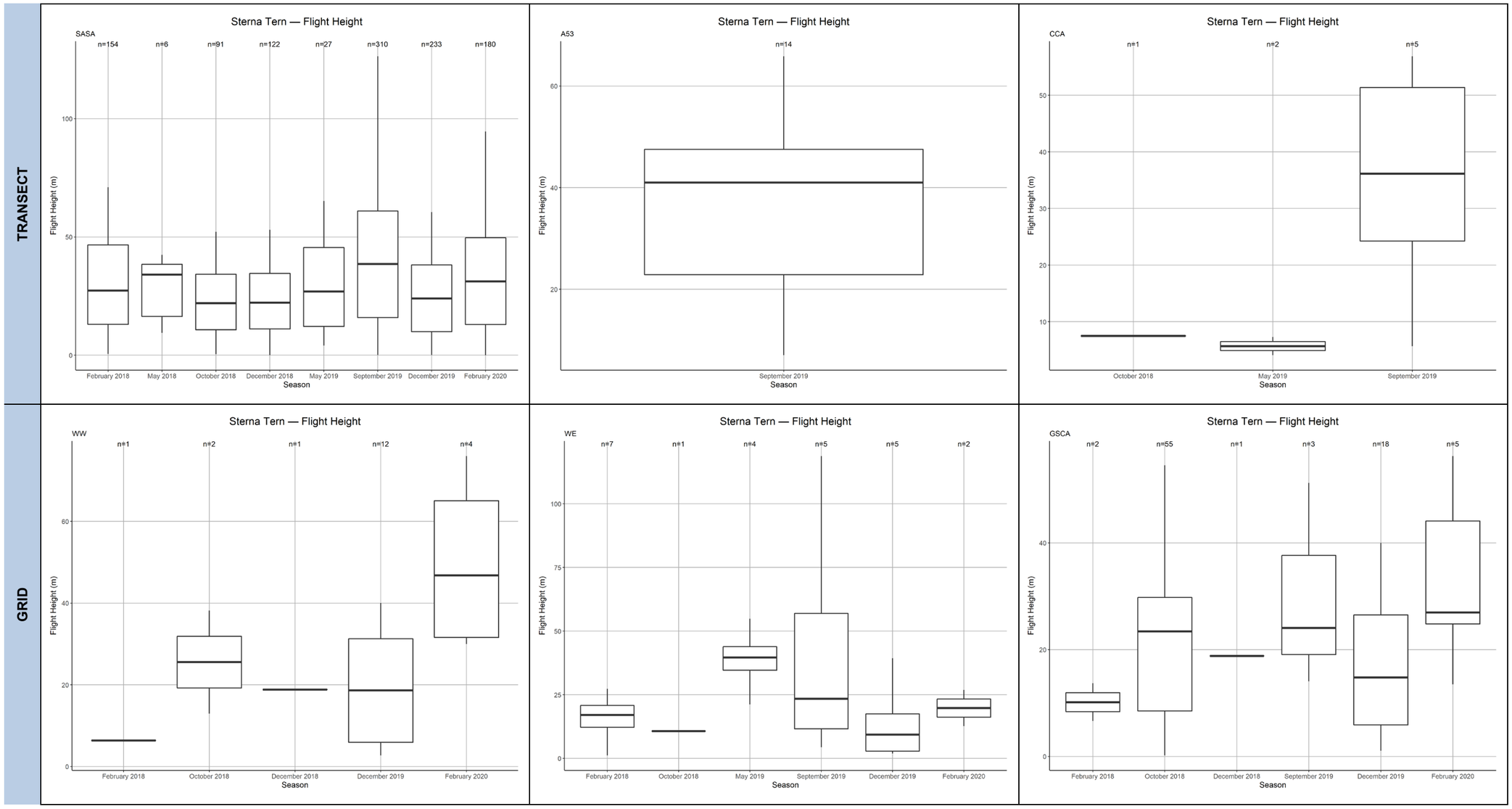


Figure C–294. Distribution of flight heights for *Sterna* terns during the February 2018 through February 2020 surveys for each survey area
Note: Y-axes are scaled according to the median flight heights for each area.

C.8 Spatial Patterns of Flight Height

C.8.1 Loons

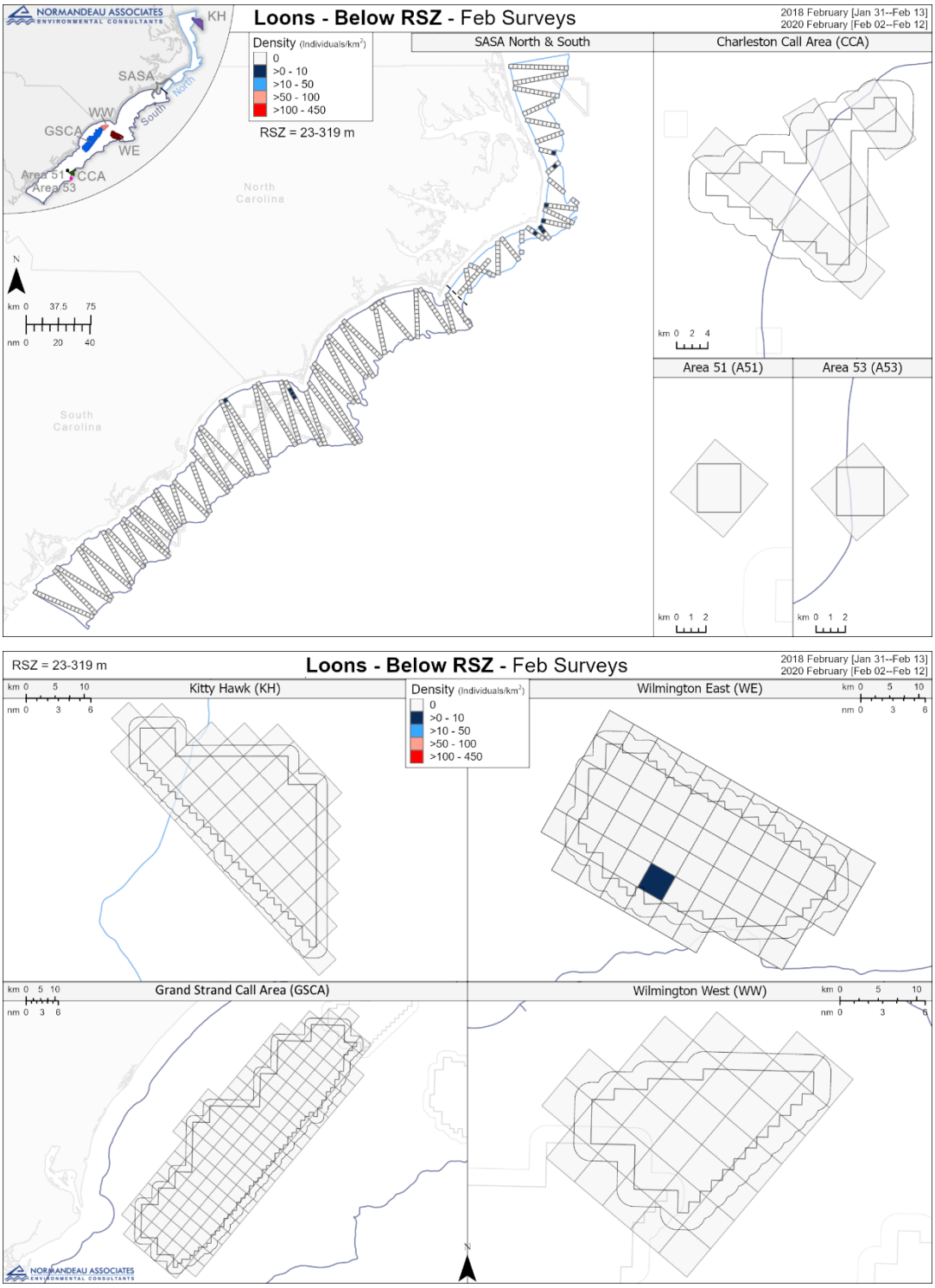


Figure C–295. Spatial distribution of loons flying below the rotor swept zone during the February surveys for all areas

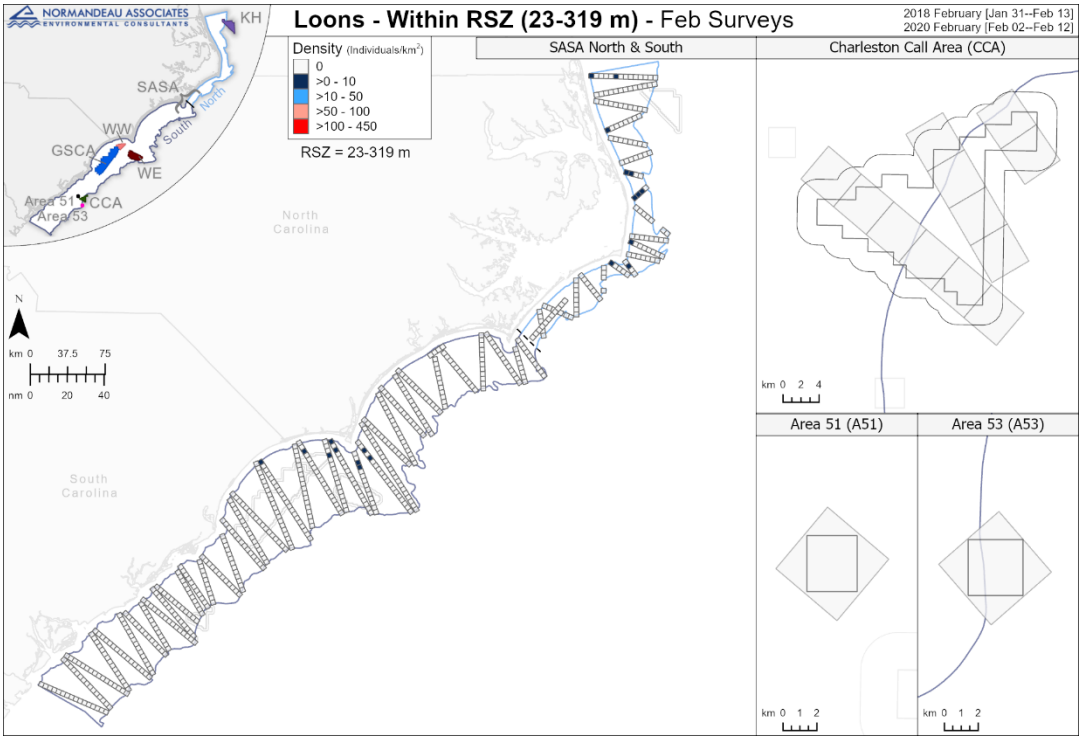


Figure C–296. Spatial distribution of loons flying within the rotor swept zone during the February surveys for all areas

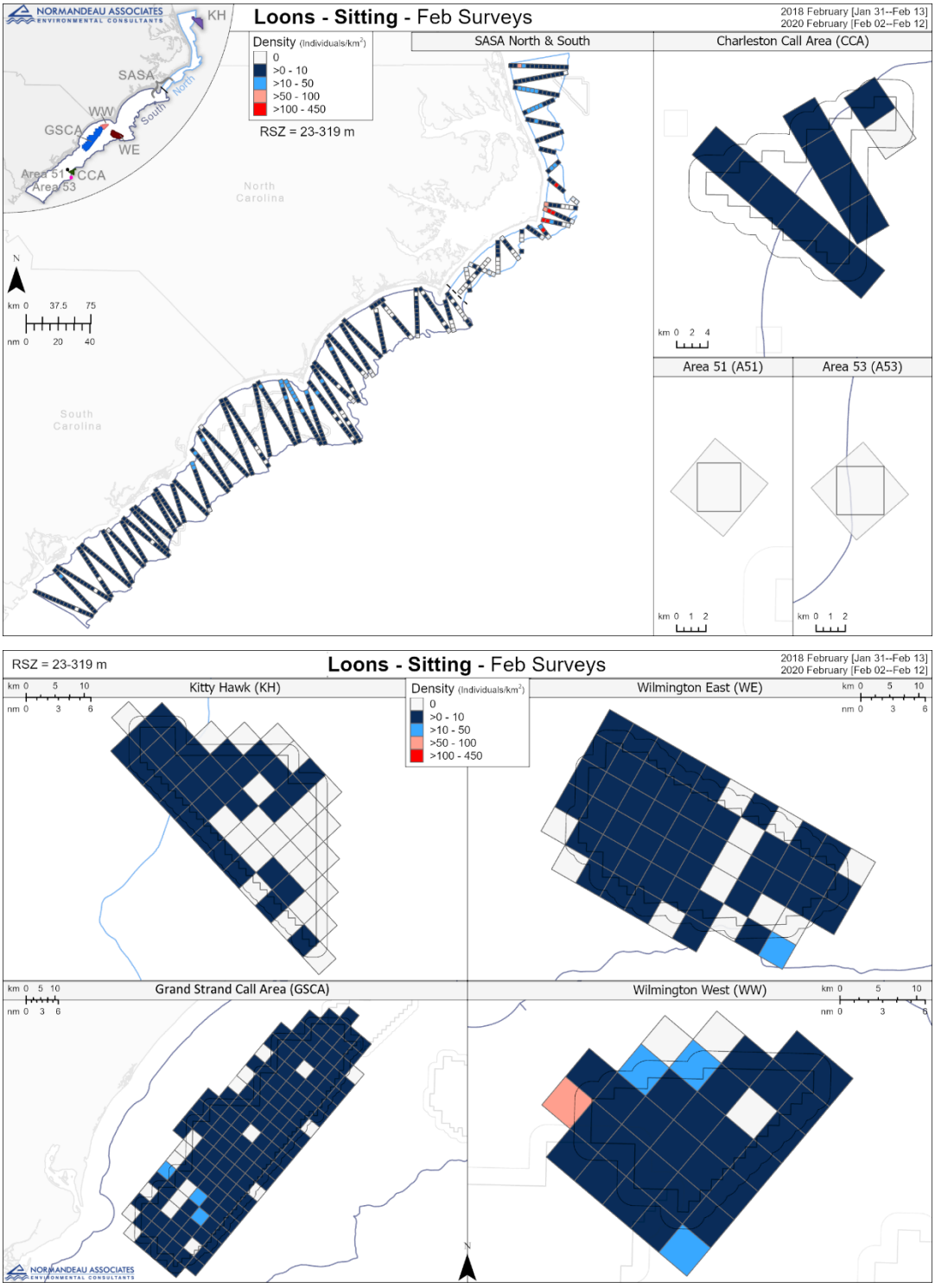


Figure C–297. Spatial distribution of sitting loons during the February surveys for all areas

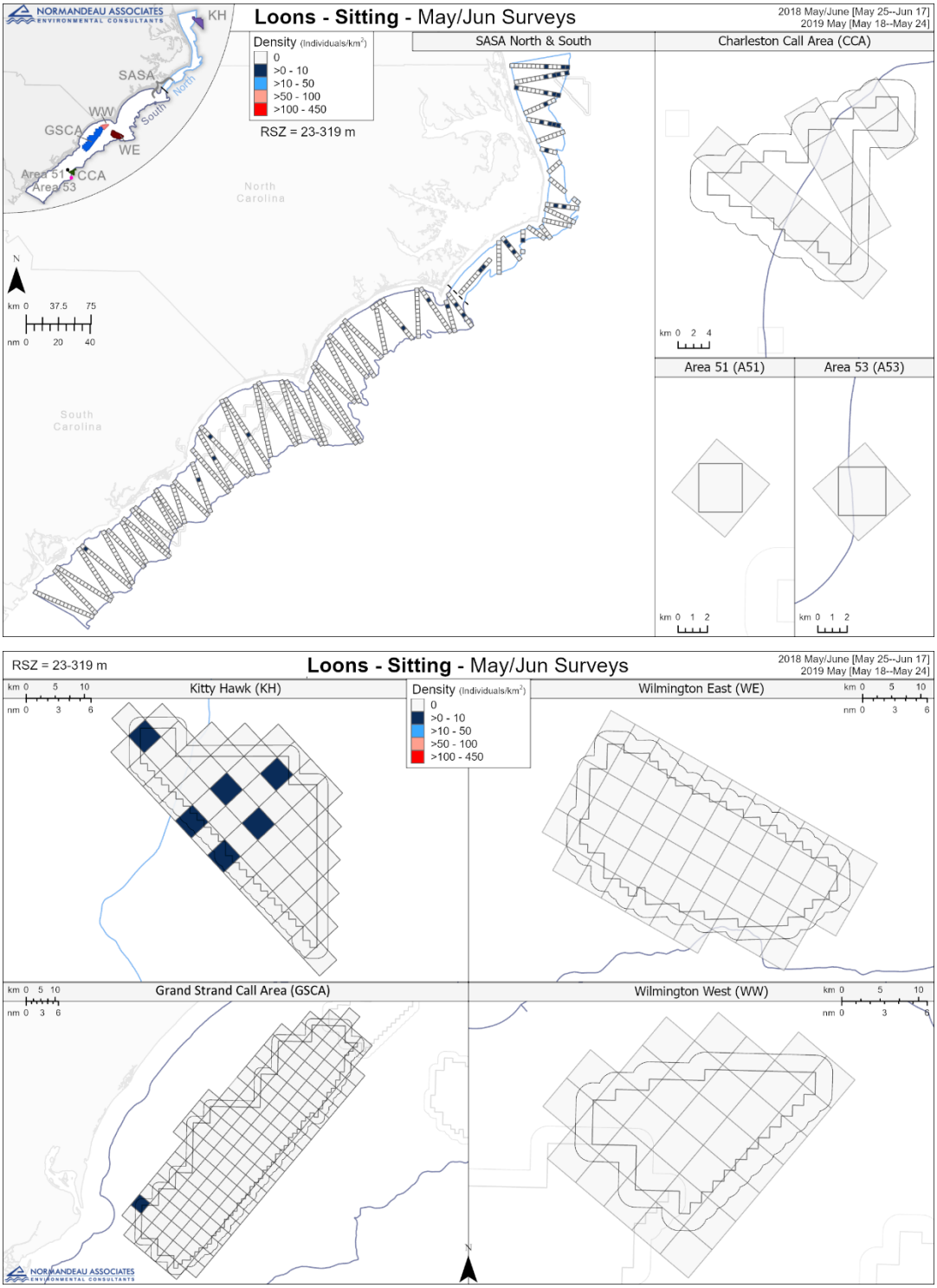


Figure C–298. Spatial distribution of sitting loons during the May/June surveys for all areas

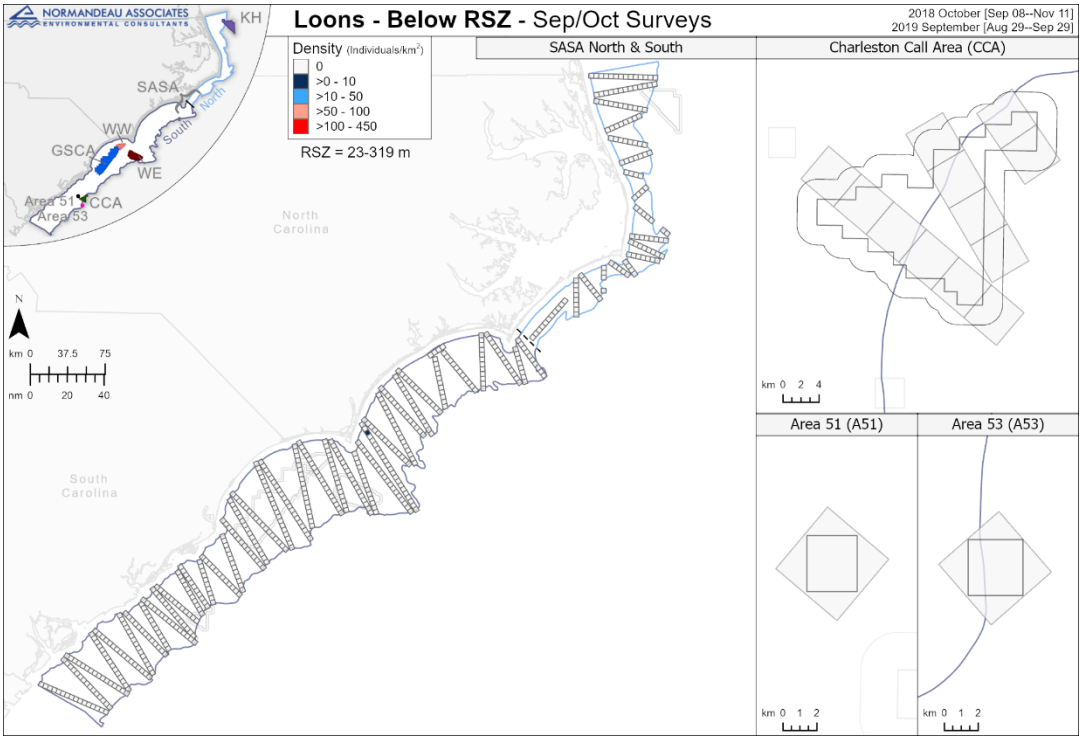


Figure C–299. Spatial distribution of loons flying below the rotor swept zone during the September/October surveys for all areas

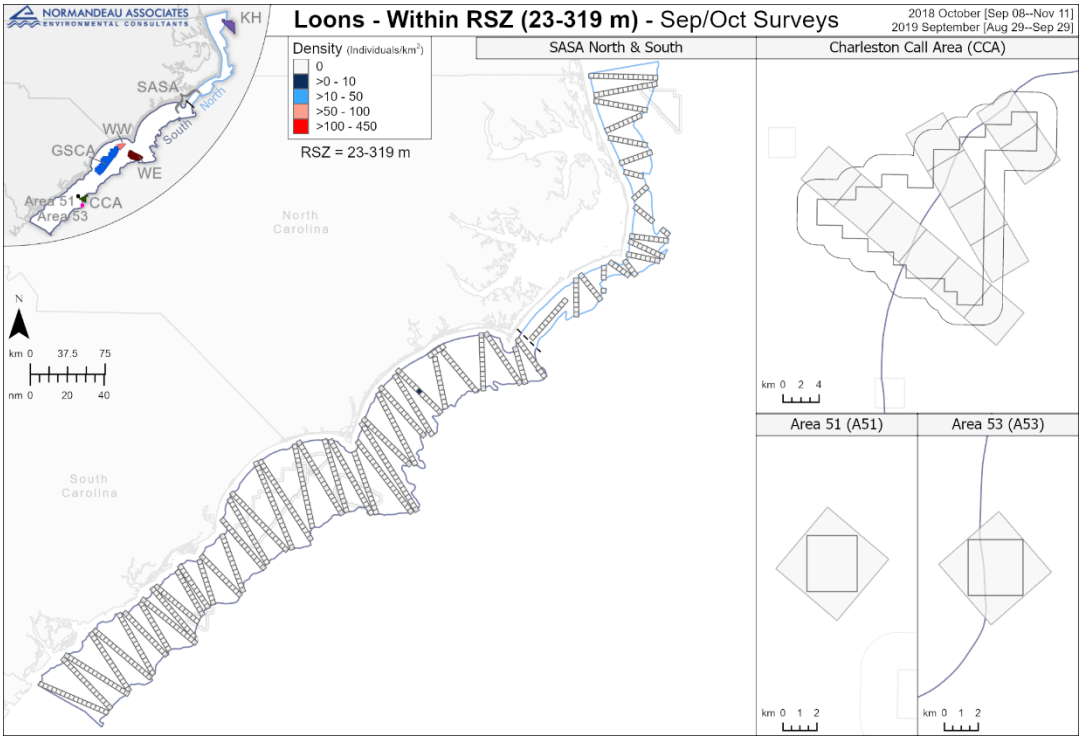


Figure C–300. Spatial distribution of loons flying within the rotor swept zone during the September/October surveys for all areas

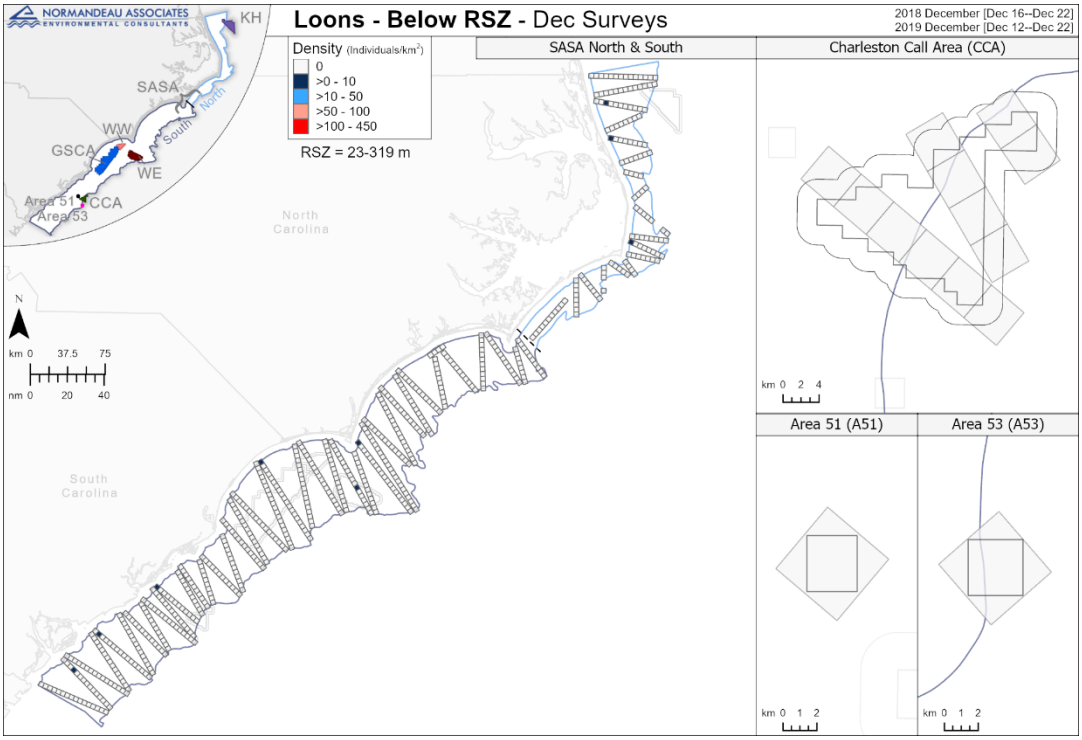


Figure C–301. Spatial distribution of loons flying below the rotor swept zone during the December surveys for all areas

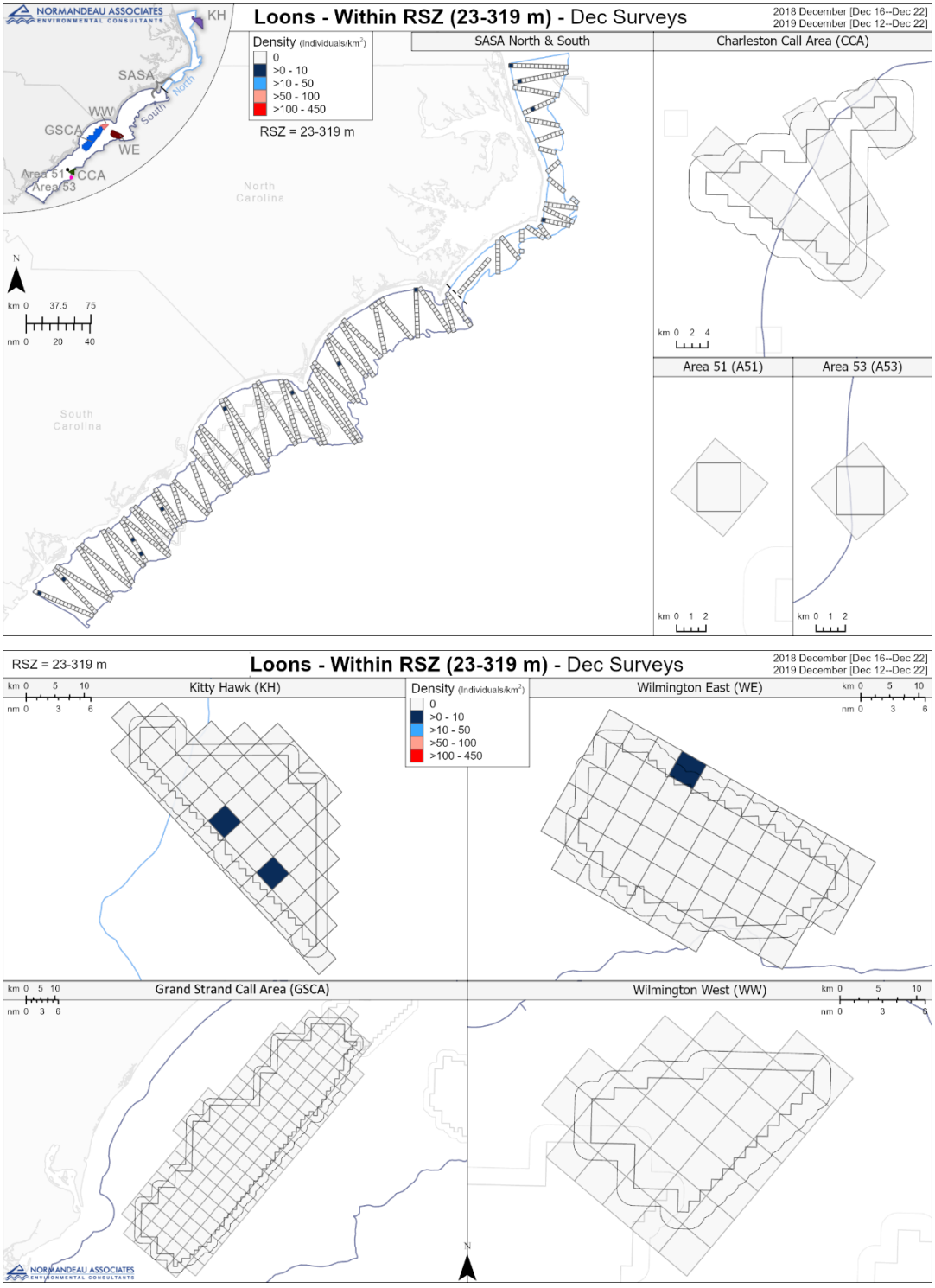


Figure C–302. Spatial distribution of loons flying within the rotor swept zone during the December surveys for all areas

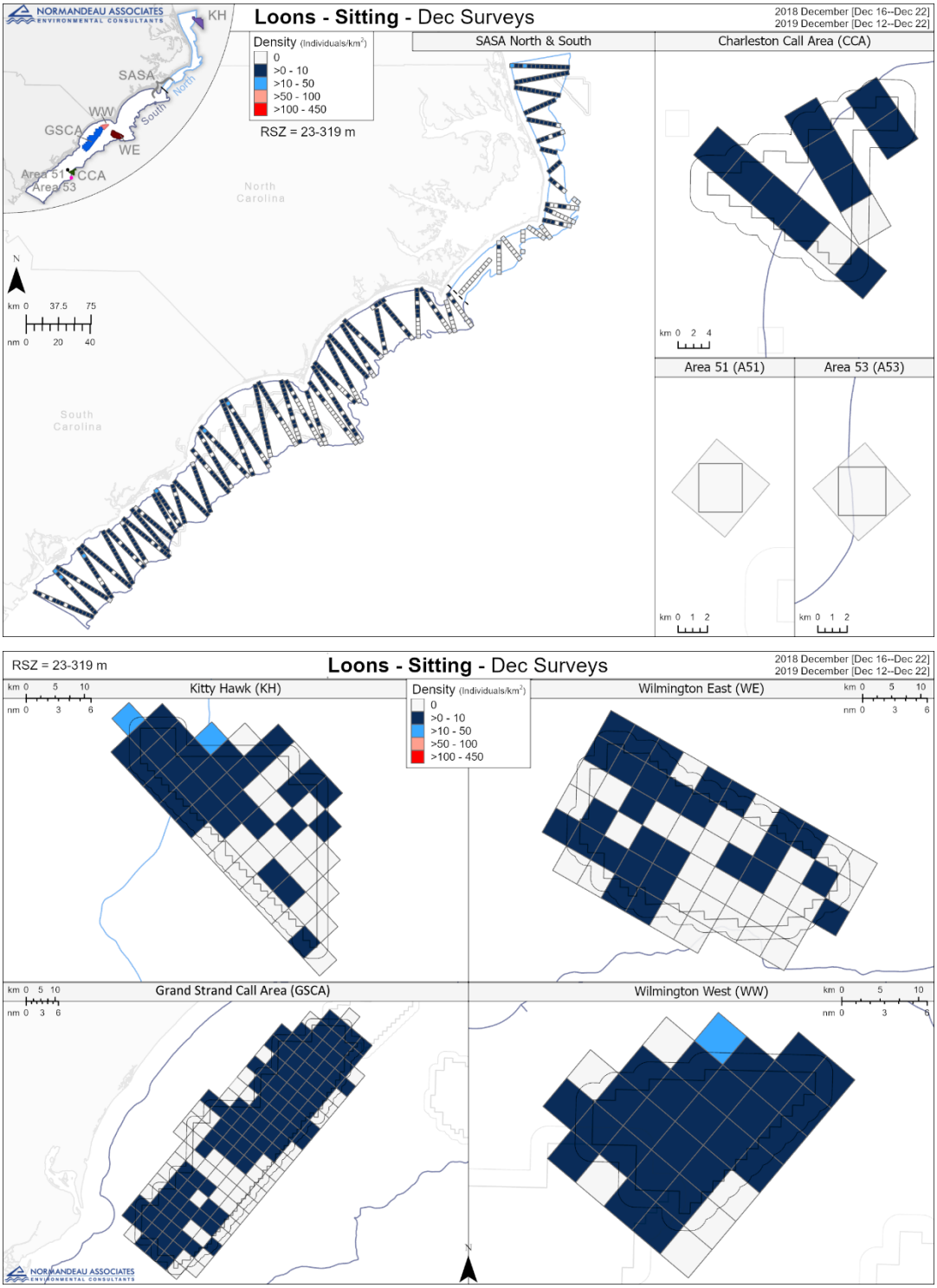


Figure C–303. Spatial distribution of sitting loons during the December surveys for all areas

C.8.2 Gannets

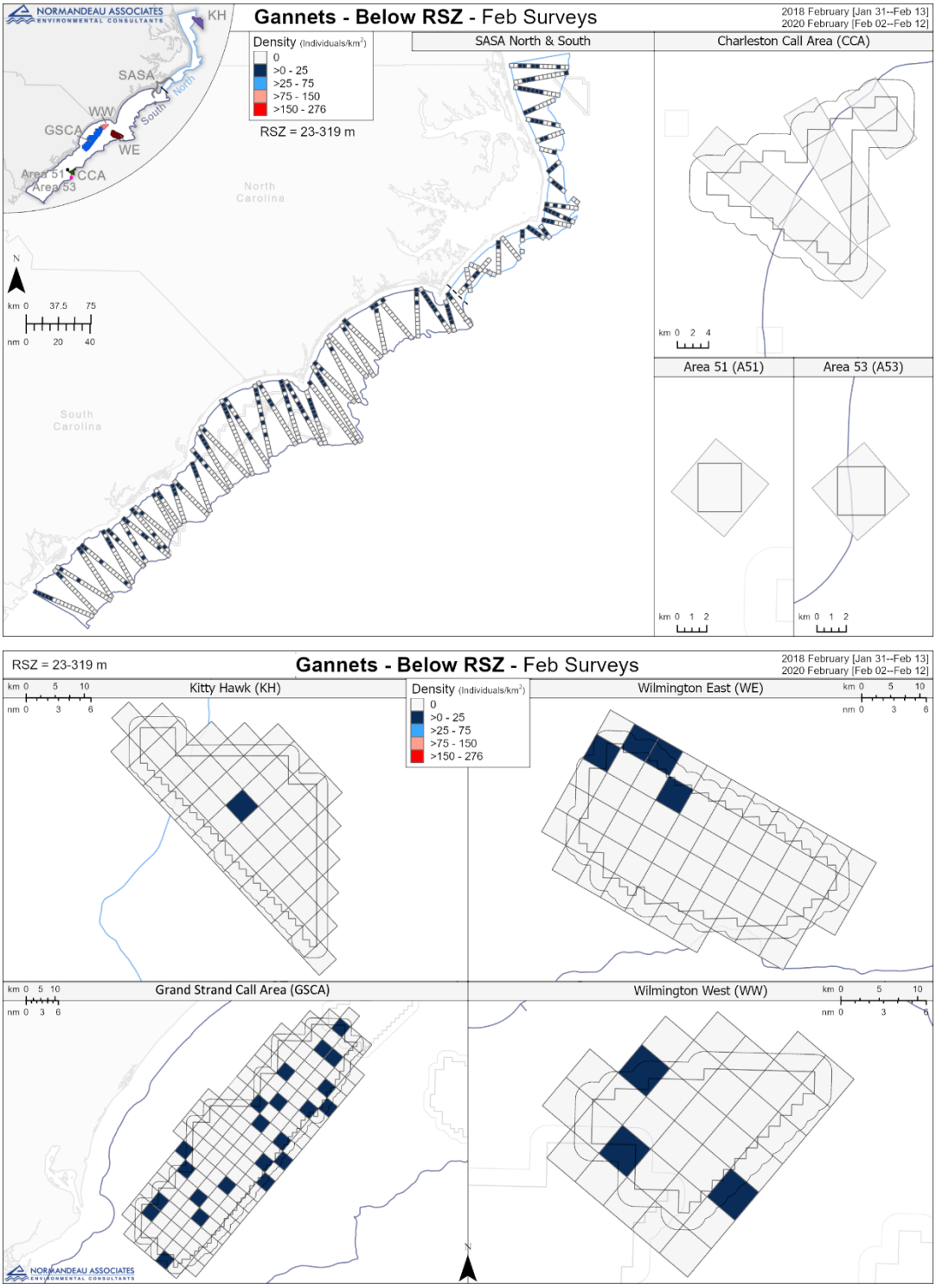


Figure C–304. Spatial distribution of gannets flying below the rotor swept zone during the February surveys for all areas

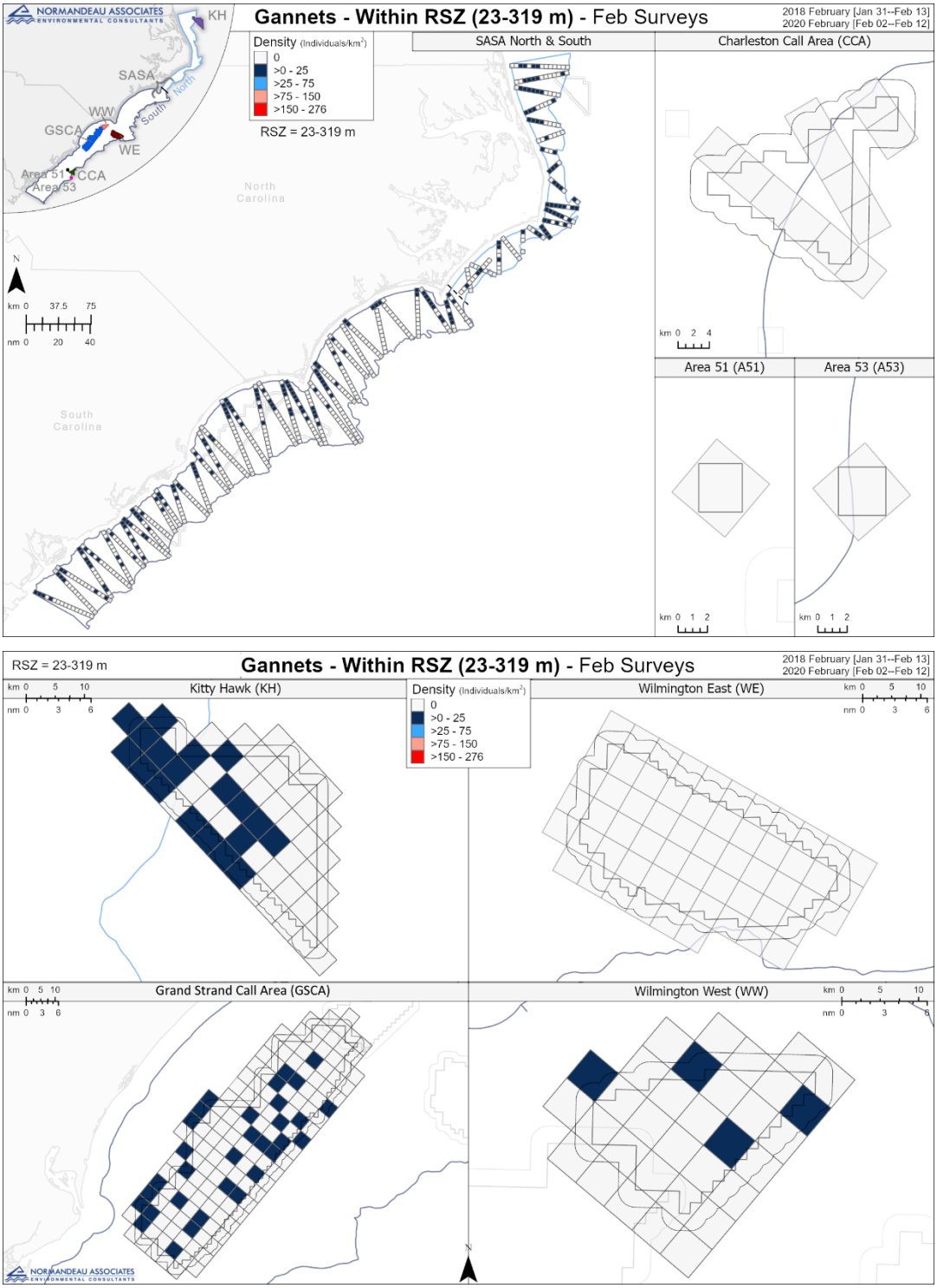


Figure C–305. Spatial distribution of gannets flying within the rotor swept zone during the February surveys for all areas

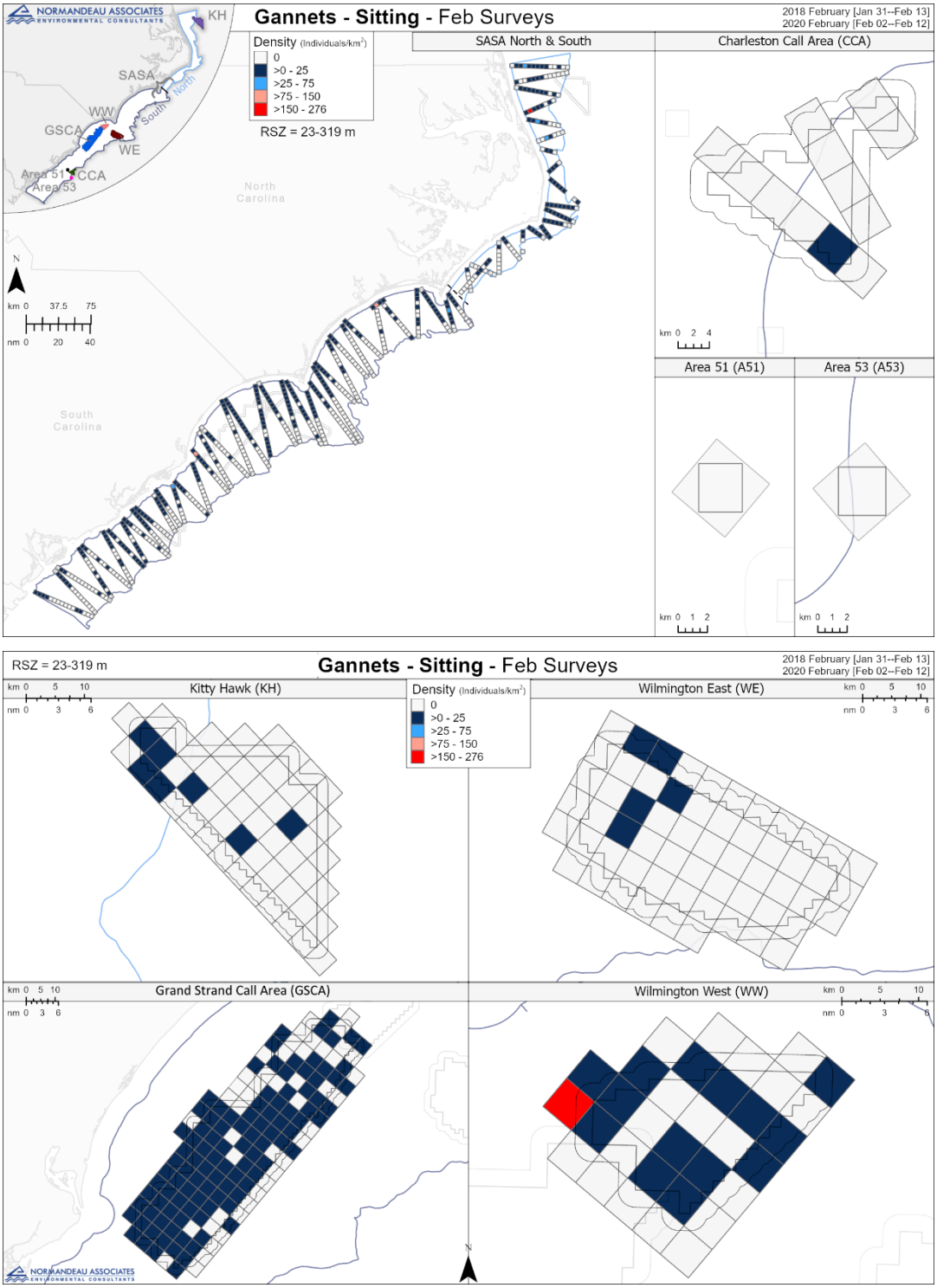


Figure C–306. Spatial distribution of sitting gannets during the February surveys for all areas

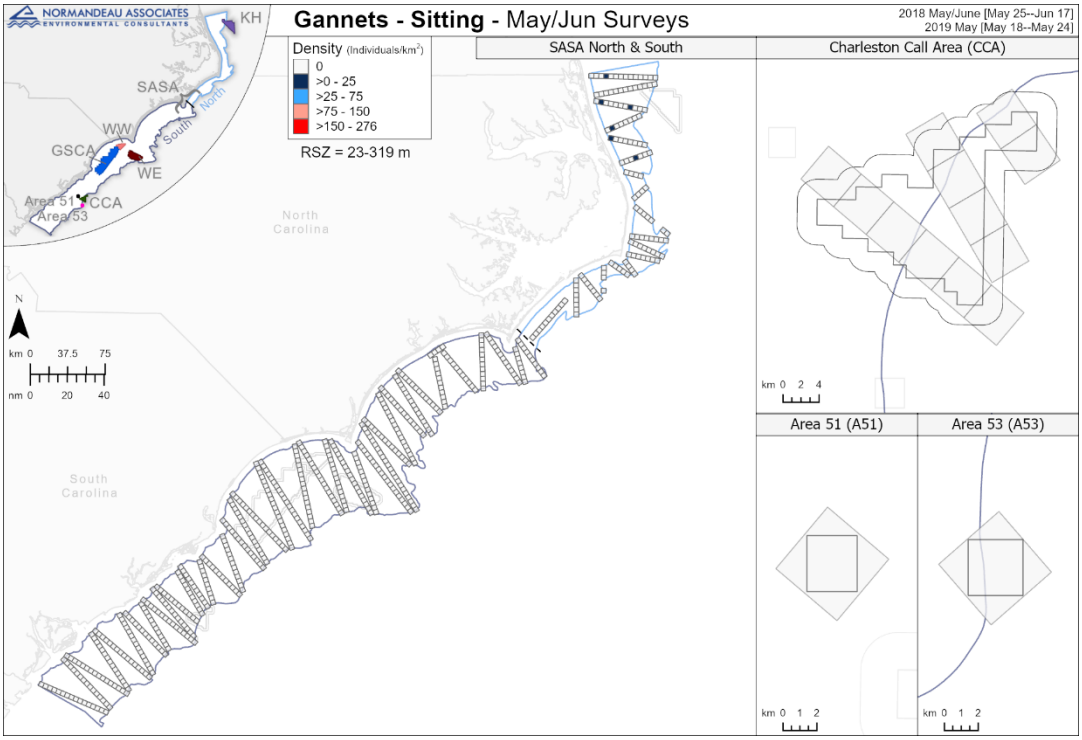


Figure C–307. Spatial distribution of sitting gannets during the May/June surveys for all areas

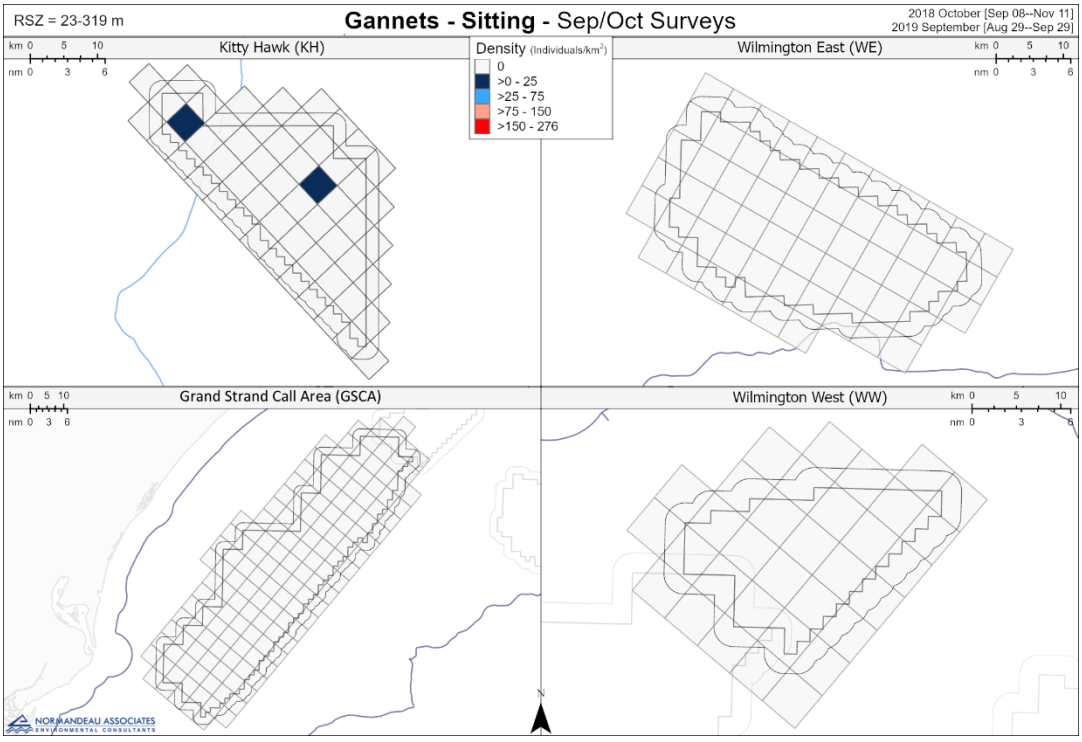


Figure C–308. Spatial distribution of sitting gannets during the September/October surveys for all areas

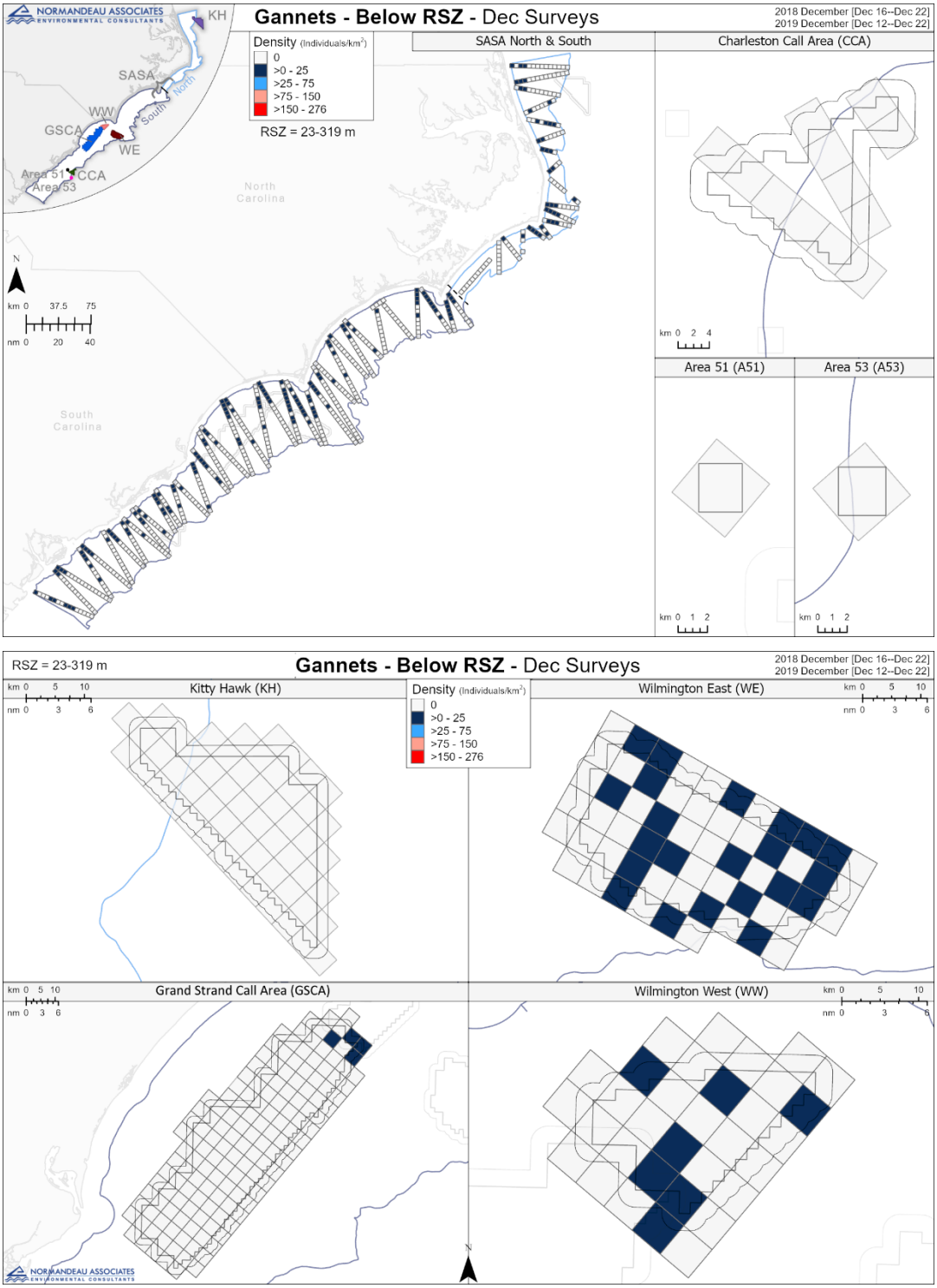


Figure C–309. Spatial distribution of gannets flying below the rotor swept zone during the December surveys for all areas

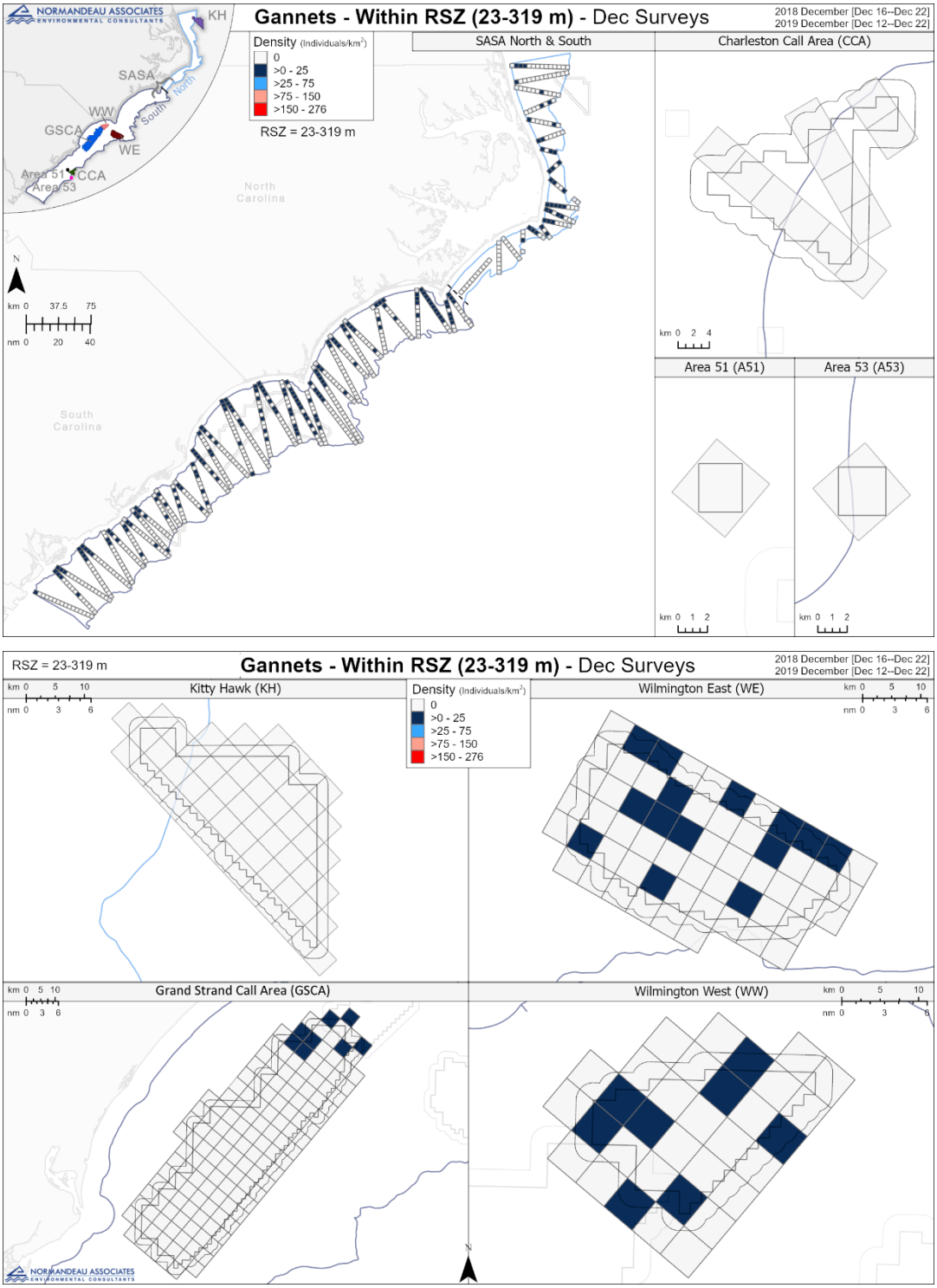


Figure C–310. Spatial distribution of gannets flying within the rotor swept zone during the December surveys for all areas

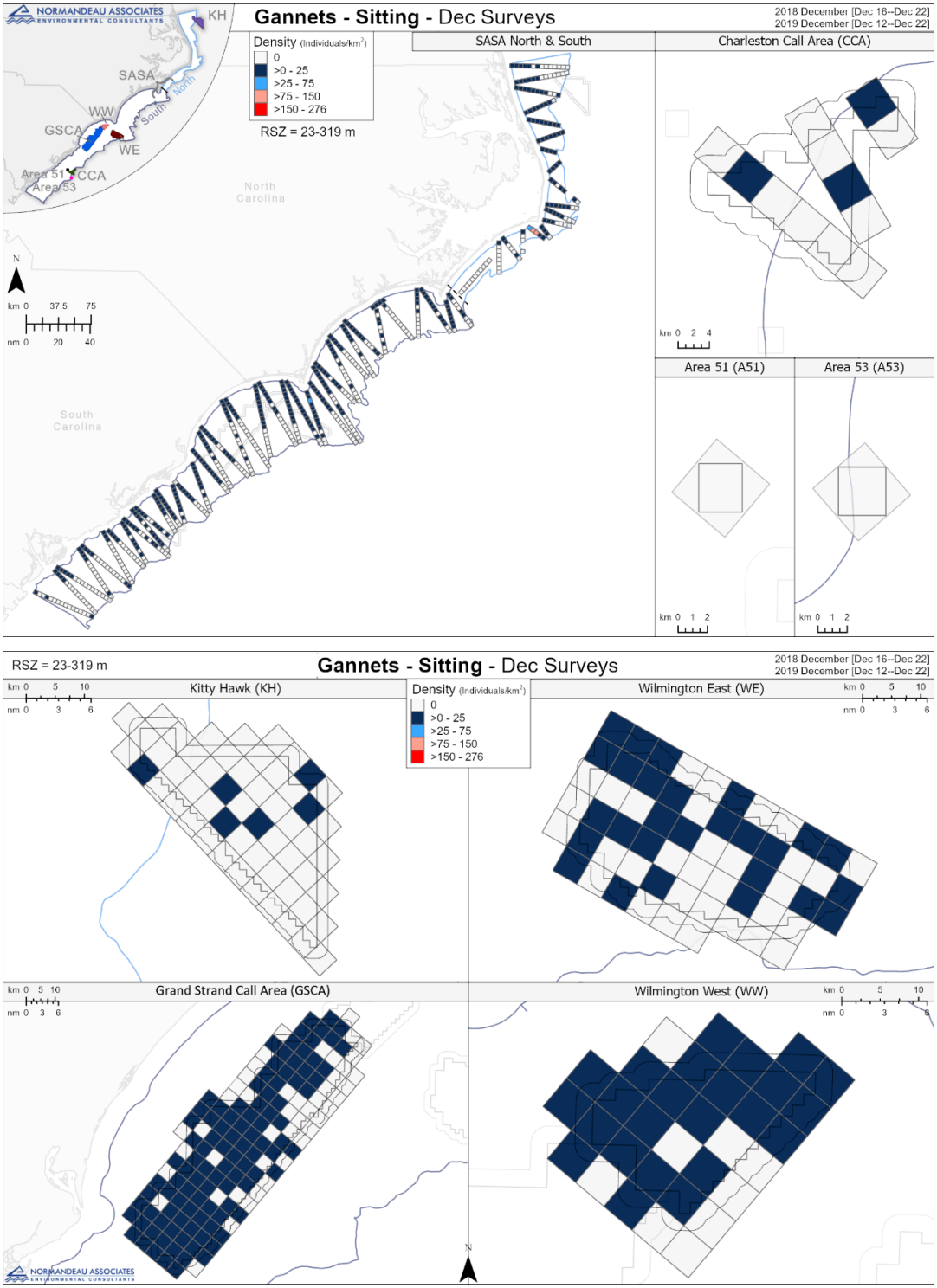


Figure C–311. Spatial distribution of sitting gannets during the December surveys for all areas

C.8.3 Gulls

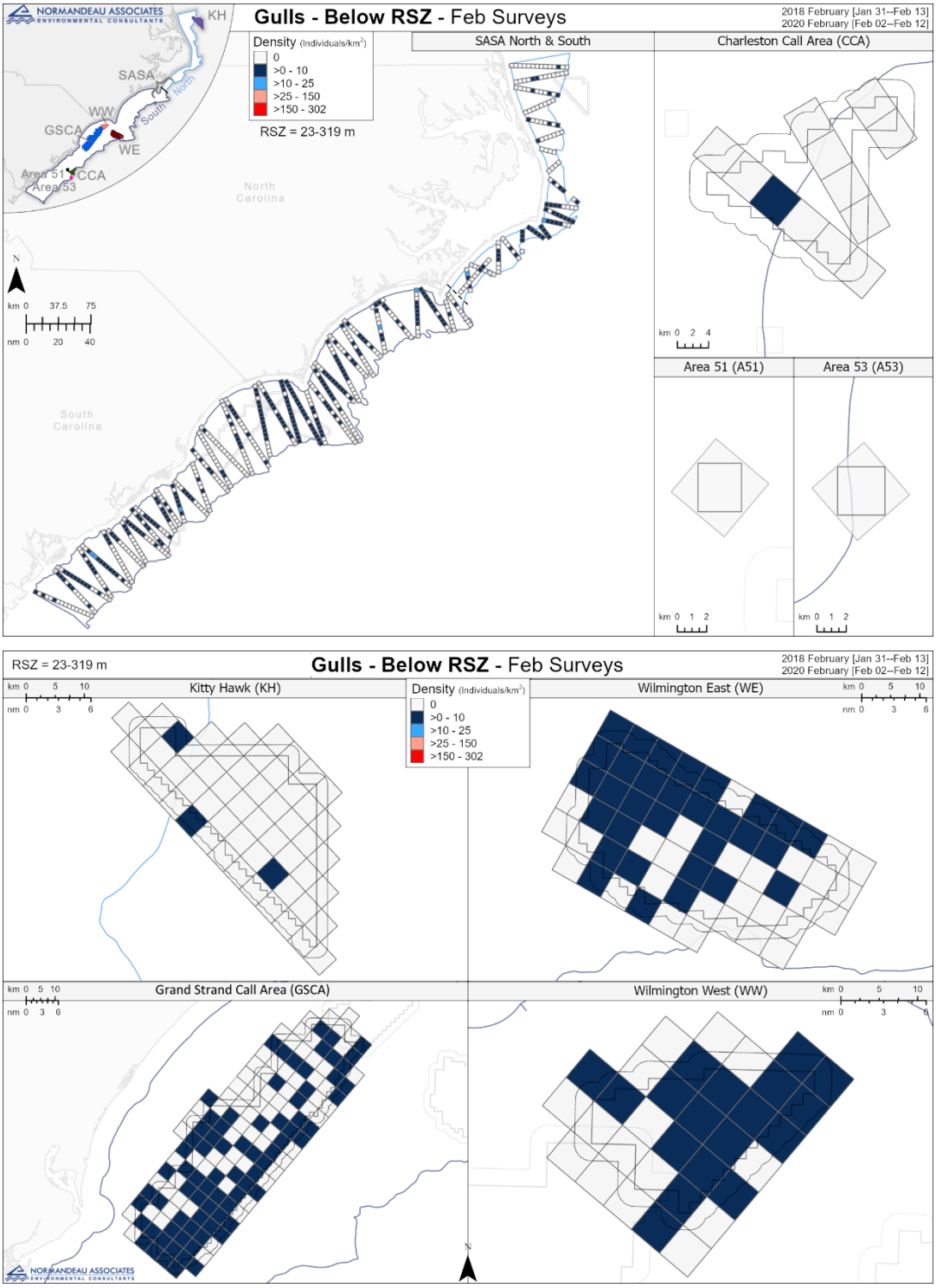


Figure C–312. Spatial distribution of gulls flying below the rotor swept zone during the February surveys for all areas

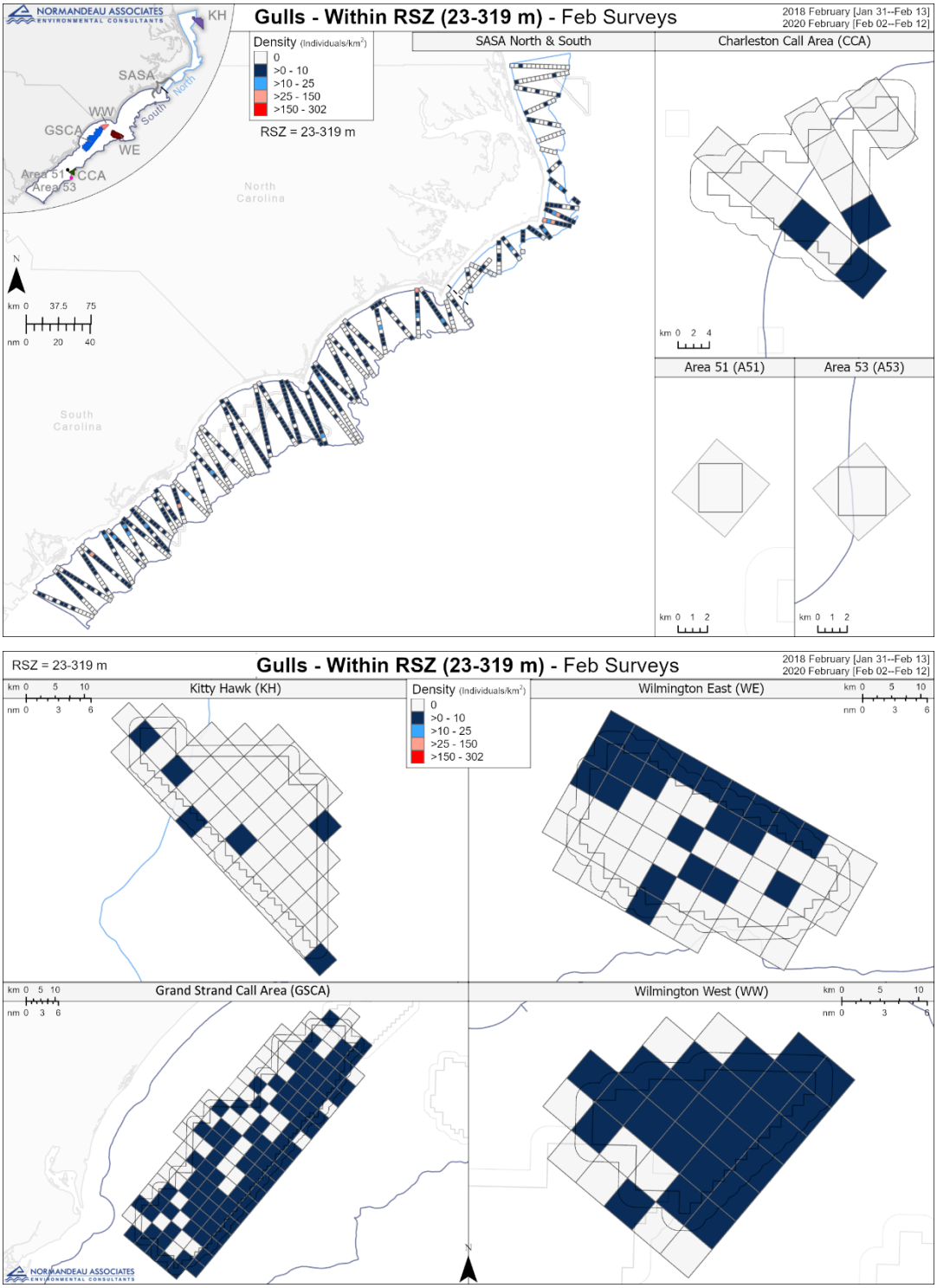


Figure C–313. Spatial distribution of gulls flying within the rotor swept zone during the February surveys for all areas

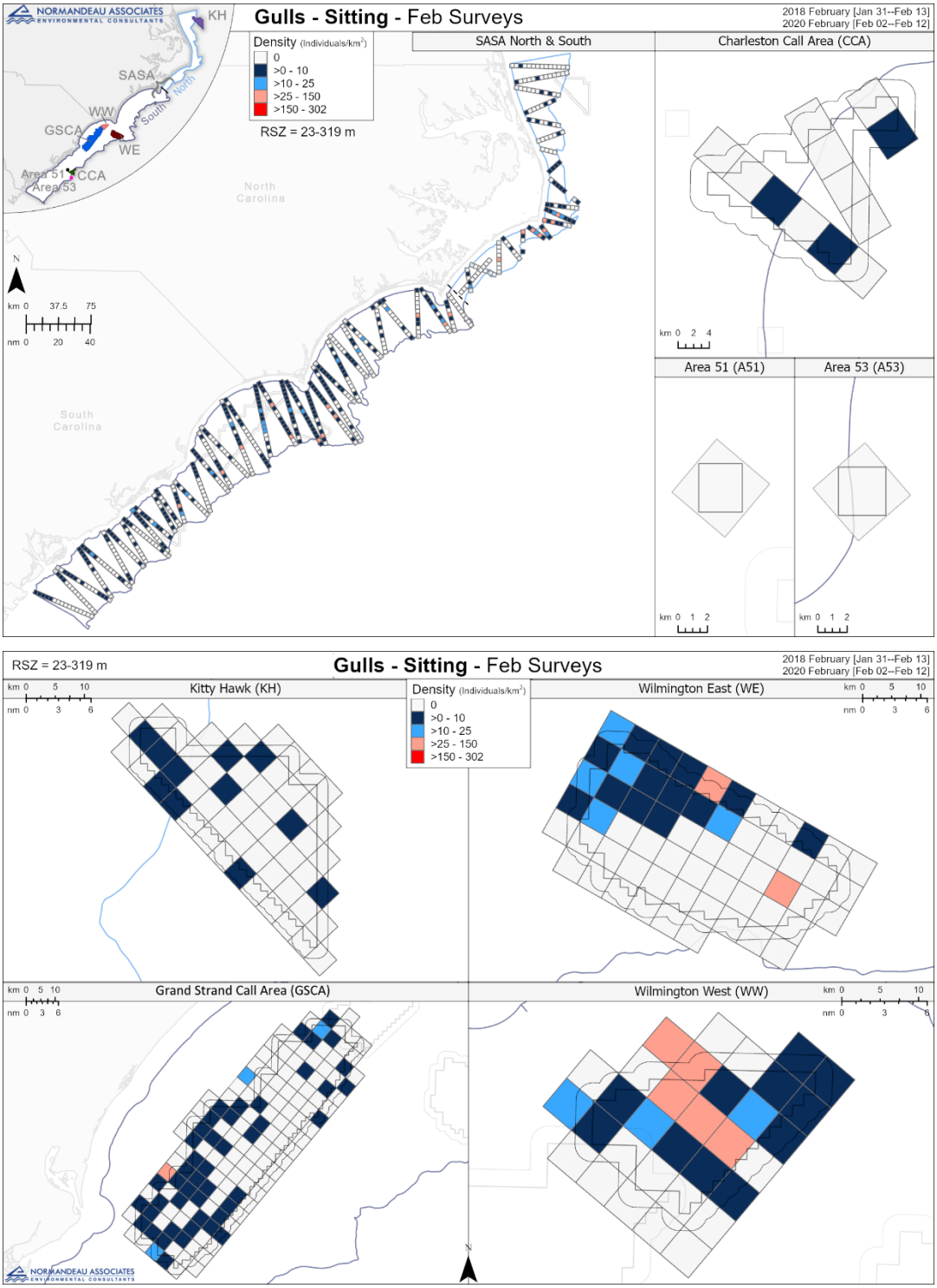


Figure C–314. Spatial distribution of sitting gulls during the February surveys for all areas

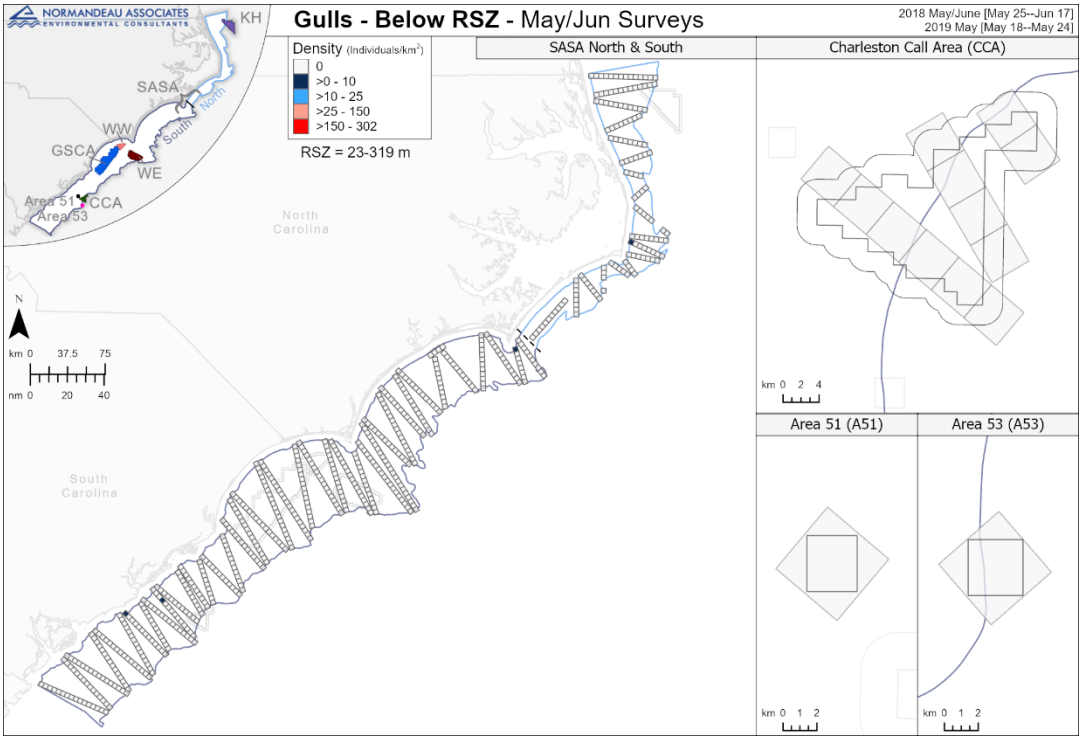


Figure C–315. Spatial distribution of gulls flying below the rotor swept zone during the May/June surveys for all areas

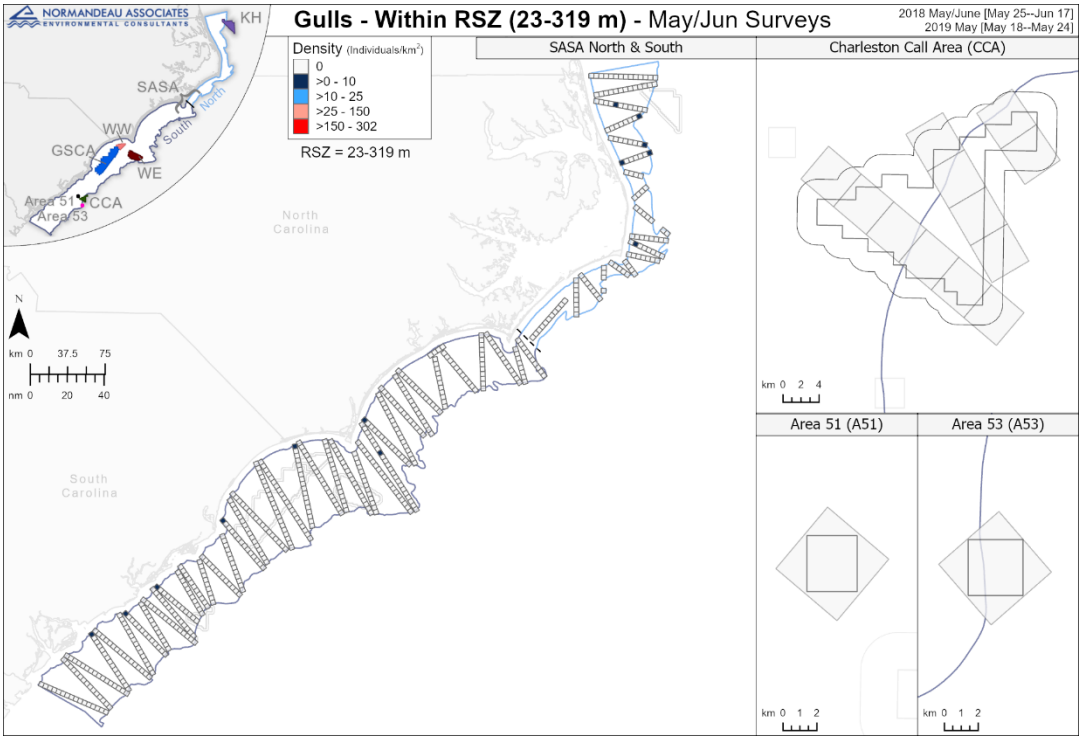


Figure C–316. Spatial distribution of gulls flying within the rotor swept zone during the May/June surveys for all areas

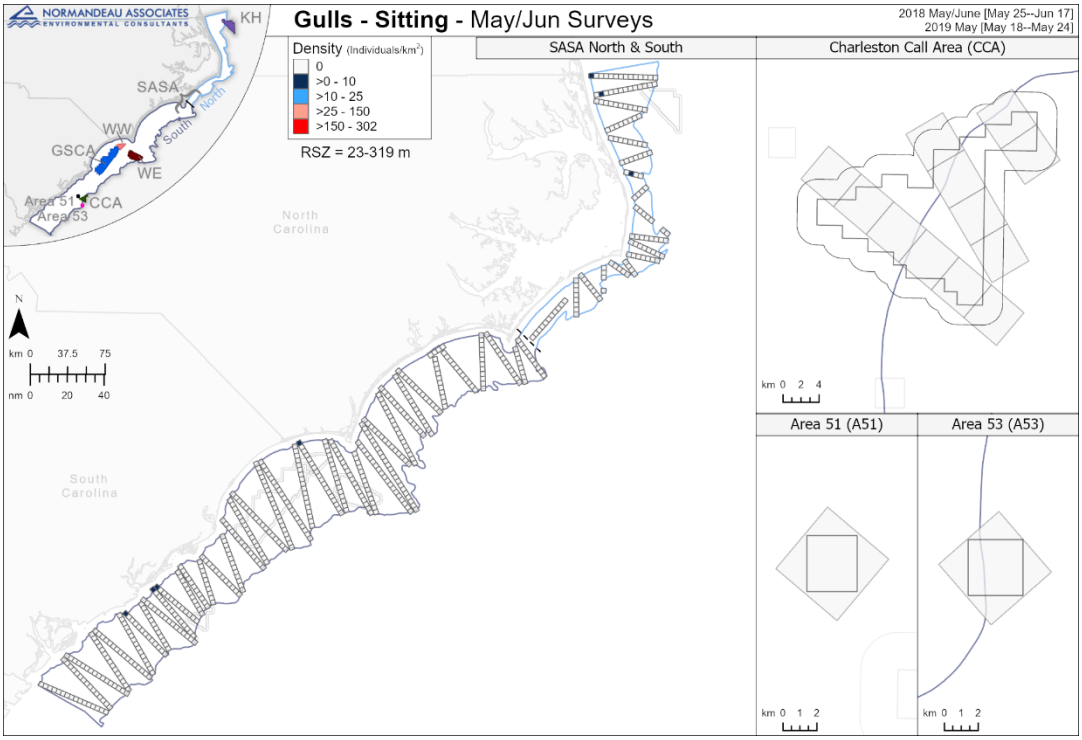


Figure C–317. Spatial distribution of sitting gulls during the May/June surveys for all areas

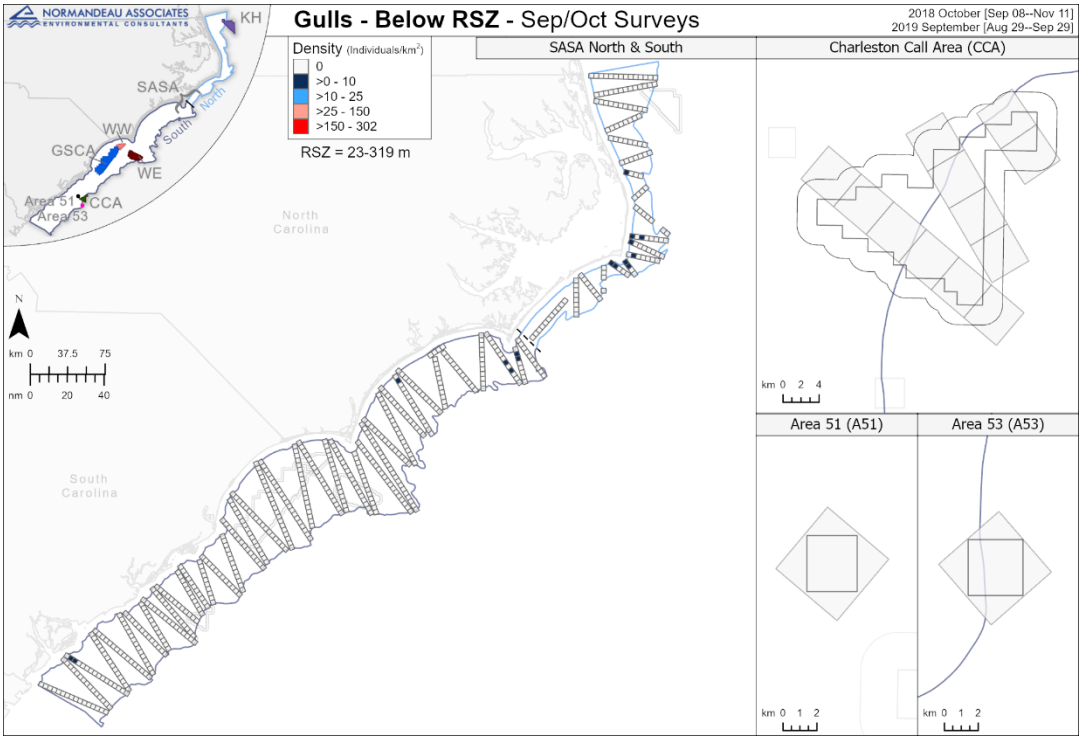


Figure C–318. Spatial distribution of gulls flying below the rotor swept zone during the September/October surveys for all areas

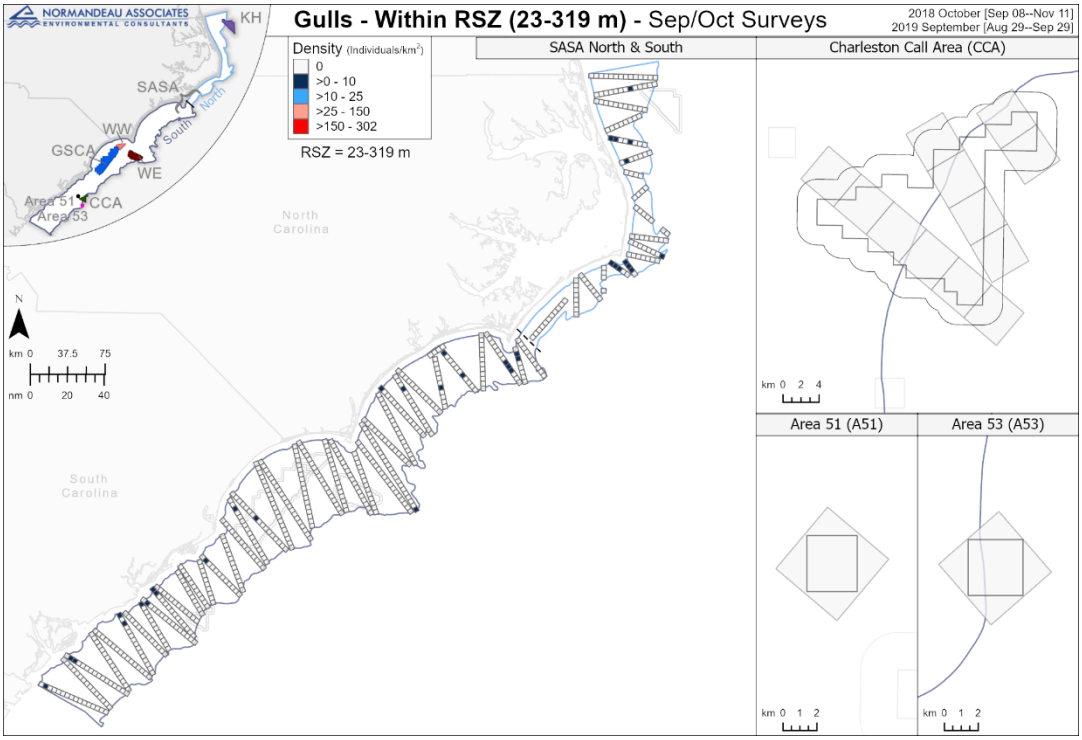


Figure C–319. Spatial distribution of gulls flying within the rotor swept zone during the September/October surveys for all areas

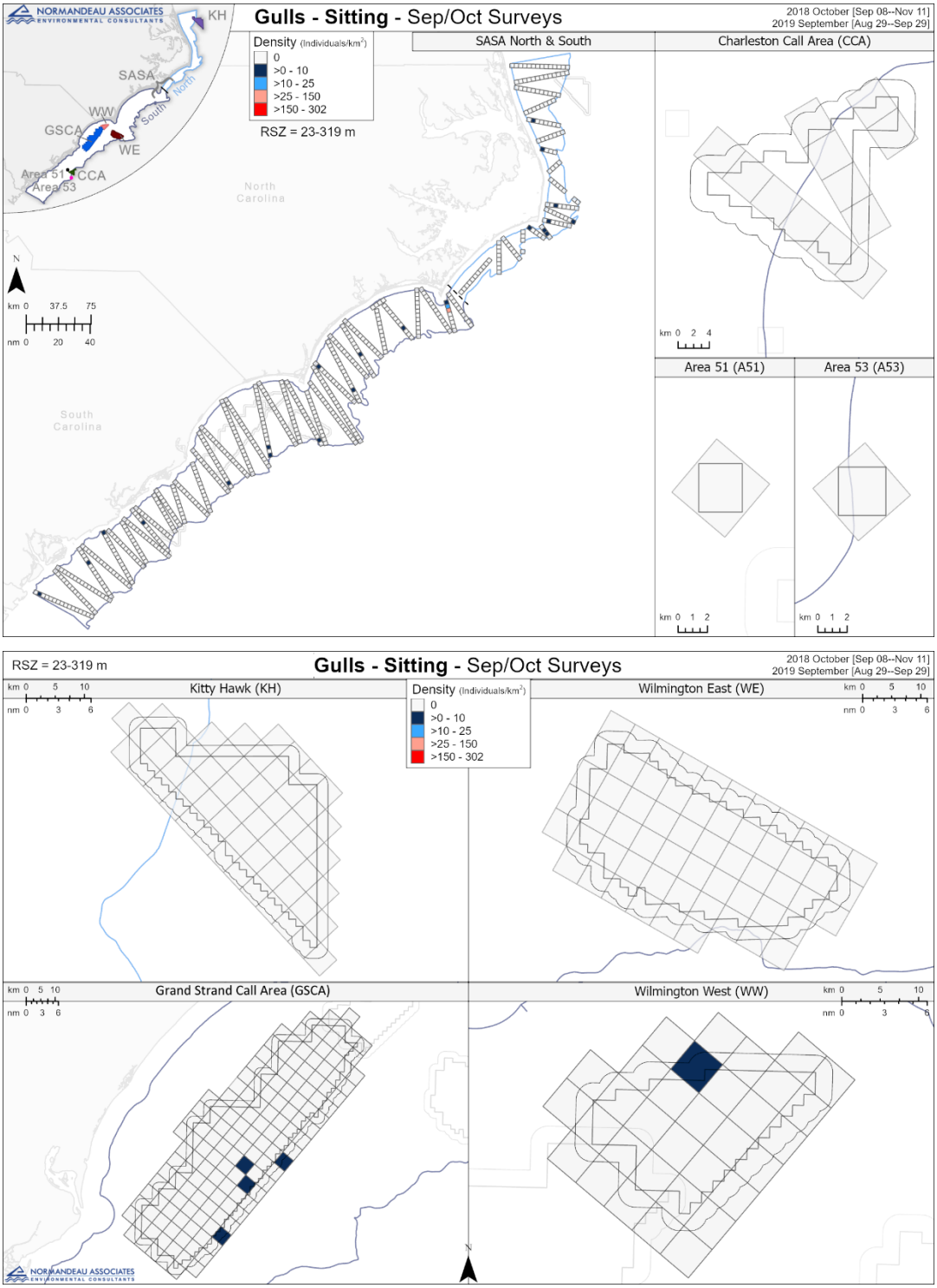


Figure C–320. Spatial distribution of sitting gulls during the September/October surveys for all areas

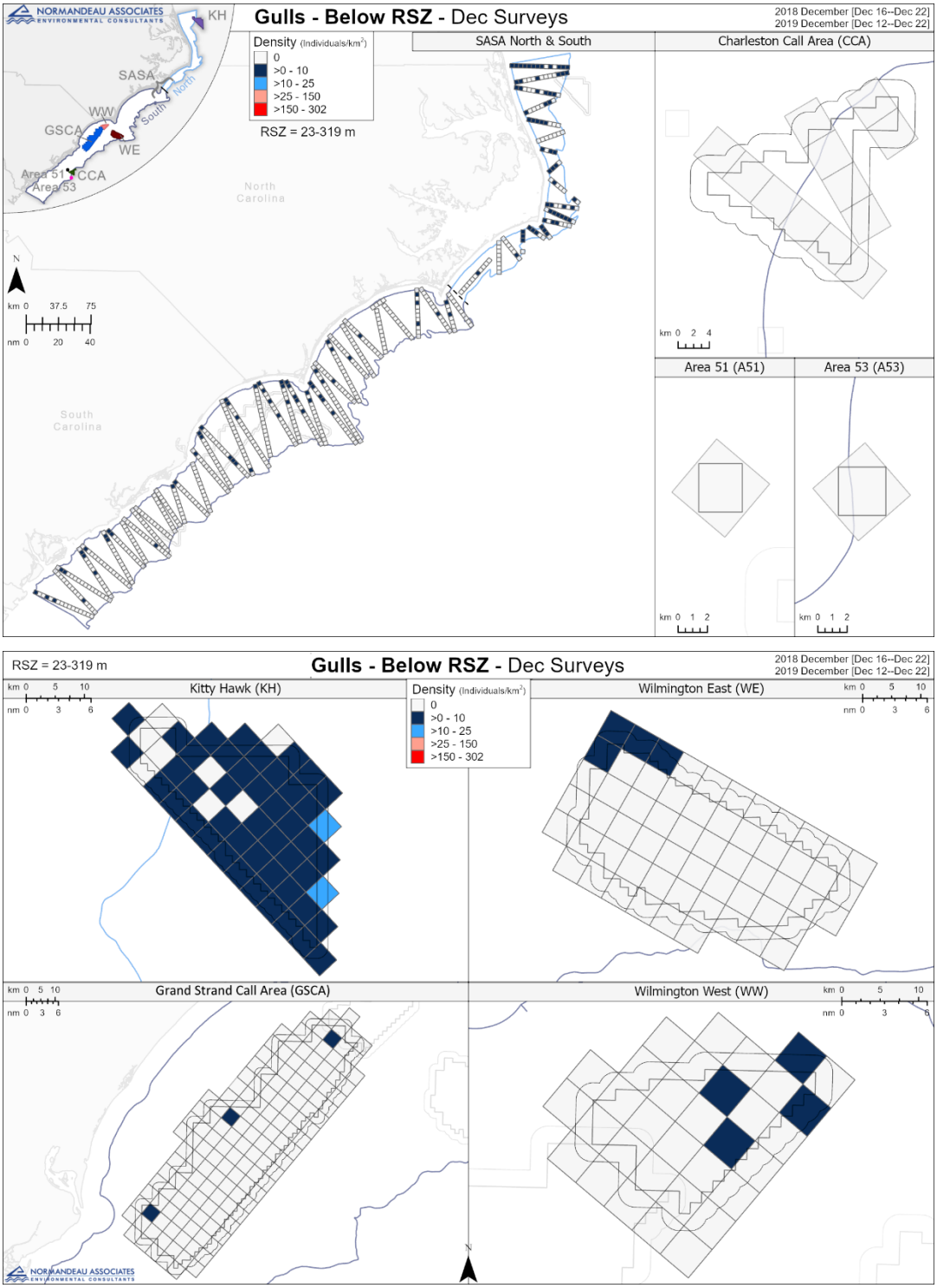


Figure C–321. Spatial distribution of gulls flying below the rotor swept zone during the December surveys for all areas

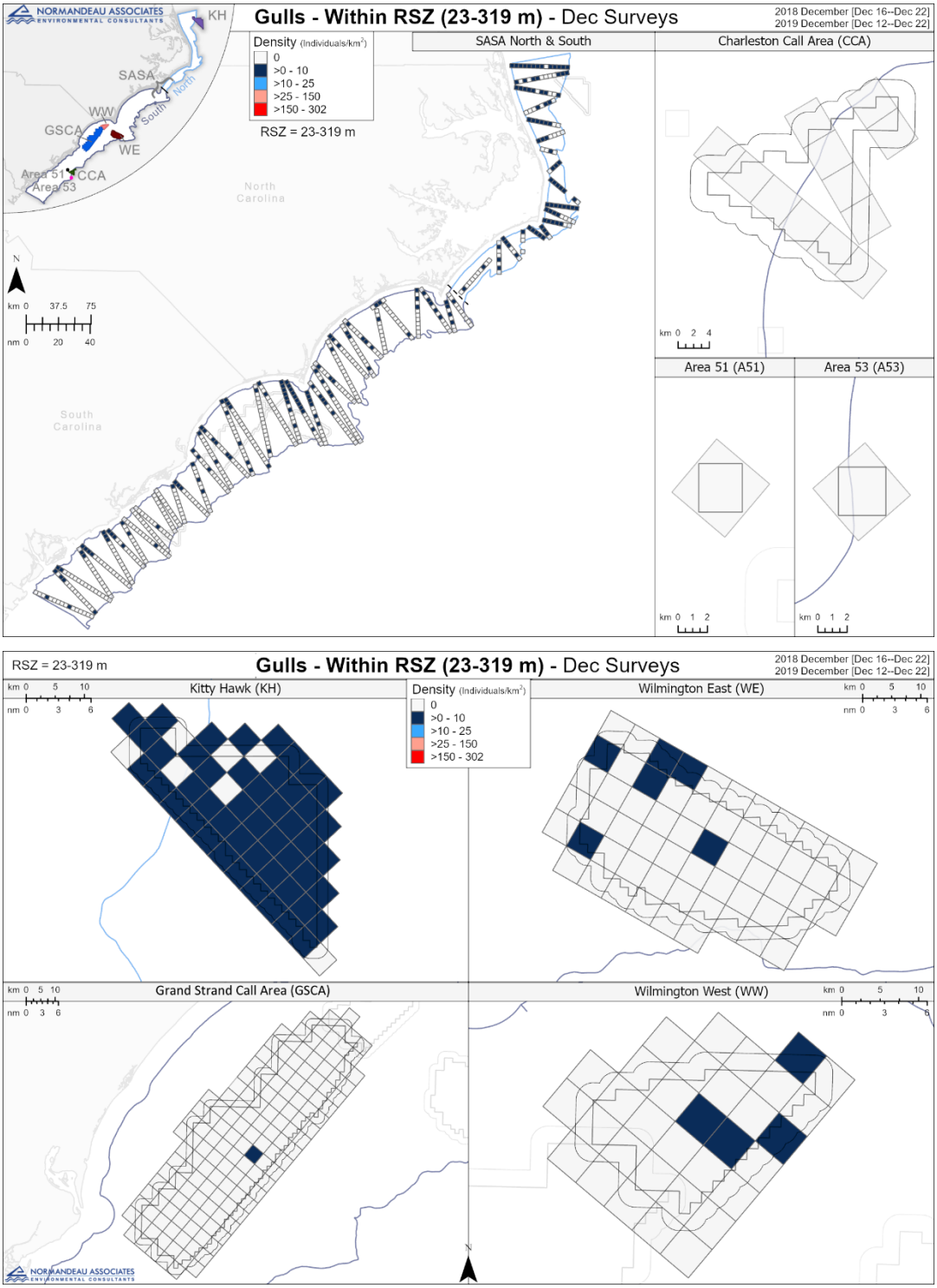


Figure C–322. Spatial distribution of gulls flying within the rotor swept zone during the December surveys for all areas

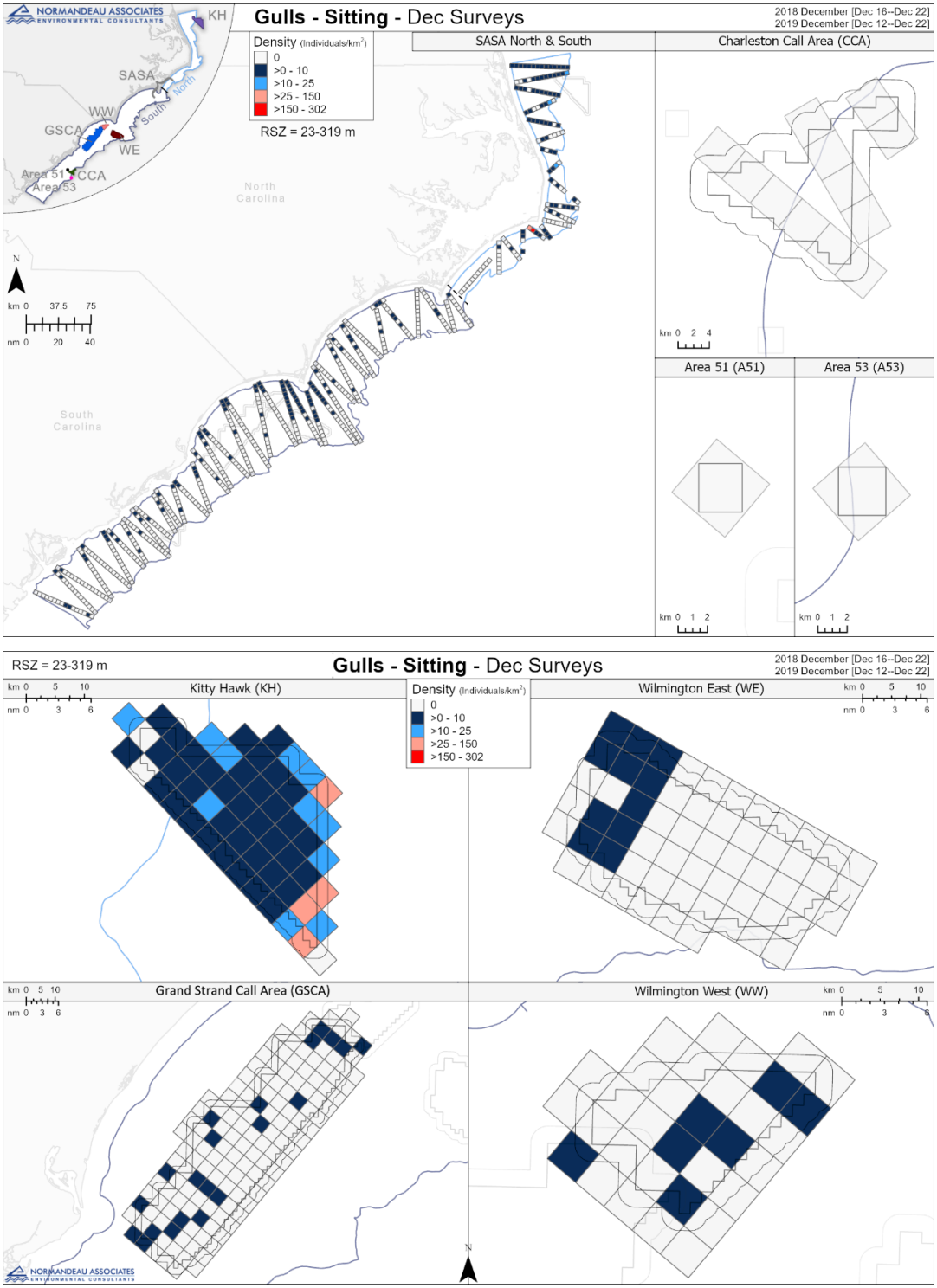


Figure C–323. Spatial distribution of sitting gulls during the December surveys for all areas

C.9 Sensitivity Maps for Birds Observed during the February 2018 through February 2020 Surveys

C.9.1 Population Sensitivity

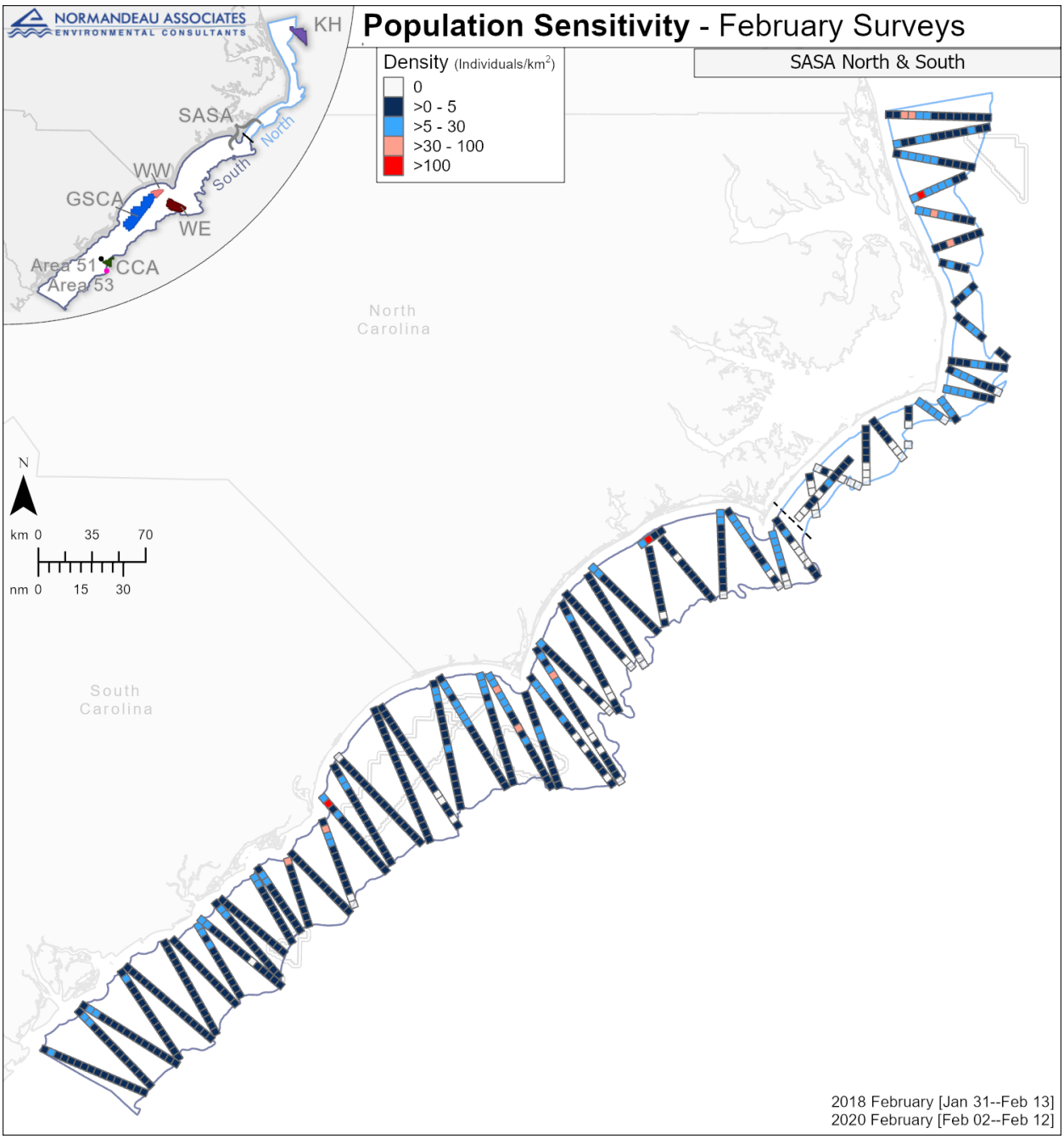


Figure C–324. Population sensitivity for SASA during the February surveys

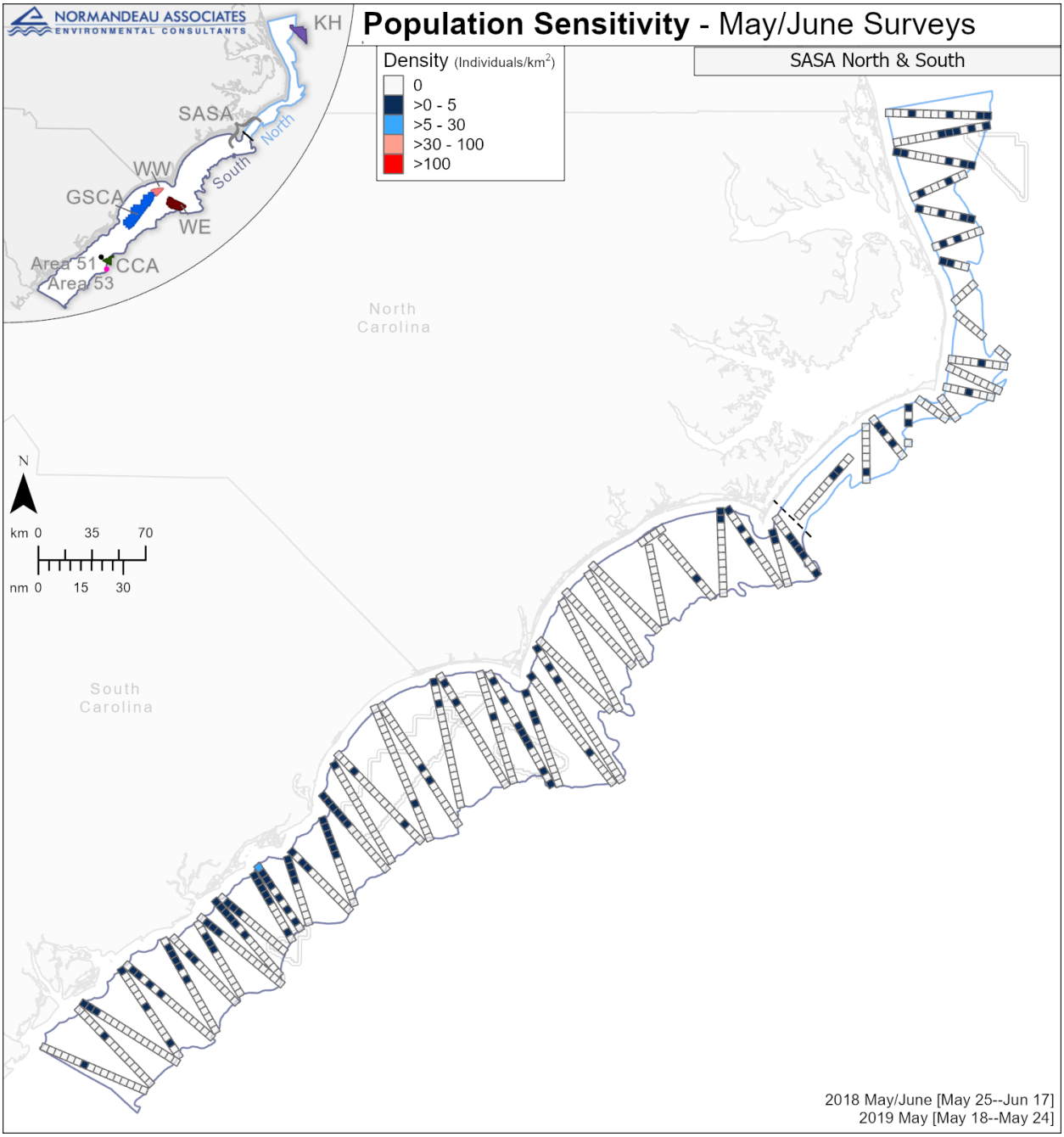


Figure C–325. Population sensitivity for SASA during the May/June surveys

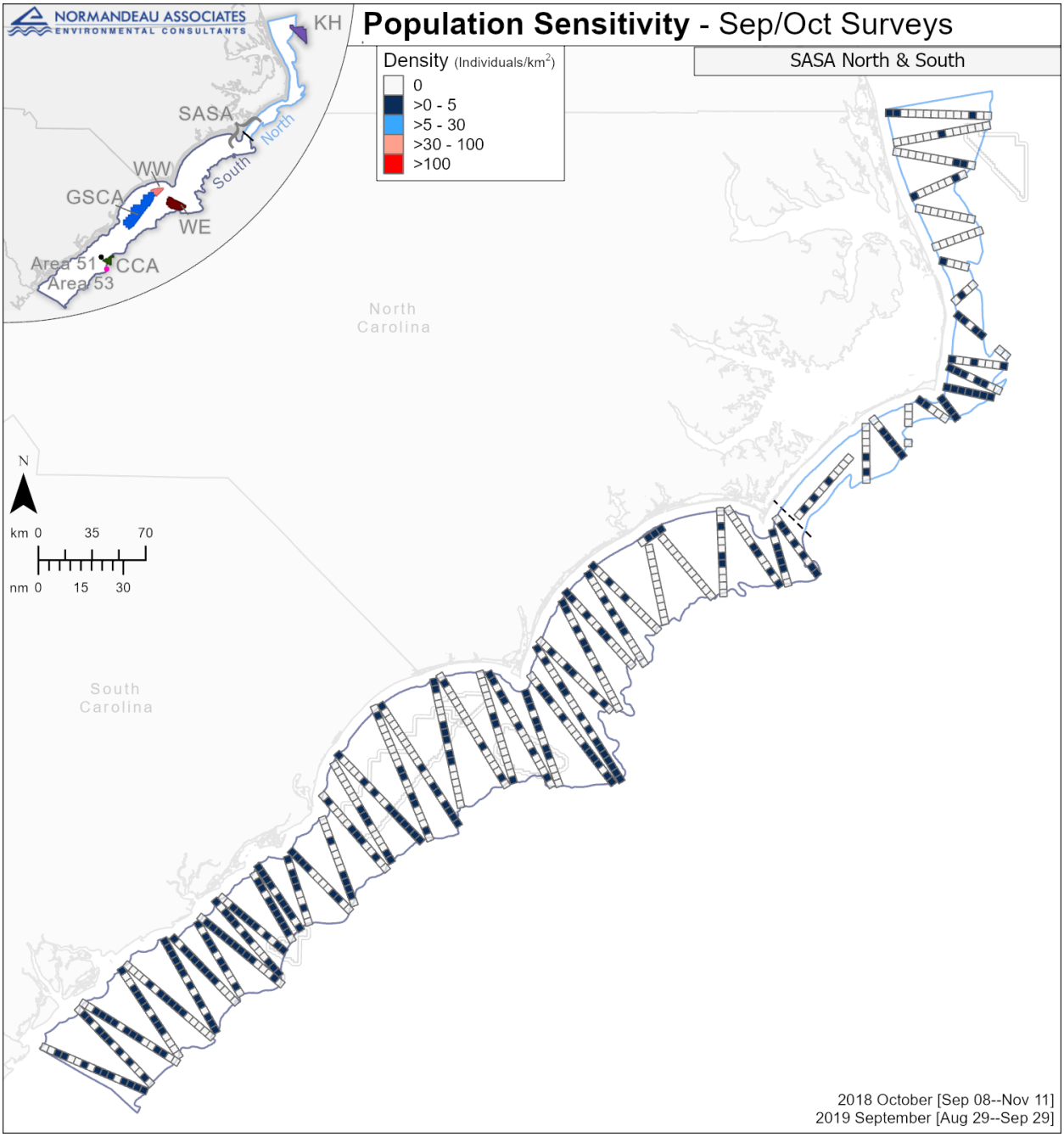


Figure C–326. Population sensitivity for SASA during the September/October surveys

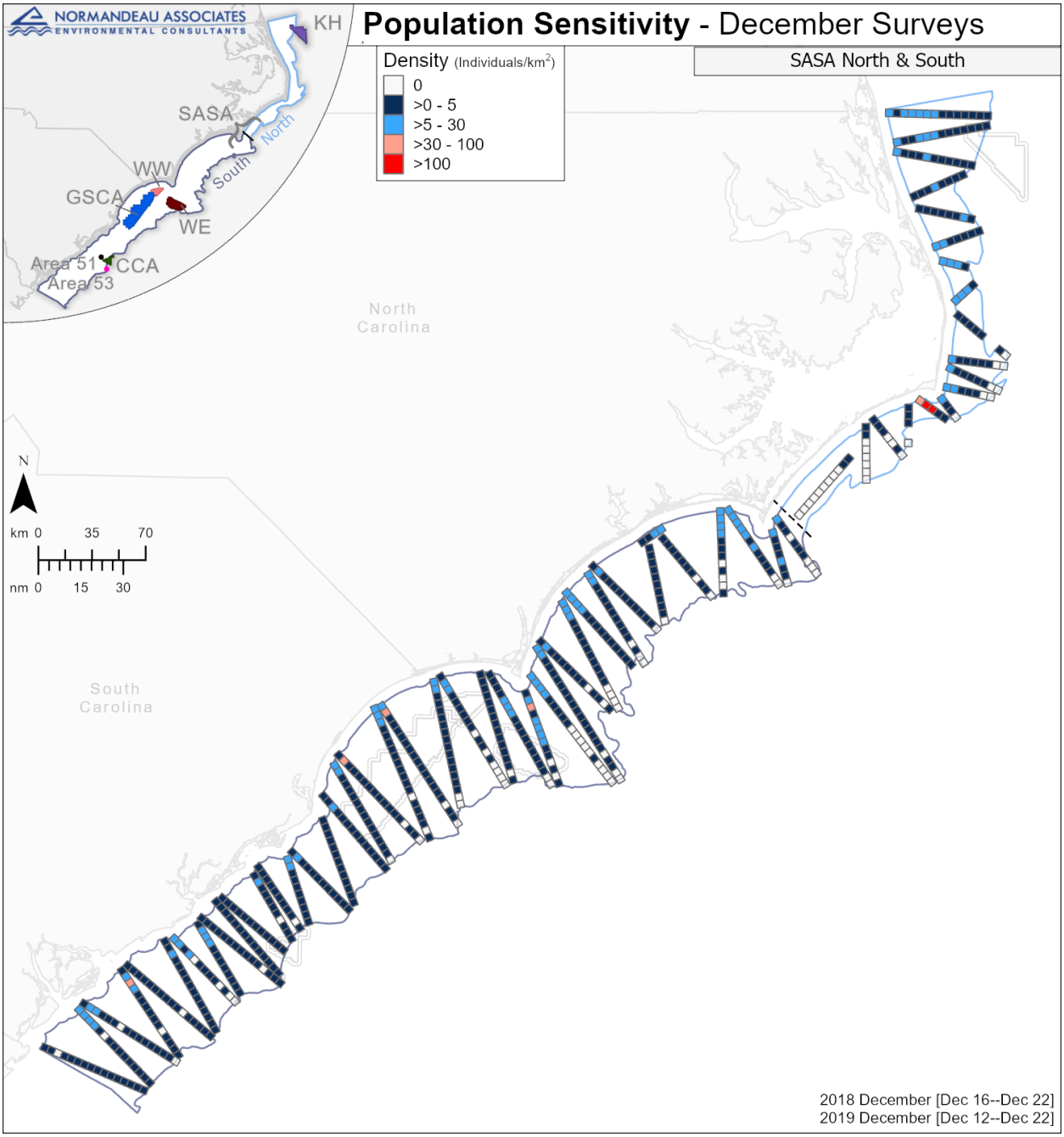


Figure C–327. Population sensitivity for SASA during the December surveys

C.9.2 Collision Sensitivity

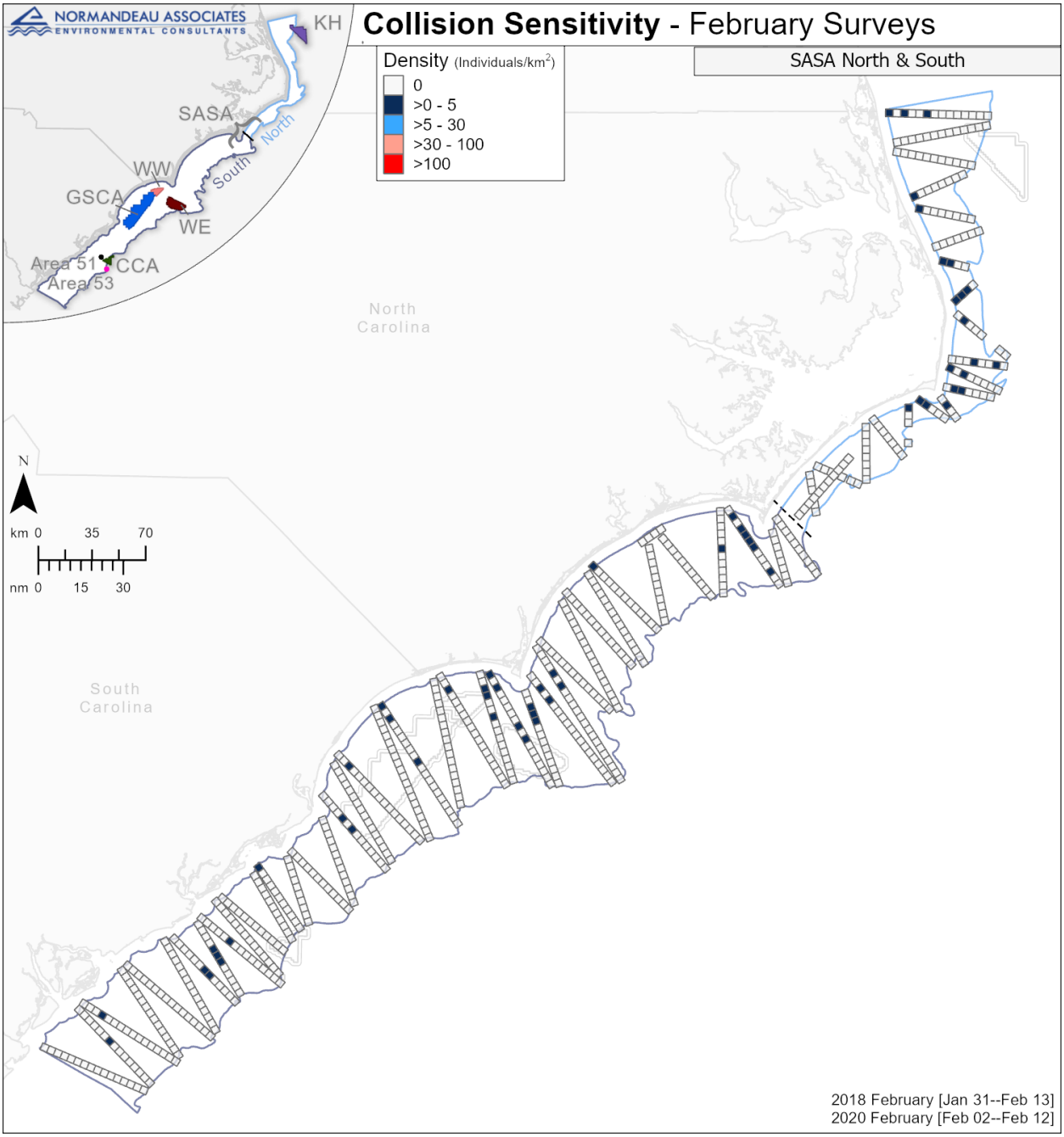


Figure C–328. Collision sensitivity for SASA during the February surveys

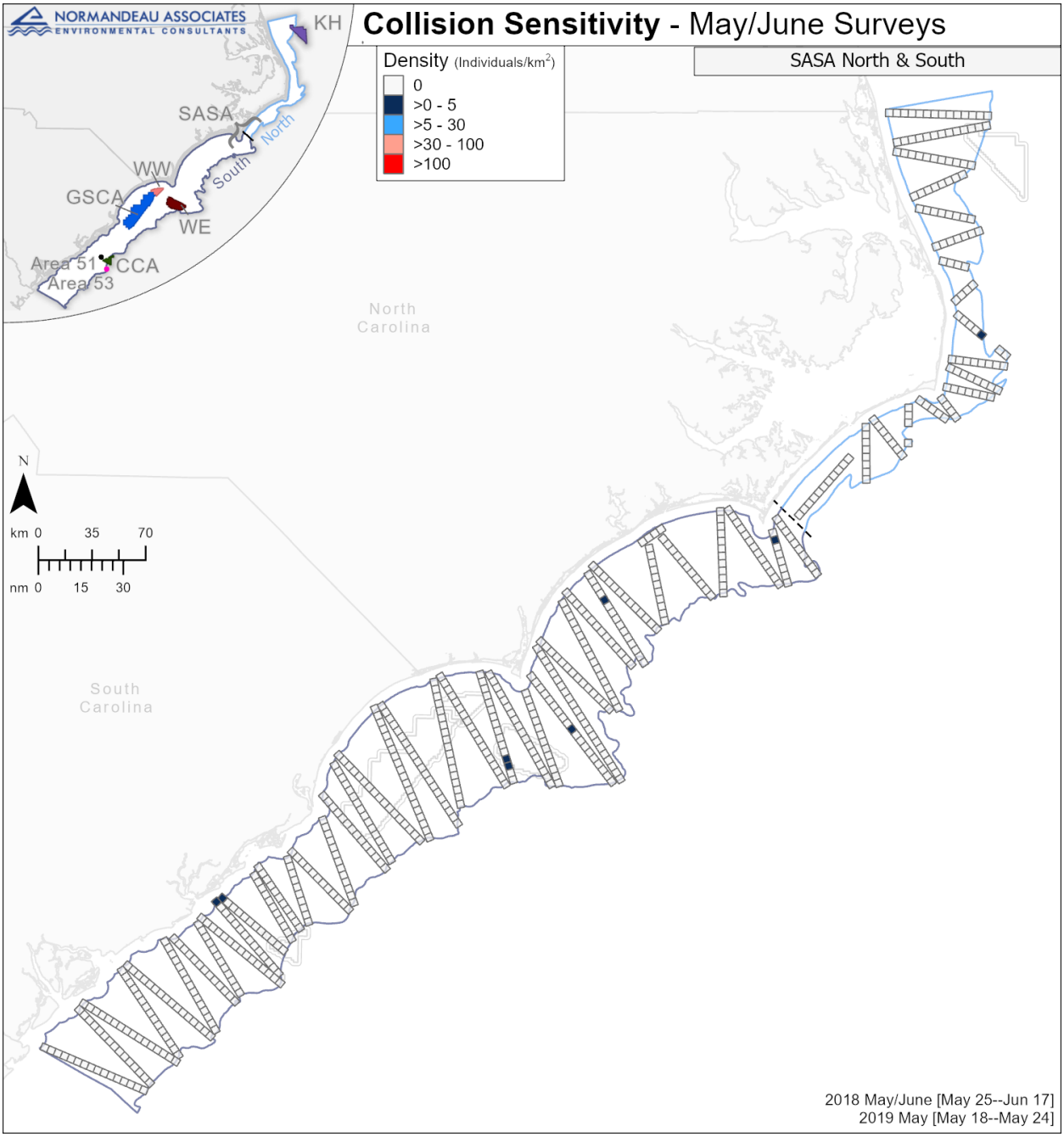


Figure C–329. Collision sensitivity for SASA during the May/June surveys

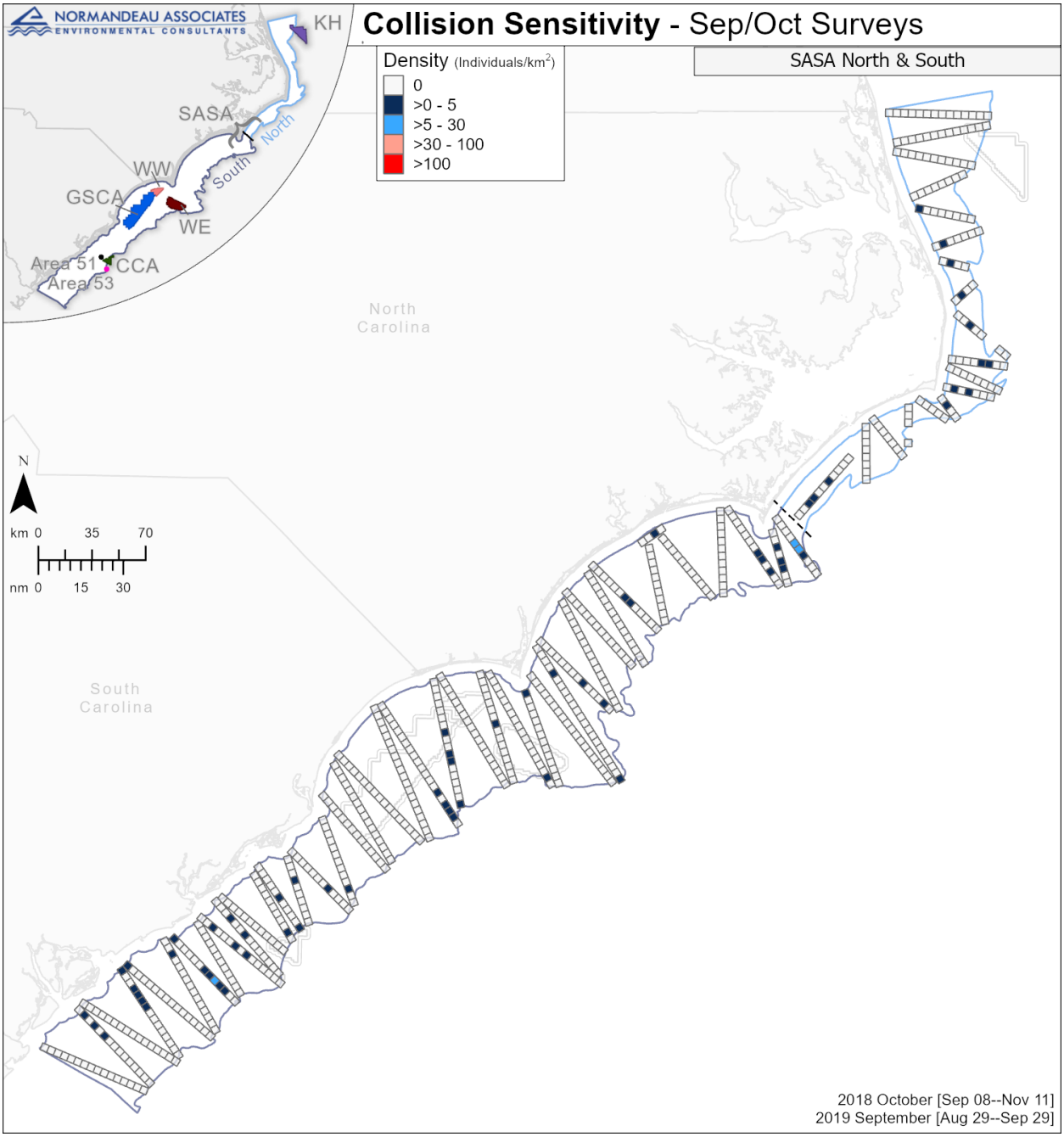


Figure C–330. Collision sensitivity for SASA during the September/October surveys

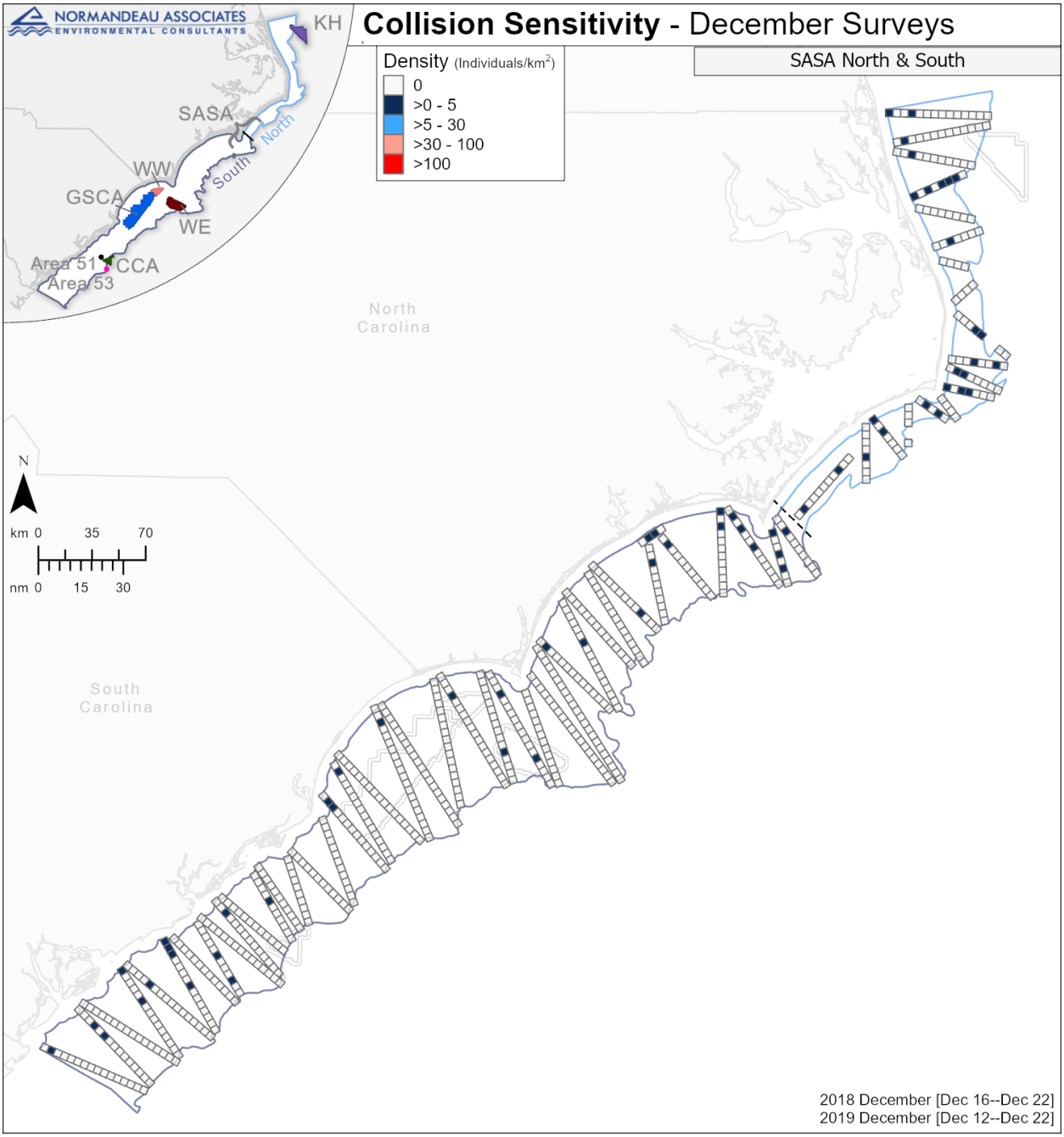


Figure C–331. Collision sensitivity for SASA during the December surveys

C.9.3 Displacement Sensitivity

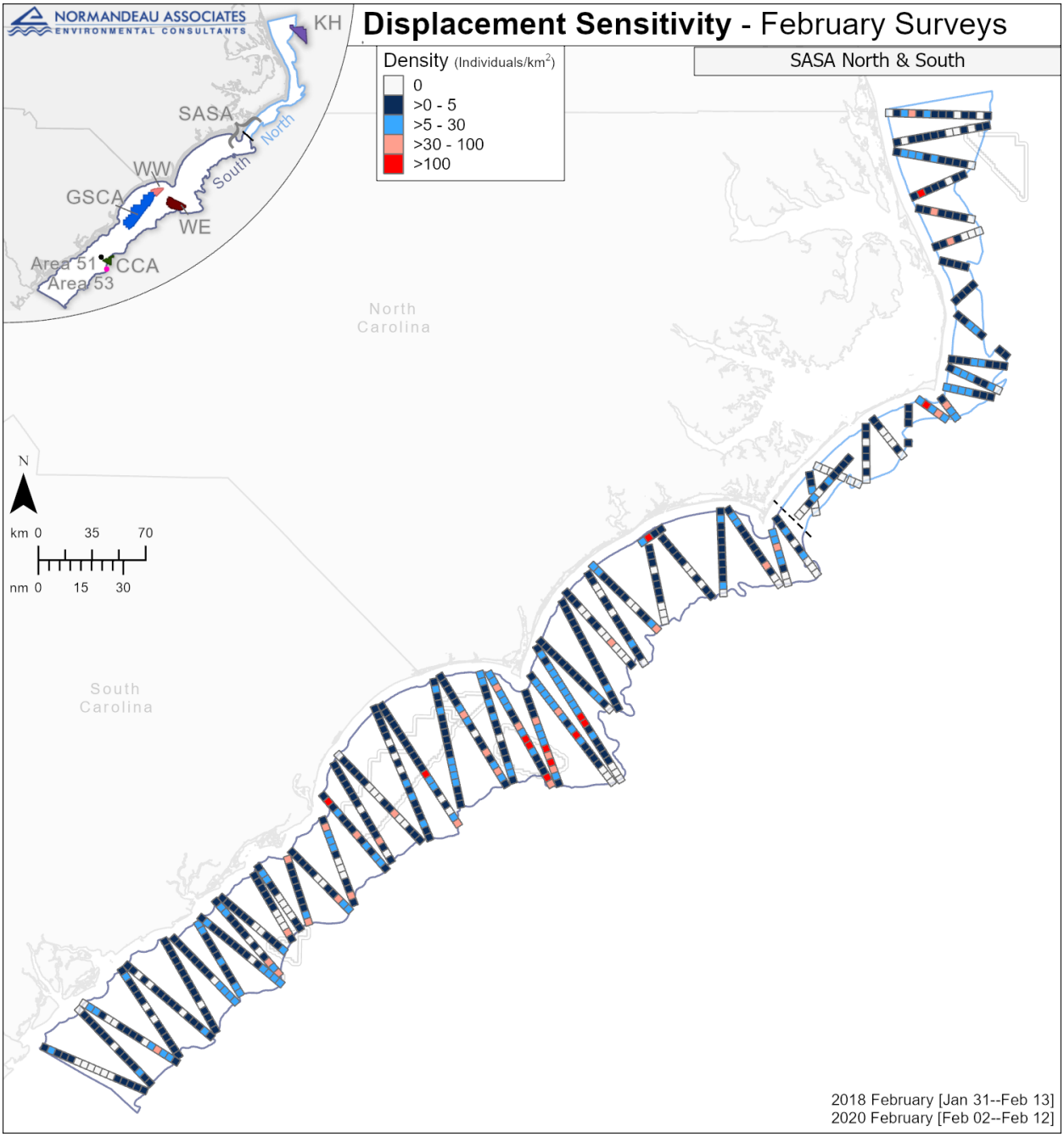


Figure C–332. Displacement sensitivity for SASA during the February surveys

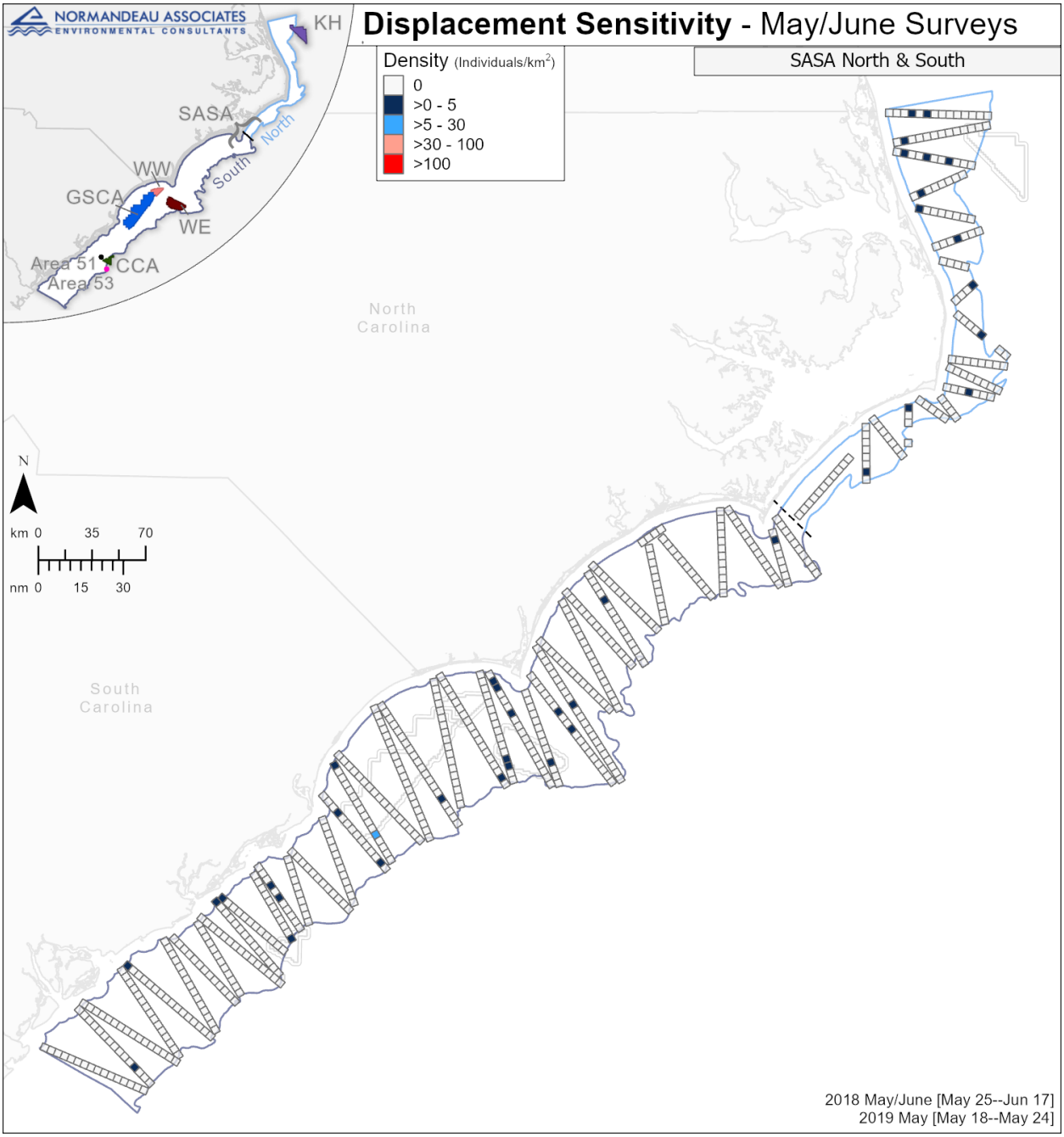


Figure C–333. Displacement sensitivity for SASA during the May/June surveys

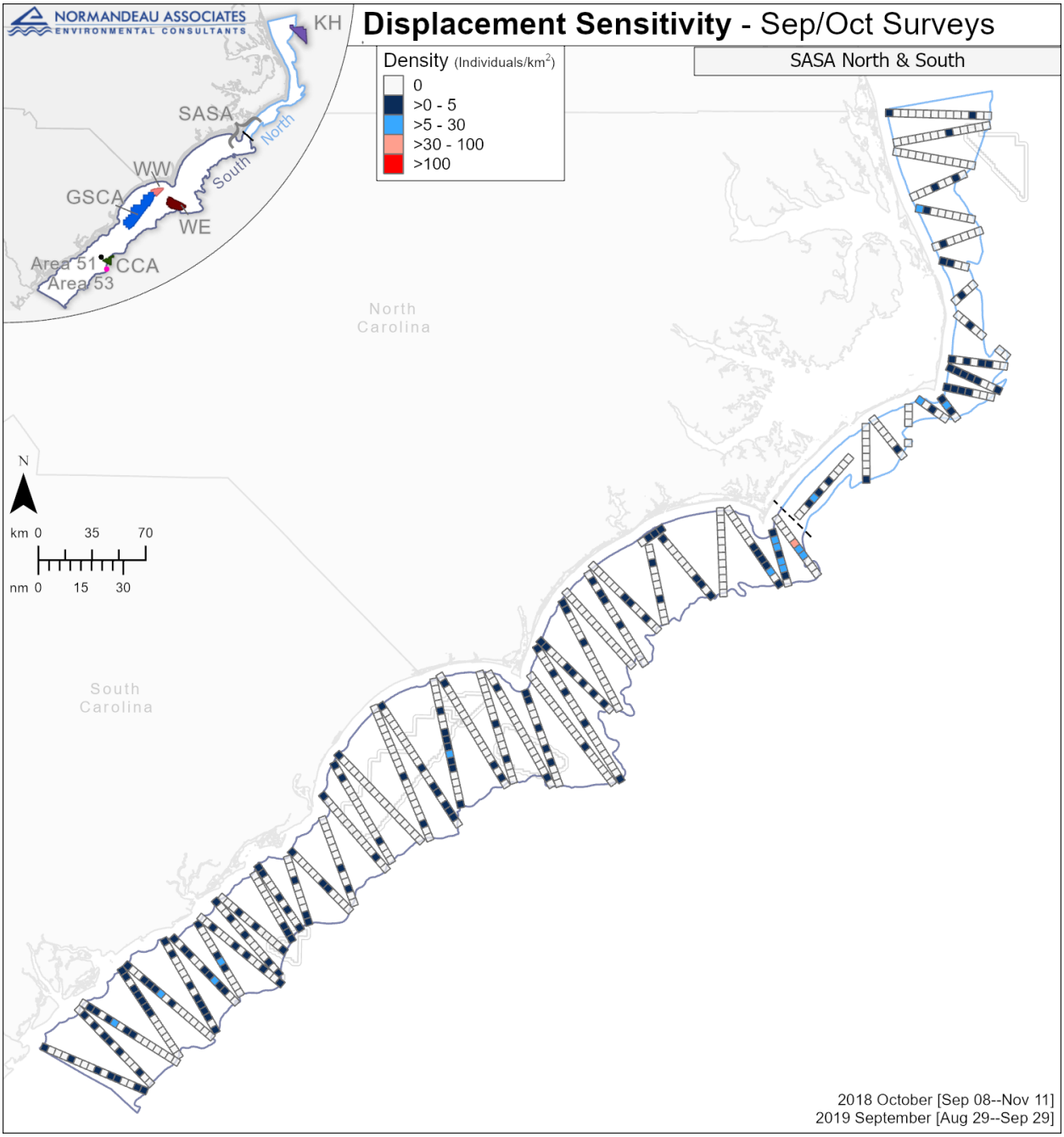
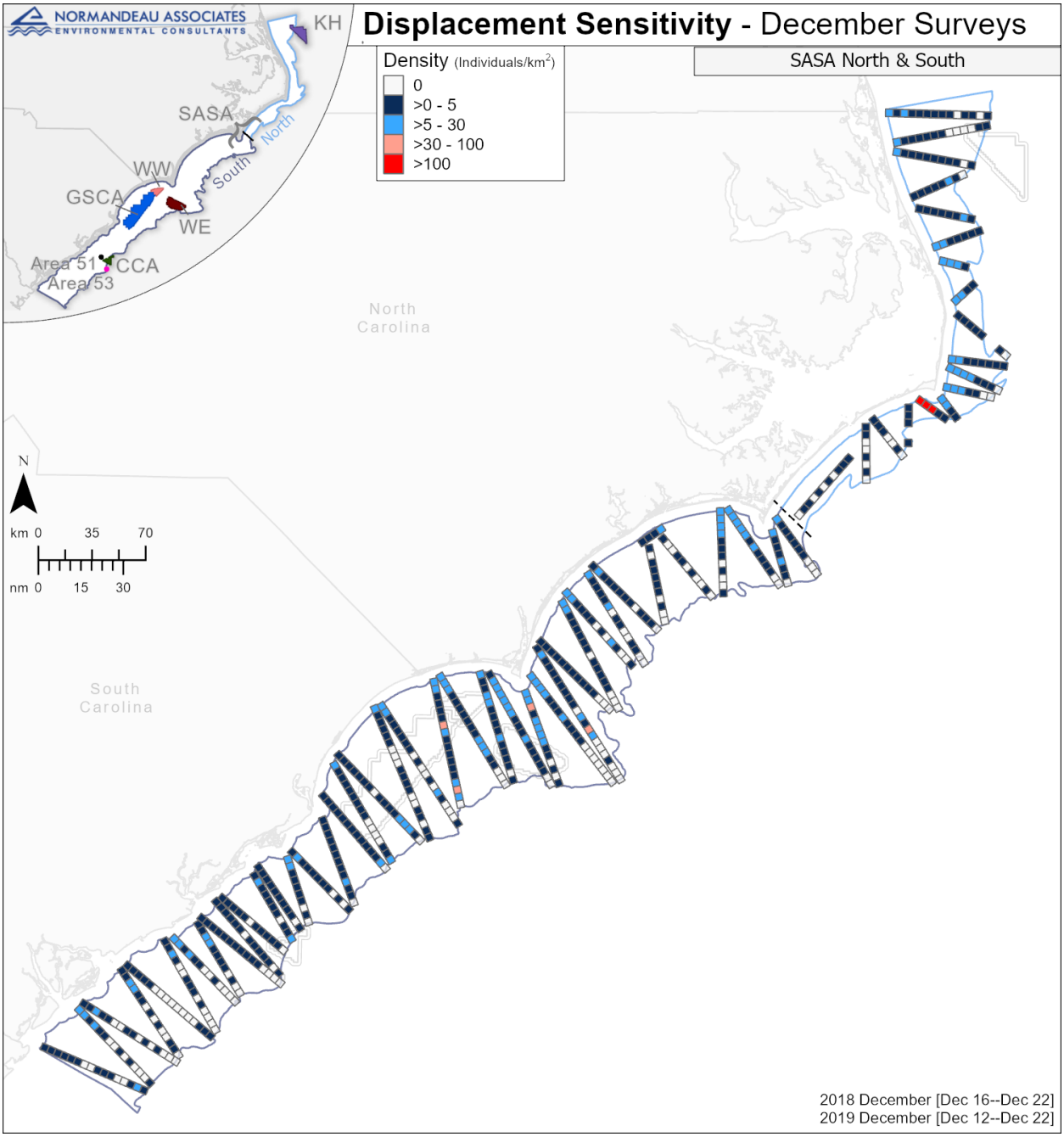


Figure C–334. Displacement sensitivity for SASA during the September/October surveys



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D.1 Raw Counts of Turtle Species Identified in the February 2018 through February 2020 Surveys by Area

Table D–1. Turtle species identified in the February 2018 through February 2020 surveys for all areas combined

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Leatherback Turtle*	15	23	1	2	1	2	7	19	7	15	3	11	1	1	1	2	75
Loggerhead Turtle*	15	148	15	110	45	172	73	207	39	192	14	112	21	114	19	130	1,185
Loggerhead/Kemp's Turtle*	9	40	7	54	8	24	33	71	23	45	9	34	2	23	22	61	352
Green Turtle*	—	2	—	1	—	—	—	—	—	1	—	—	—	—	1	2	6
Kemp's Ridley Turtle*	13	133	7	90	2	10	—	26	5	61	—	11	11	141	29	197	669
species unknown*	10	33	27	96	18	33	65	98	55	80	24	68	26	66	93	288	762
Totals	**62**	**379**	**57**	**353**	**74**	**241**	**178**	**421**	**129**	**394**	**50**	**236**	**61**	**345**	**165**	**680**	**3,049**

*Listed under the Endangered Species Act

**Significantly submerged

Table D–2. Turtle species identified in the February 2018 through February 2020 surveys in the South Atlantic Survey Area (SASA; counts include all of A51, part of A53, and part of CCA)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Leatherback Turtle*	13	20	—	1	1	2	4	16	6	14	2	6	1	1	1	2	61
Loggerhead Turtle*	13	141	11	99	32	125	48	135	37	174	6	88	20	109	17	117	990
Loggerhead/Kemp's Turtle*	9	38	5	50	6	21	27	58	23	43	7	27	2	20	18	50	308
Green Turtle*	—	2	—	1	—	—	—	—	—	1	—	—	—	—	1	2	6
Kemp's Ridley Turtle*	8	111	2	74	2	10	—	25	4	46	—	10	11	136	15	164	576
species unknown*	10	31	24	85	15	27	53	83	54	78	23	55	24	60	71	256	676
Totals	**53**	**343**	**42**	**309**	**58**	**185**	**132**	**317**	**124**	**356**	**38**	**186**	**58**	**326**	**123**	**591**	**2,617**

*Listed under the Endangered Species Act

**Significantly submerged

Table D–3. Turtle species identified in the February 2018 through February 2020 surveys in Areas A51

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Loggerhead Turtle*	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	2
Kemp's Ridley Turtle*	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Totals	**—**	**1**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**—**	**3**

*Listed under the Endangered Species Act

**Significantly submerged

Table D–4. Turtle species identified in the February 2018 through February 2020 surveys in Areas A53

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Leatherback Turtle*	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Loggerhead Turtle*	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	1	2
species unknown*	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—	2
Totals	**—**	**1**	**1**	**1**	**—**	**—**	**—**	**—**	**1**	**2**	**—**	**—**	**—**	**—**	**—**	**1**	**5**

*Listed under the Endangered Species Act

**Significantly submerged

Table D–5. Turtle species identified in the February 2018 through February 2020 surveys in the Charleston Call Area (CCA)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Loggerhead Turtle*	—	4	—	2	—	1	1	2	—	—	—	1	1	3	—	—	13
Loggerhead/Kemp's Turtle*	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Kemp's Ridley Turtle*	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	1
species unknown*	—	—	2	2	—	—	—	1	—	—	—	2	1	1	—	2	8
Totals	**—**	**4**	**4**	**6**	**—**	**1**	**1**	**3**	**—**	**—**	**—**	**3**	**2**	**4**	**—**	**2**	**23**

*Listed under the Endangered Species Act

**Significantly submerged

Table D–6. Turtle species identified in the February 2018 through February 2020 surveys in the Kitty Hawk (KH) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Leatherback Turtle*	—	—	—	—	—	—	3	3	—	—	1	5	—	—	—	—	8
Loggerhead Turtle*	—	1	—	—	12	38	24	59	—	4	7	19	—	—	—	1	120
Loggerhead/Kemp's Turtle*	—	1	—	—	2	3	6	11	—	1	2	3	—	1	—	2	21
Kemp's Ridley Turtle*	1	1	—	—	—	—	—	1	1	14	—	1	—	—	—	—	17
species unknown*	—	—	1	1	3	6	10	12	—	—	1	6	—	2	—	1	27
Totals	**1**	**3**	**1**	**1**	**17**	**47**	**43**	**86**	**1**	**19**	**11**	**34**	**—**	**3**	**—**	**4**	**193**

*Listed under the Endangered Species Act

**Significantly submerged

Table D–7. Turtle species identified in the February 2018 through February 2020 surveys in the Wilmington West (WW) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Loggerhead Turtle*	—	—	—	1	—	—	—	2	1	1	—	—	—	—	—	1	5
Loggerhead/Kemp's Turtle*	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
species unknown*	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	2
Totals	**—**	**—**	**—**	**2**	**—**	**—**	**—**	**2**	**1**	**2**	**—**	**1**	**—**	**—**	**—**	**1**	**8**

*Listed under the Endangered Species Act

**Significantly submerged

Table D–8. Turtle species identified in the February 2018 through February 2020 surveys in the Wilmington East (WE) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Leatherback Turtle*	2	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	3
Loggerhead Turtle*	1	2	—	2	1	4	1	2	—	3	—	1	—	1	1	3	18
Loggerhead/Kemp's Turtle*	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2	3	4
Kemp's Ridley Turtle*	3	19	—	3	—	—	—	—	—	1	—	—	—	2	6	10	35
species unknown*	—	2	—	2	—	—	—	—	—	—	—	1	1	3	8	9	17
Totals	**6**	**25**	**1**	**9**	**1**	**4**	**1**	**2**	**—**	**4**	**—**	**2**	**1**	**6**	**17**	**25**	**77**

*Listed under the Endangered Species Act

**Significantly submerged

Table D–9. Turtle species identified in the February 2018 through February 2020 surveys in the Grand Strand Call Area (GSCA; counts include part of WW)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Leatherback Turtle*	—	—	—	1	—	—	—	—	1	1	—	—	—	—	—	—	2
Loggerhead Turtle*	1	2	3	6	—	5	—	9	1	10	1	4	—	1	1	7	44
Loggerhead/Kemp's Turtle*	—	1	2	3	—	—	—	2	—	—	—	4	—	2	2	6	18
Kemp's Ridley Turtle*	1	2	4	12	—	—	—	—	—	—	—	—	—	3	8	23	40
species unknown*	—	—	2	7	—	—	2	2	1	2	—	3	—	—	14	20	34
Totals	**2**	**5**	**11**	**29**	**—**	**5**	**2**	**13**	**3**	**13**	**1**	**11**	**—**	**6**	**25**	**56**	**138**

*Listed under the Endangered Species Act

**Significantly submerged

D.2 Species Composition and Density (per km^2) by Survey Area for Each Survey

Table D–10. Density (per km^2) of each turtle species for each area during the February 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Leatherback Turtle	0.0104		0.3846		0.0108			0.0255		0.0052	**0.0098**
Loggerhead Turtle	0.0736			0.1321	0.0733	0.0136		0.0255	0.0101	0.0130	**0.0633**
Loggerhead/Kemp's Turtle	0.0198				0.0195	0.0136			0.0050	0.0052	**0.0171**
Green Turtle	0.0010				0.0010						**0.0009**
Kemp's Ridley Turtle	0.0579	0.4237			0.0569	0.0136		0.2425	0.0101	0.0570	**0.0569**
species unknown	0.0162				0.0159			0.0255		0.0052	**0.0141**
Totals	**0.1790**	**0.4237**	**0.3846**	**0.1321**	**0.1773**	**0.0408**	**—**	**0.3191**	**0.0252**	**0.0855**	**0.1622**

Table D–11. Density (per km^2) of each turtle species for each area during the February 2020 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Leatherback Turtle								0.0128	0.0050	0.0052	0.0009
Loggerhead Turtle	0.0519		0.3846	0.0661	0.0520		0.0284	0.0256	0.0302	0.0234	0.0473
Loggerhead/Kemp's Turtle	0.0262			0.0330	0.0258			0.0128	0.0151	0.0104	0.0232
Green Turtle	0.0005				0.0005						0.0004
Kemp's Ridley Turtle	0.0388			0.0330	0.0386			0.0384	0.0605	0.0389	0.0387
species unknown	0.0446			0.0661	0.0438	0.0136	0.0284	0.0256	0.0353	0.0286	0.0413
Totals	**0.1621**	**—**	**0.3846**	**0.1982**	**0.1607**	**0.0136**	**0.0568**	**0.1152**	**1.1461**	**0.1064**	**0.1517**

Table D–12. Density (per km^2) of each turtle species for each area during the May/June 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Leatherback Turtle	0.0012				0.0011						**0.0009**
Loggerhead Turtle	0.0721	0.4237		0.0330	0.0706	0.5163		0.0511	0.0247	0.1207	**0.0797**
Loggerhead/Kemp's Turtle	0.0121				0.0119	0.0408				0.0077	**0.0111**
Kemp's Ridley Turtle	0.0058				0.0057						**0.0046**
species unknown	0.0156				0.0153	0.0815				0.0154	**0.0153**
Totals	**0.1067**	**0.4237**	**—**	**0.0330**	**0.1046**	**0.6386**	**—**	**0.0511**	**0.0247**	**0.1438**	**0.1116**

Table D–13. Density (per km^2) of each turtle species for each area during the May 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Leatherback Turtle	0.0084				0.0082	0.0409				0.0074	0.0081
Loggerhead Turtle	0.0708			0.0661	0.0701	0.8037	0.0568	0.0256	0.0407	0.1742	0.0881
Loggerhead/Kemp's Turtle	0.0304				0.0299	0.1498			0.0091	0.0319	0.0302
Kemp's Ridley Turtle	0.0131				0.0129	0.0136				0.0025	0.0111
species unknown	0.0435			0.0330	0.0433	0.1635			0.0091	0.0343	0.0417
Total	**0.1663**	**—**	**—**	**0.0991**	**0.1643**	**1.1715**	**0.0568**	**0.0256**	**0.0589**	**0.2502**	**0.1792**

Table D–14. Density (per km^2) of each turtle species for each area during the October 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Leatherback Turtle	0.0077				0.0076				0.0044	0.0024	**0.0066**
Loggerhead Turtle	0.0962				0.0944	0.0543	0.0240	0.0383	0.0444	0.0430	**0.0849**
Loggerhead/Kemp's Turtle	0.0238				0.0233	0.0136	0.0240			0.0048	**0.0199**
Green Turtle	0.0006				0.0005						**0.0004**
Kemp's Ridley Turtle	0.0254				0.0250	0.1902		0.0128		0.0358	**0.0270**
species unknown	0.0431		0.7722		0.0423				0.0089	0.0048	**0.0354**
Totals	**0.1969**	**—**	**0.7722**	**—**	**0.1931**	**0.2582**	**0.0481**	**0.0511**	**0.0577**	**0.0908**	**0.1742**

Table D–15. Density (per km^2) of each turtle species for each area during the September 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Leatherback Turtle	0.0031				0.0031	0.0681				0.0130	0.0047
Loggerhead Turtle	0.0459	0.4237		0.0330	0.0451	0.2588		0.0128	0.0202	0.0624	0.0479
Loggerhead/Kemp's Turtle	0.0141				0.0138	0.0409			0.0202	0.0182	0.0146
Kemp's Ridley Turtle	0.0052				0.0051	0.0136				0.0026	0.0047
species unknown	0.0287			0.0661	0.0292	0.0817	0.0284	0.0128	0.0152	0.0286	0.0291
Total	**0.0970**	**0.4237**	**—**	**0.0991**	**0.0963**	**0.4632**	**0.0284**	**0.0256**	**0.0556**	**0.1248**	**0.1010**

Table D–16. Density (per km^2) of each turtle species for each area during the December 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Leatherback Turtle	0.0005				0.0005						**0.0004**
Loggerhead Turtle	0.0569			0.0987	0.0574				0.0048	0.0050	**0.0486**
Loggerhead/Kemp's Turtle	0.0104				0.0103	0.0136			0.0096	0.0076	**0.0098**
Kemp's Ridley Turtle	0.0710				0.0697				0.0144	0.0126	**0.0601**
species unknown	0.0313			0.0329	0.0313	0.0272				0.0126	**0.0281**
Totals	**0.1702**	**—**	**—**	**0.1315**	**0.1692**	**0.0408**	**—**	**—**	**0.0288**	**0.0378**	**0.1469**

Table D–17. Density (per km^2) of each turtle species for each area during the December 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Leatherback Turtle	0.0010				0.0010						0.0009
Loggerhead Turtle	0.0613		0.3876		0.0607	0.0136	0.0644	0.0384	0.0673	0.0442	0.0587
Loggerhead/Kemp's Turtle	0.0262				0.0257	0.0272		0.0384	0.0576	0.0406	0.0275
Green Turtle	0.0010				0.0010						0.0009
Kemp's Ridley Turtle	0.0859				0.0844			0.1280	0.2210	0.1217	0.0890
species unknown	0.1342			0.0661	0.1328	0.0136		0.1152	0.1922	0.1106	0.1300
Total	**0.3097**	**—**	**0.3876**	**0.0661**	**0.3057**	**0.0545**	**0.0644**	**0.3200**	**0.5380**	**0.3171**	**0.3071**

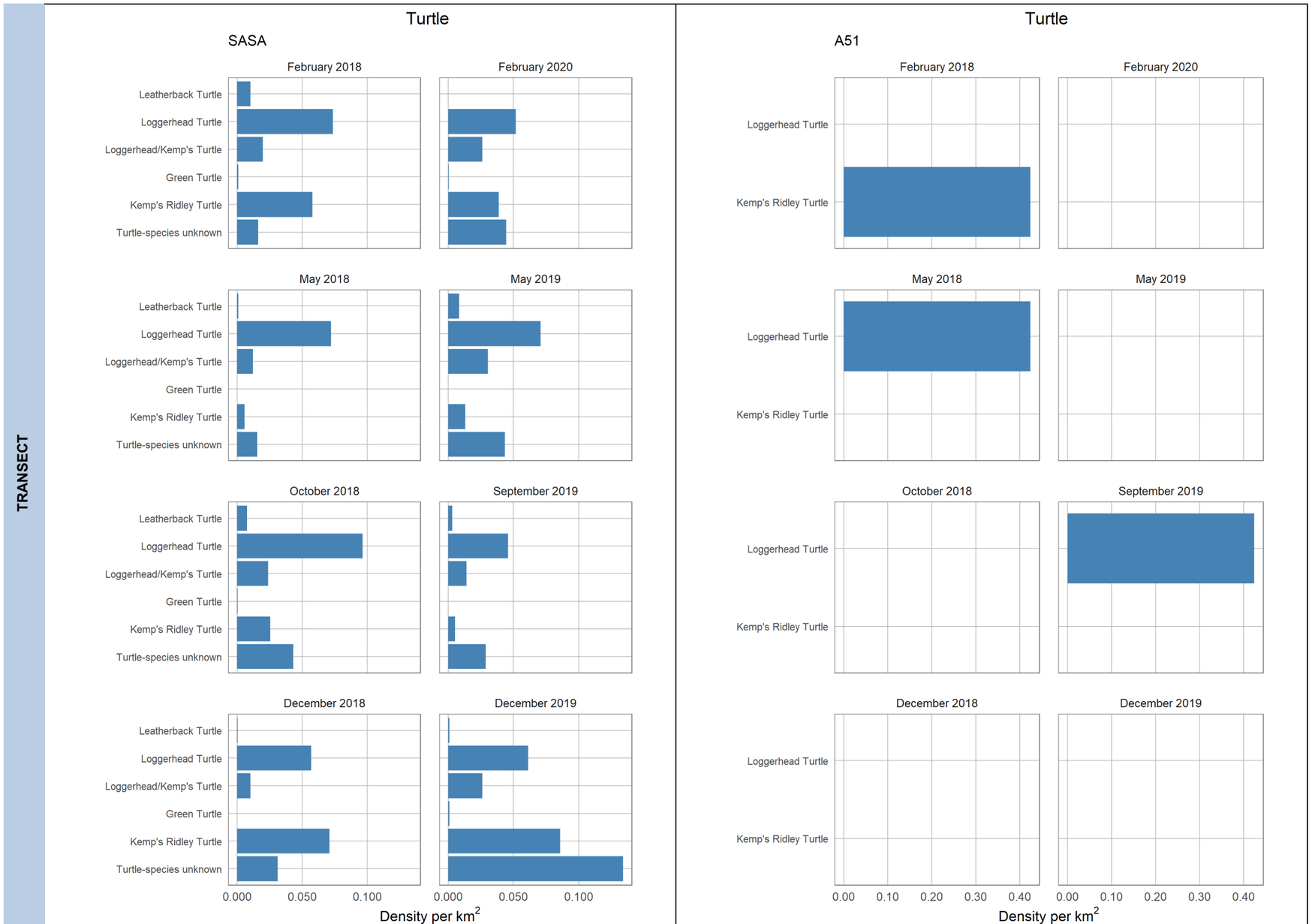


Figure D–1. Density (per km^2) of turtle species encountered during the February 2018 through February 2020 surveys for each area by survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

TRANSECT

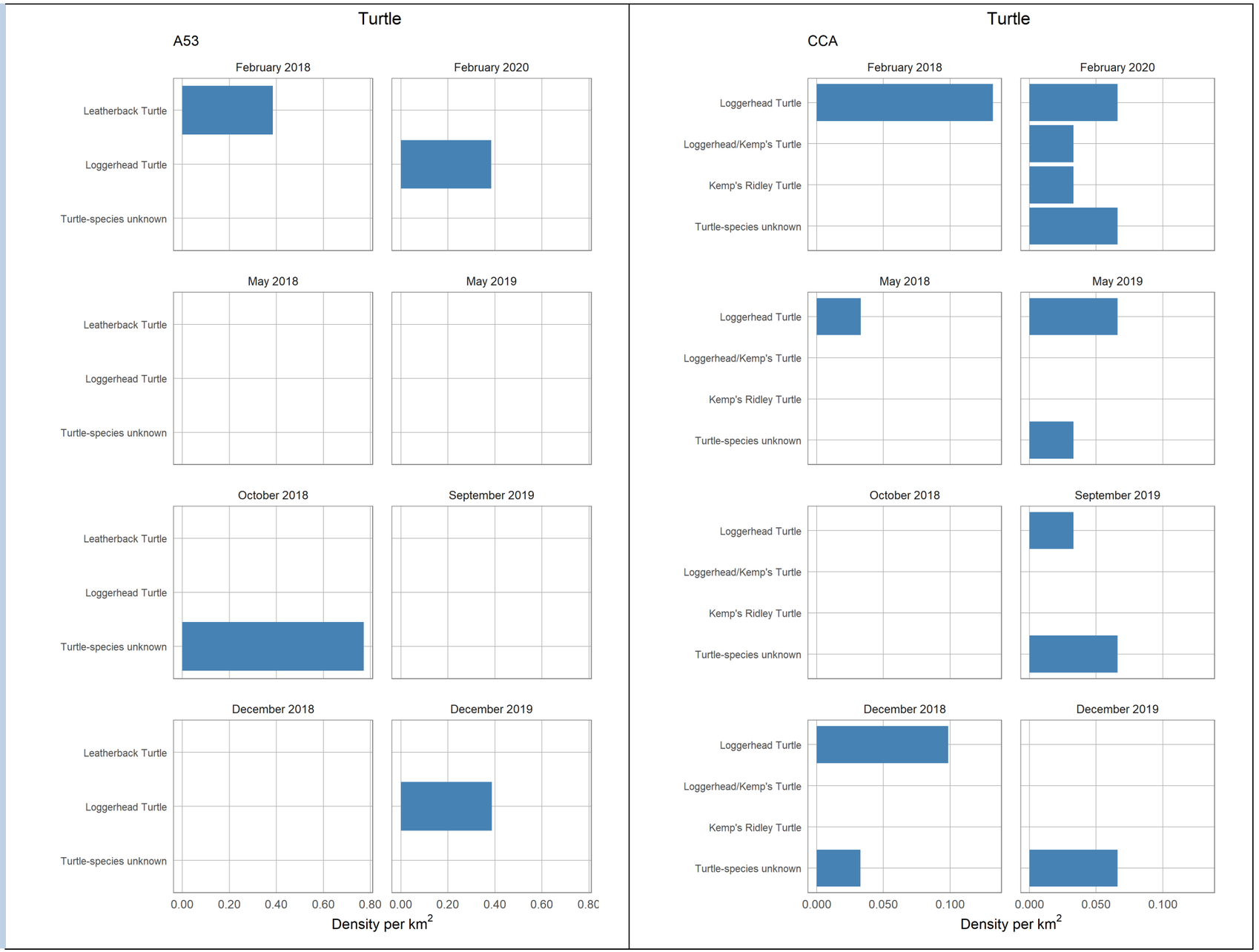


Figure D–1. (Continued)

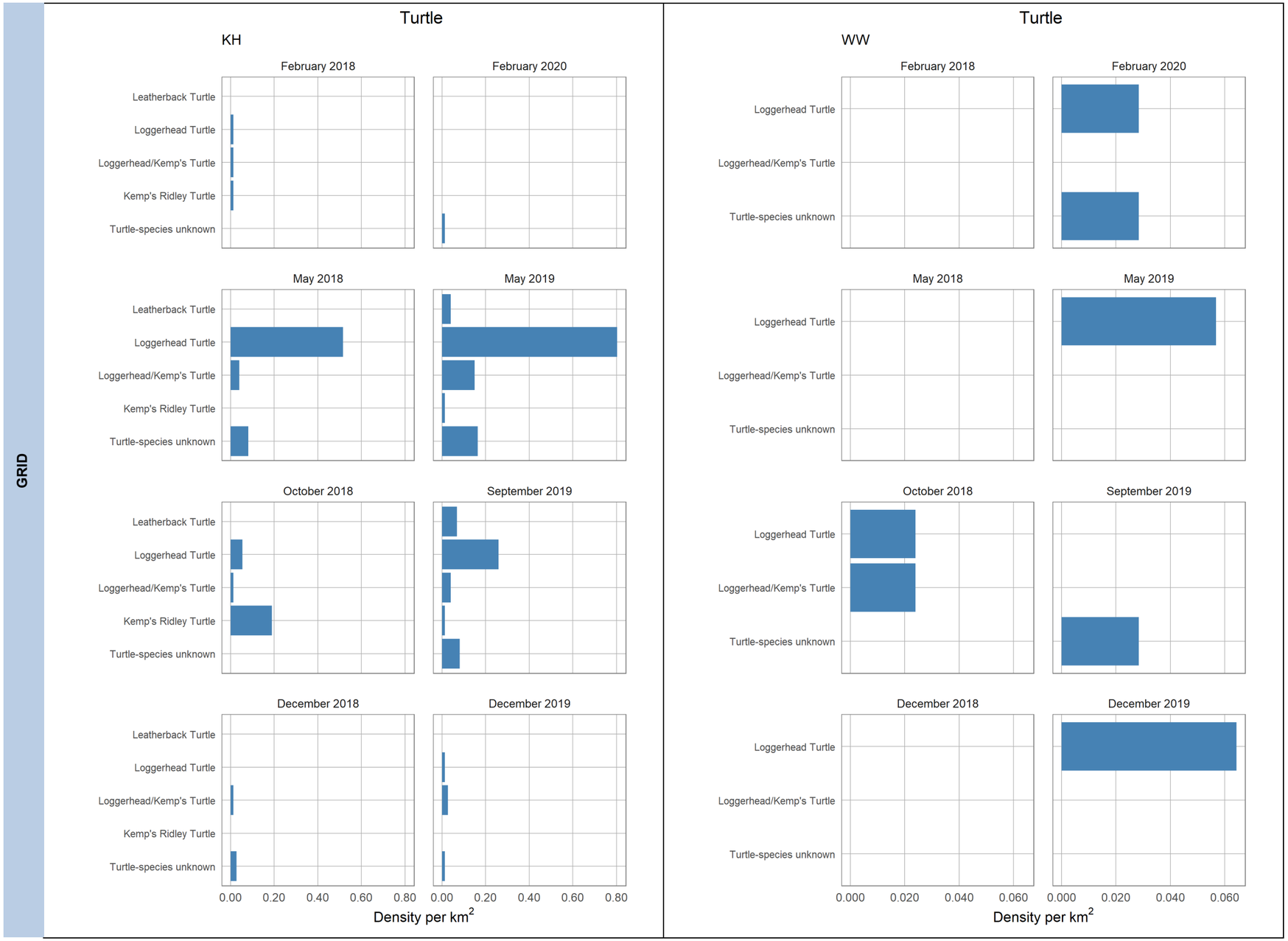


Figure D–1. (Continued)

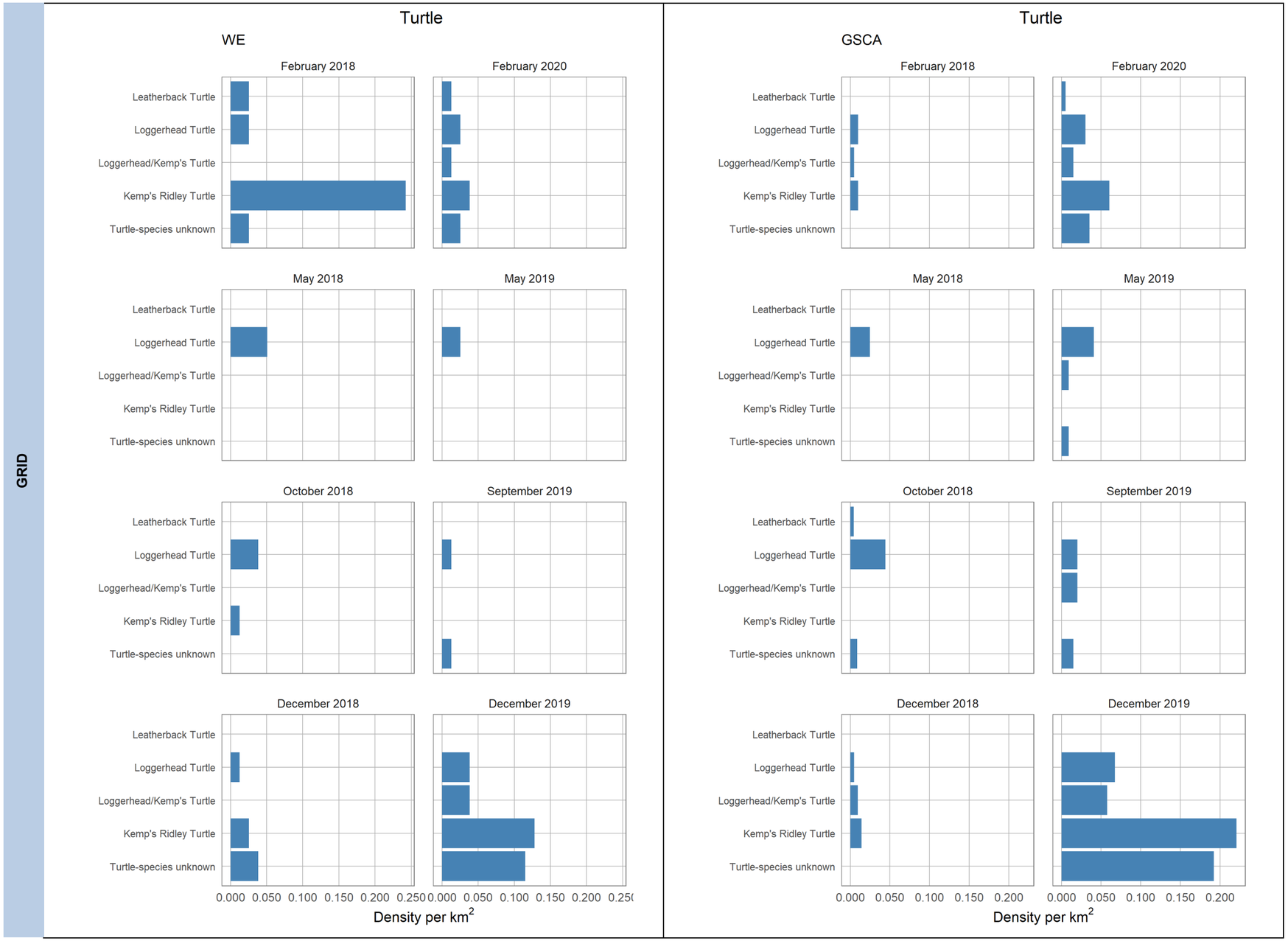


Figure D–1. (Continued)

D.3 Turtle Species Spatial Distribution Maps

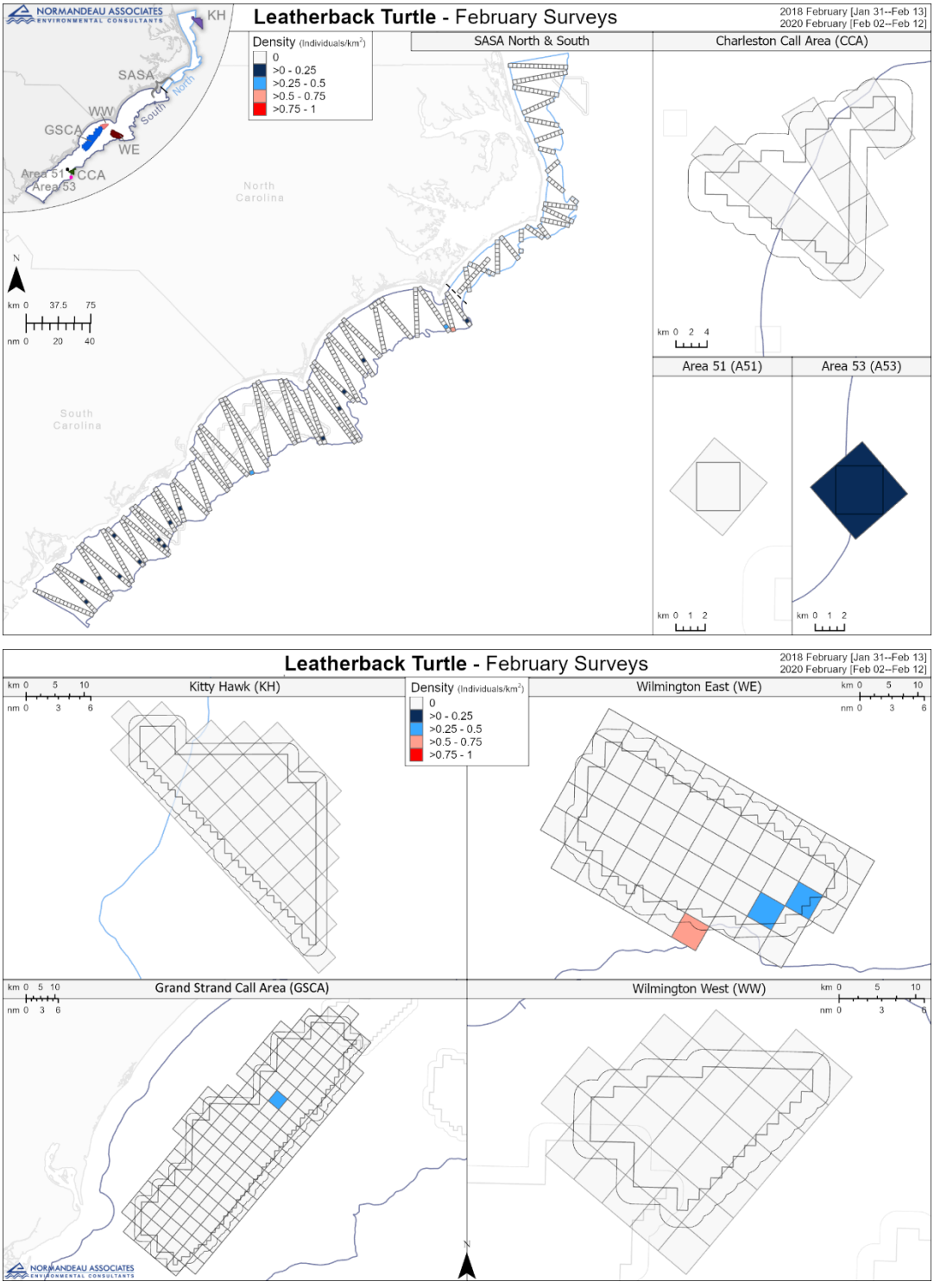


Figure D–2. Spatial distribution of leatherback turtles during the February surveys for all areas

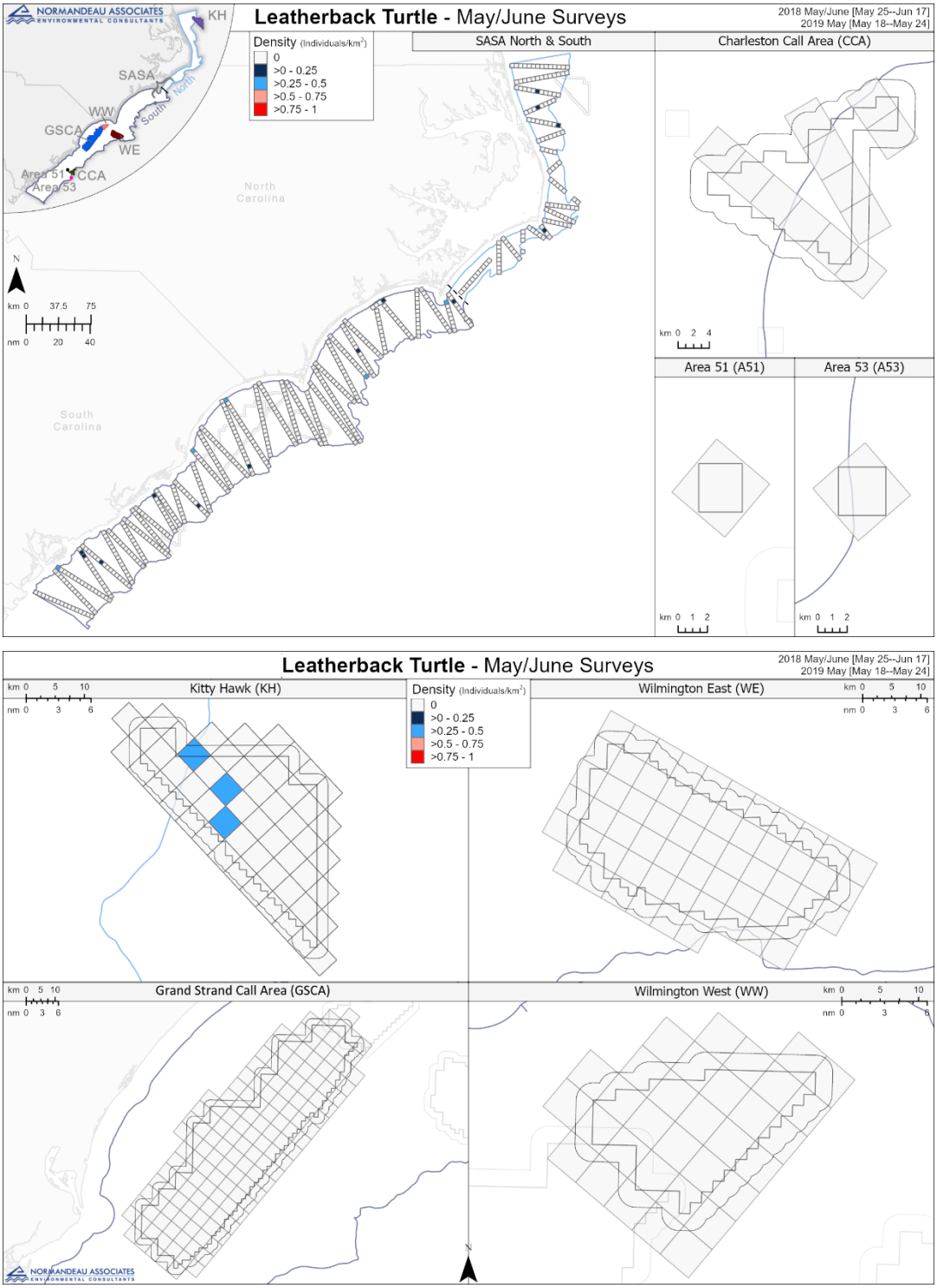


Figure D–3. Spatial distribution of leatherback turtles during the May/June surveys for all areas

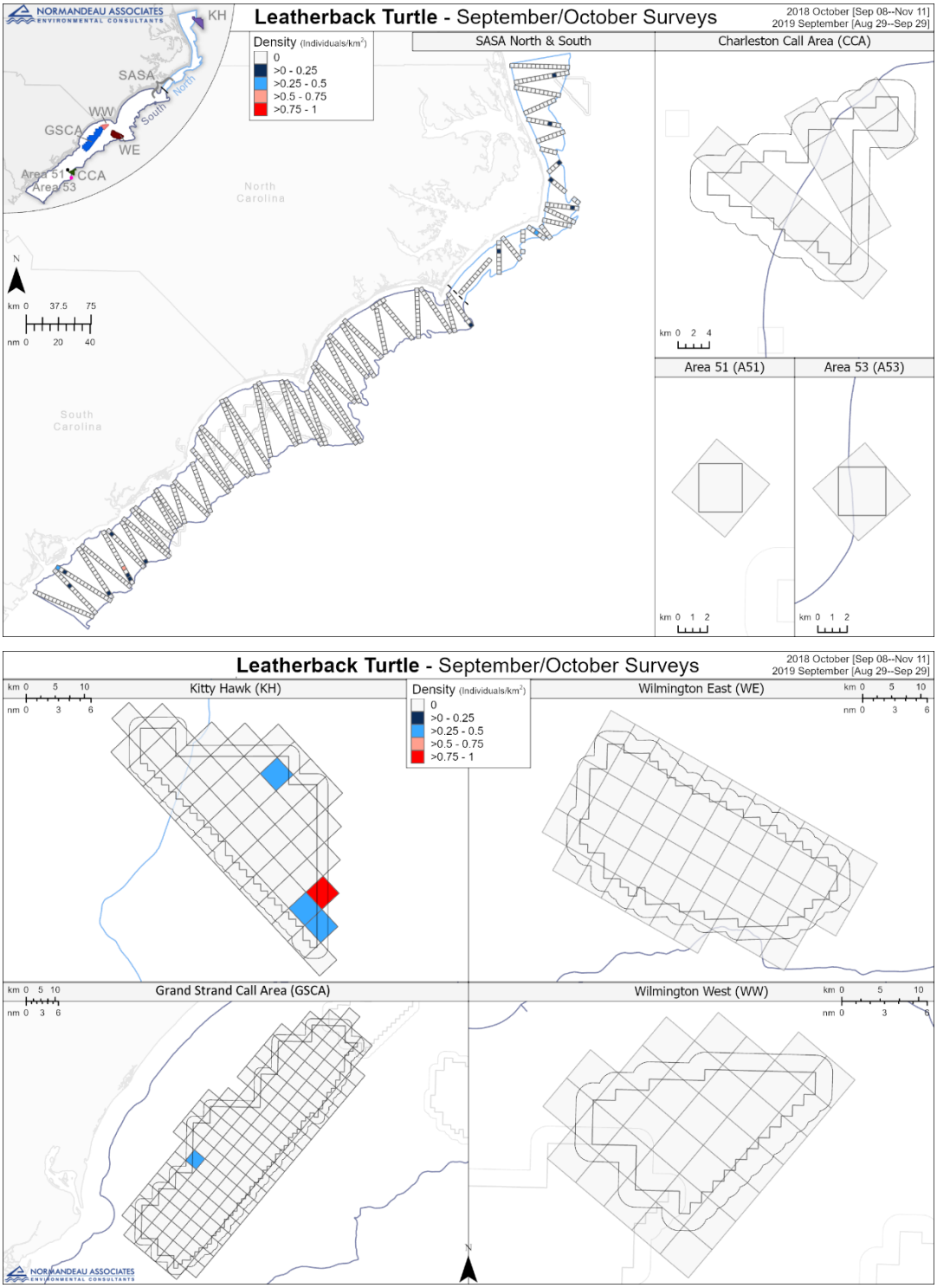


Figure D–4. Spatial distribution of leatherback turtles during the September/ October surveys for all areas

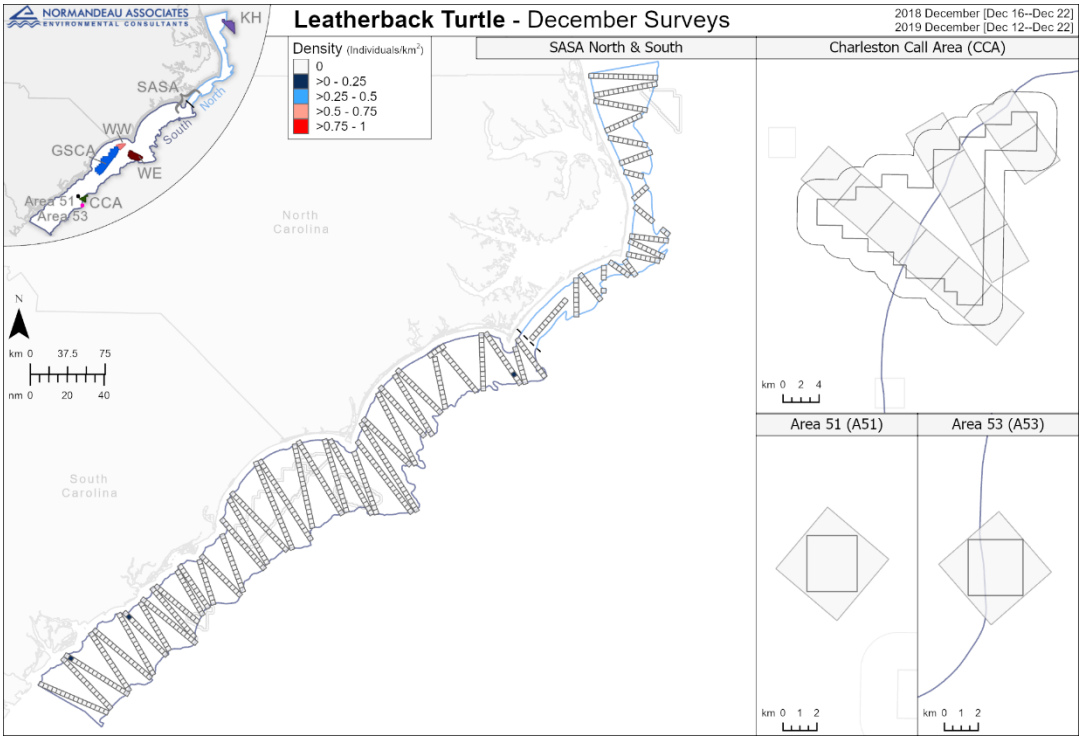


Figure D–5. Spatial distribution of leatherback turtles during the December surveys for all areas

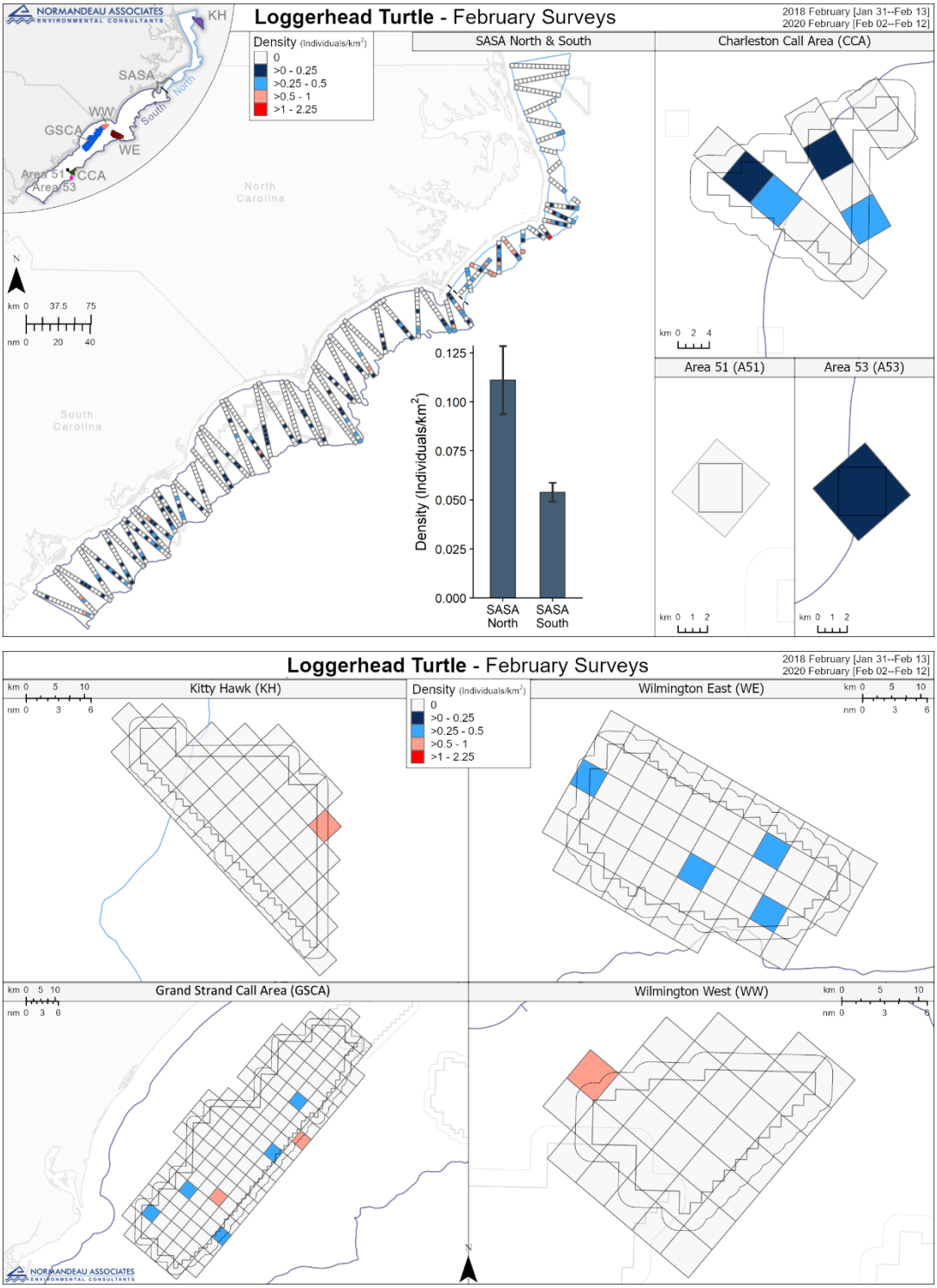


Figure D–6. Spatial distribution of loggerhead turtles during the February surveys for all areas

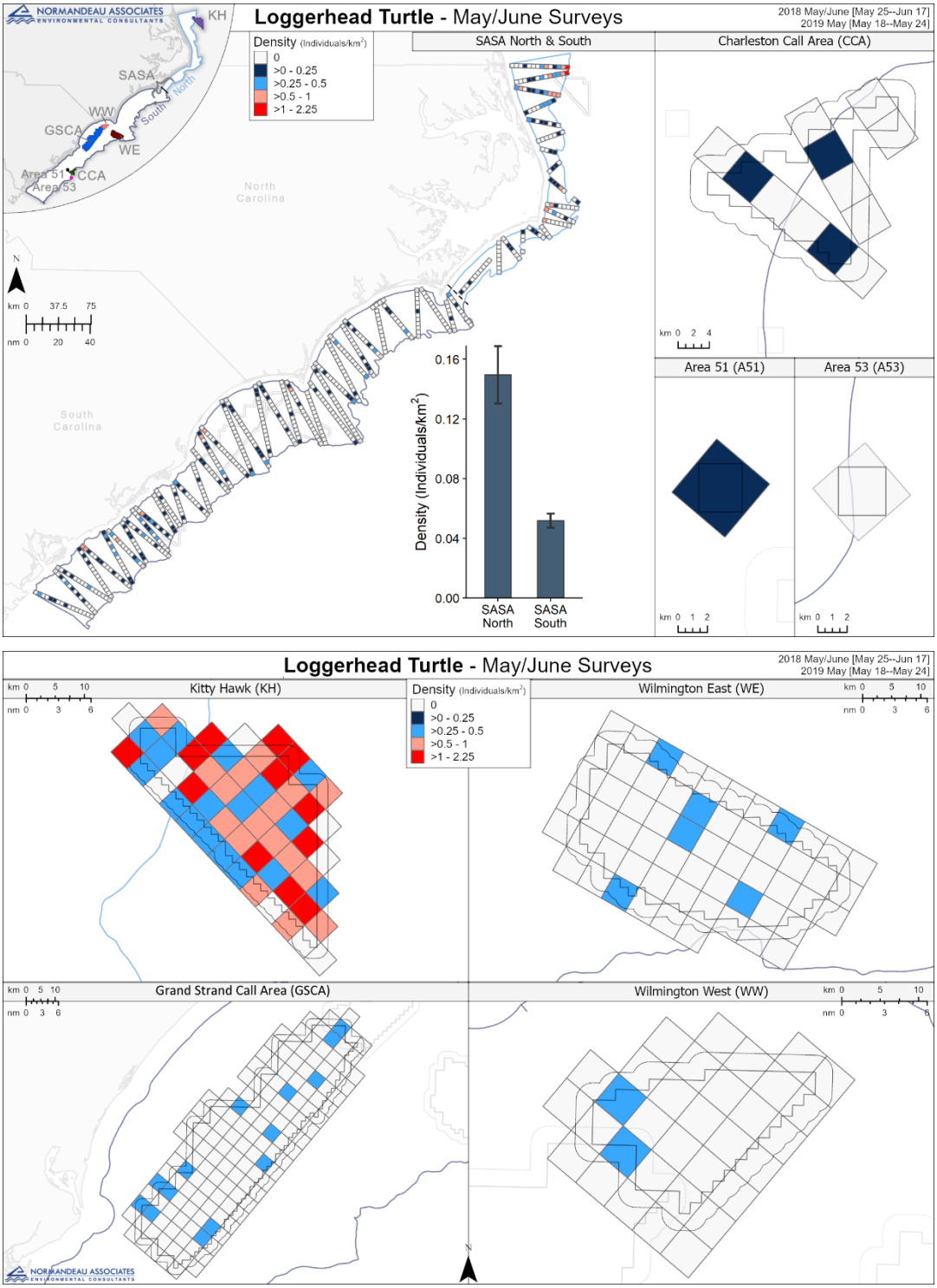


Figure D–7. Spatial distribution of loggerhead turtles during the May/June surveys for all areas

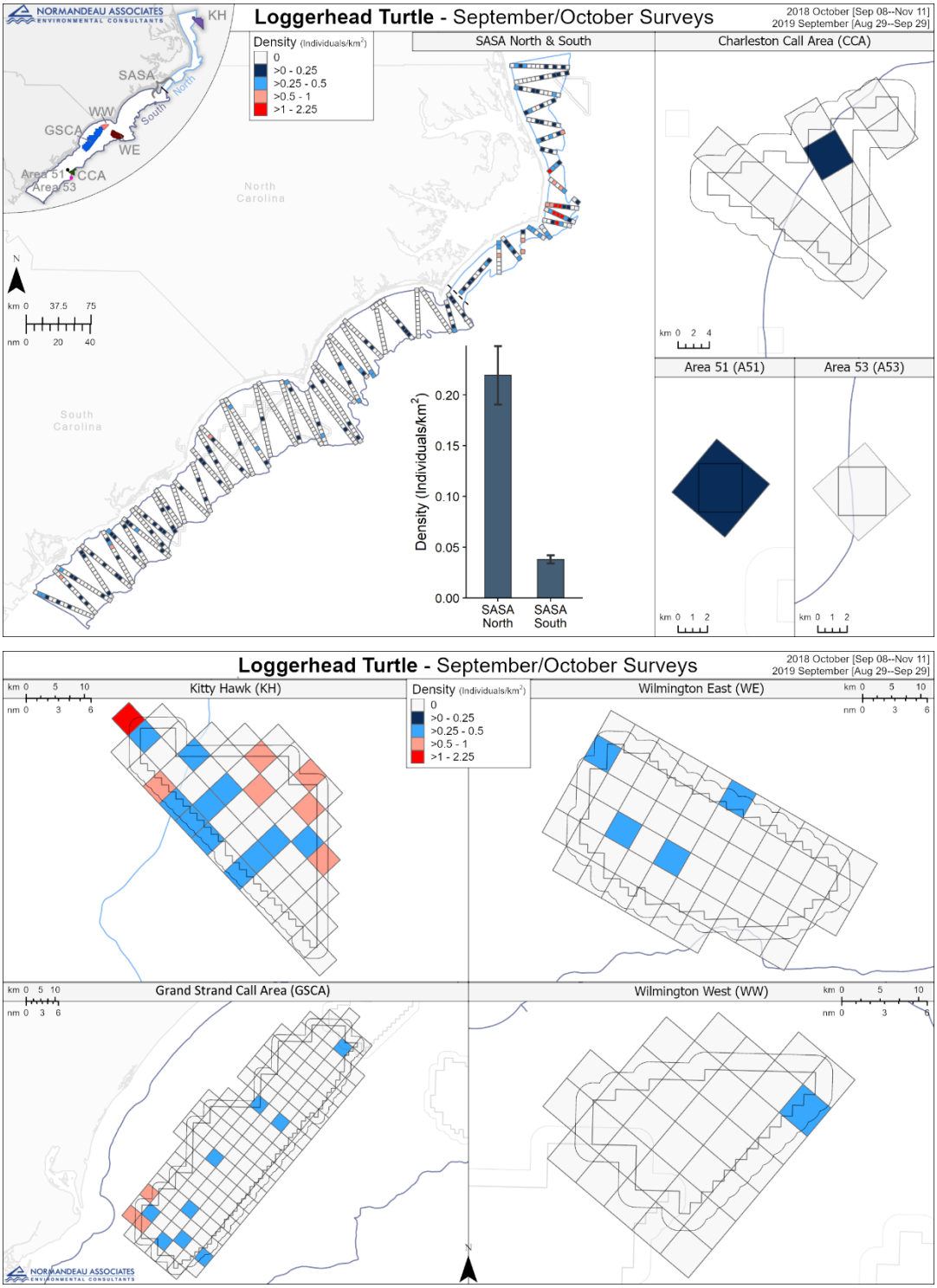


Figure D–8. Spatial distribution of loggerhead turtles during the September/ October surveys for all areas

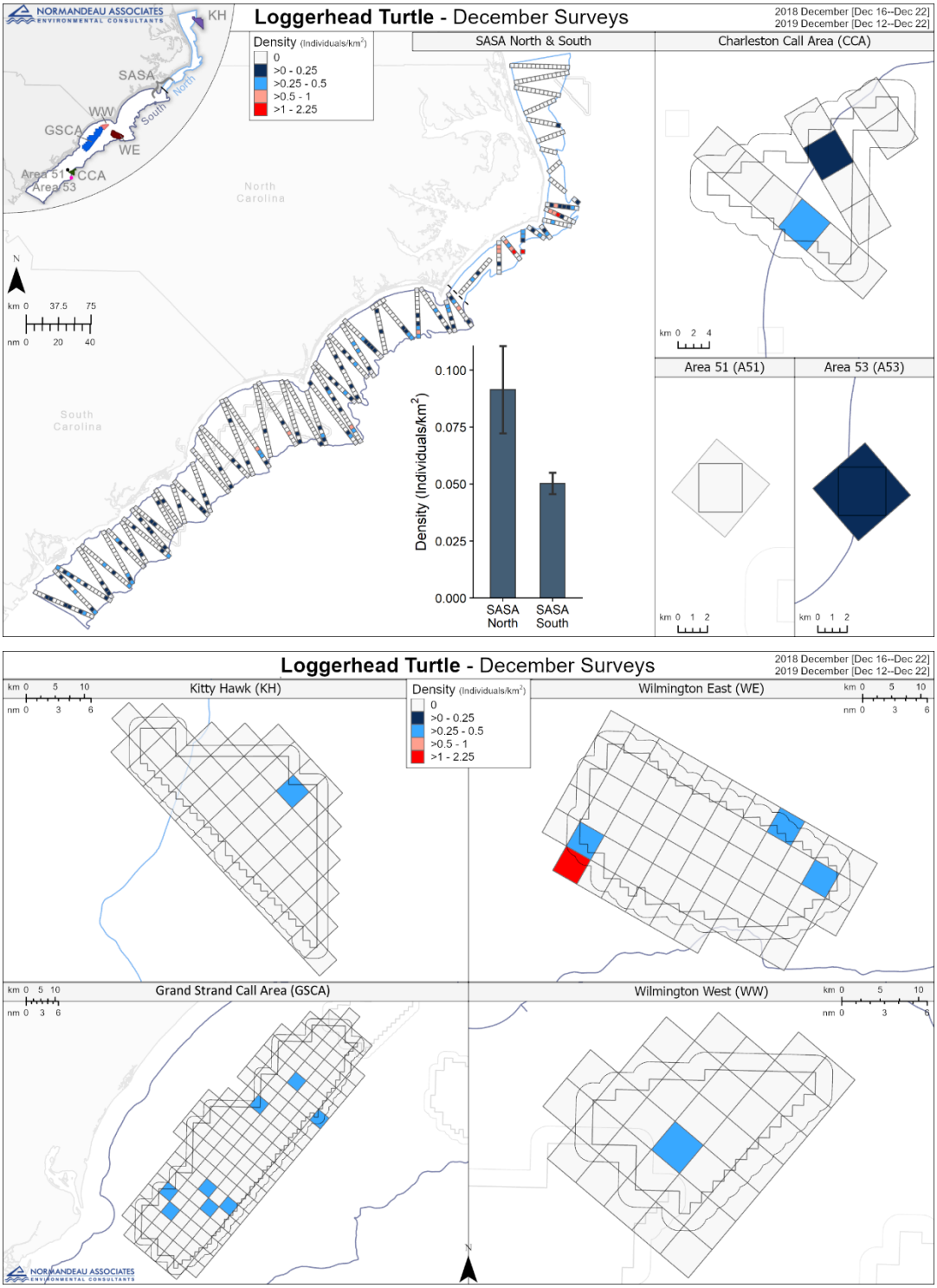


Figure D–9. Spatial distribution of loggerhead turtles during the December surveys for all areas

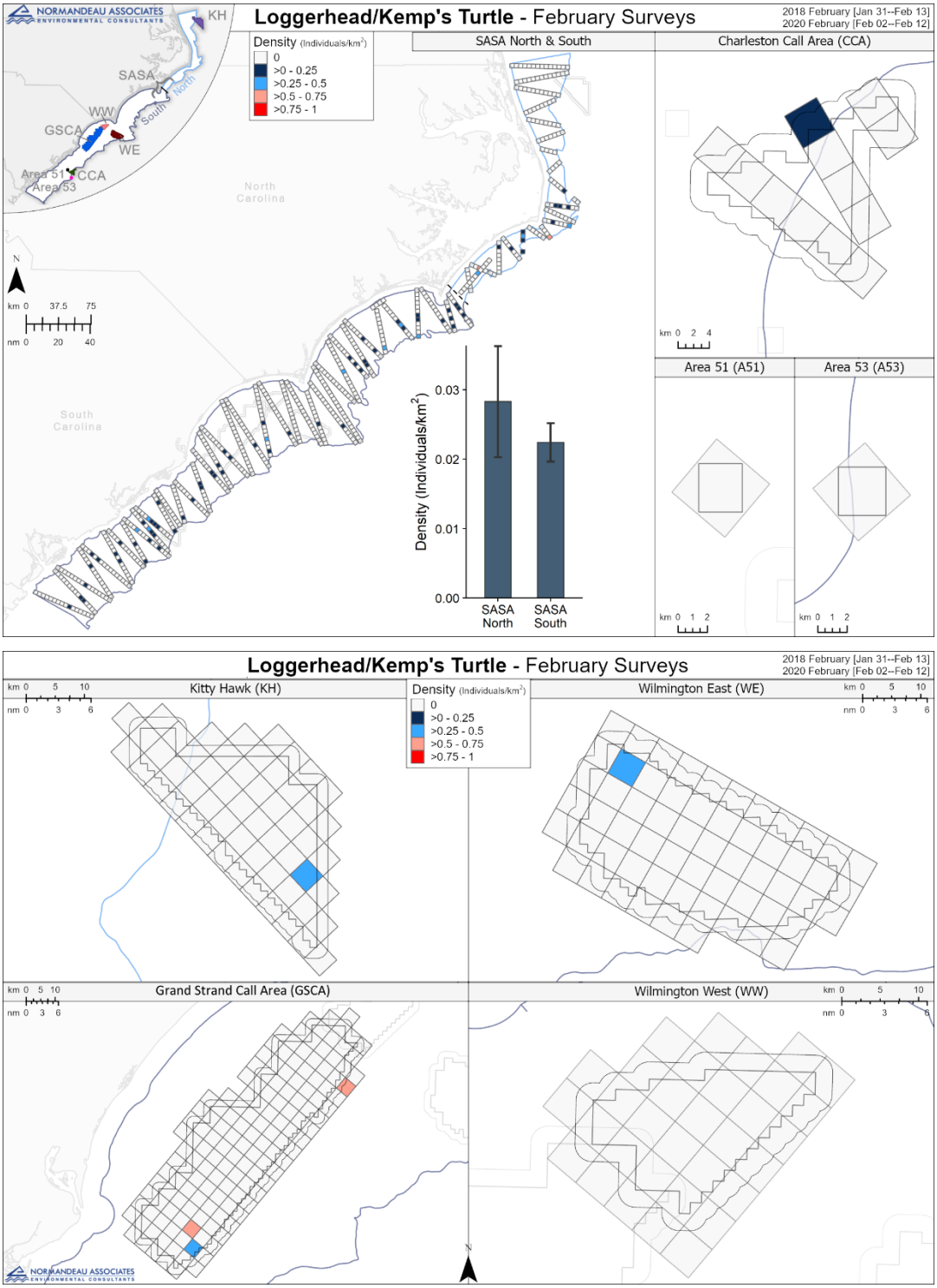


Figure D–10. Spatial distribution of loggerhead/Kemp's turtles during the February surveys for all areas

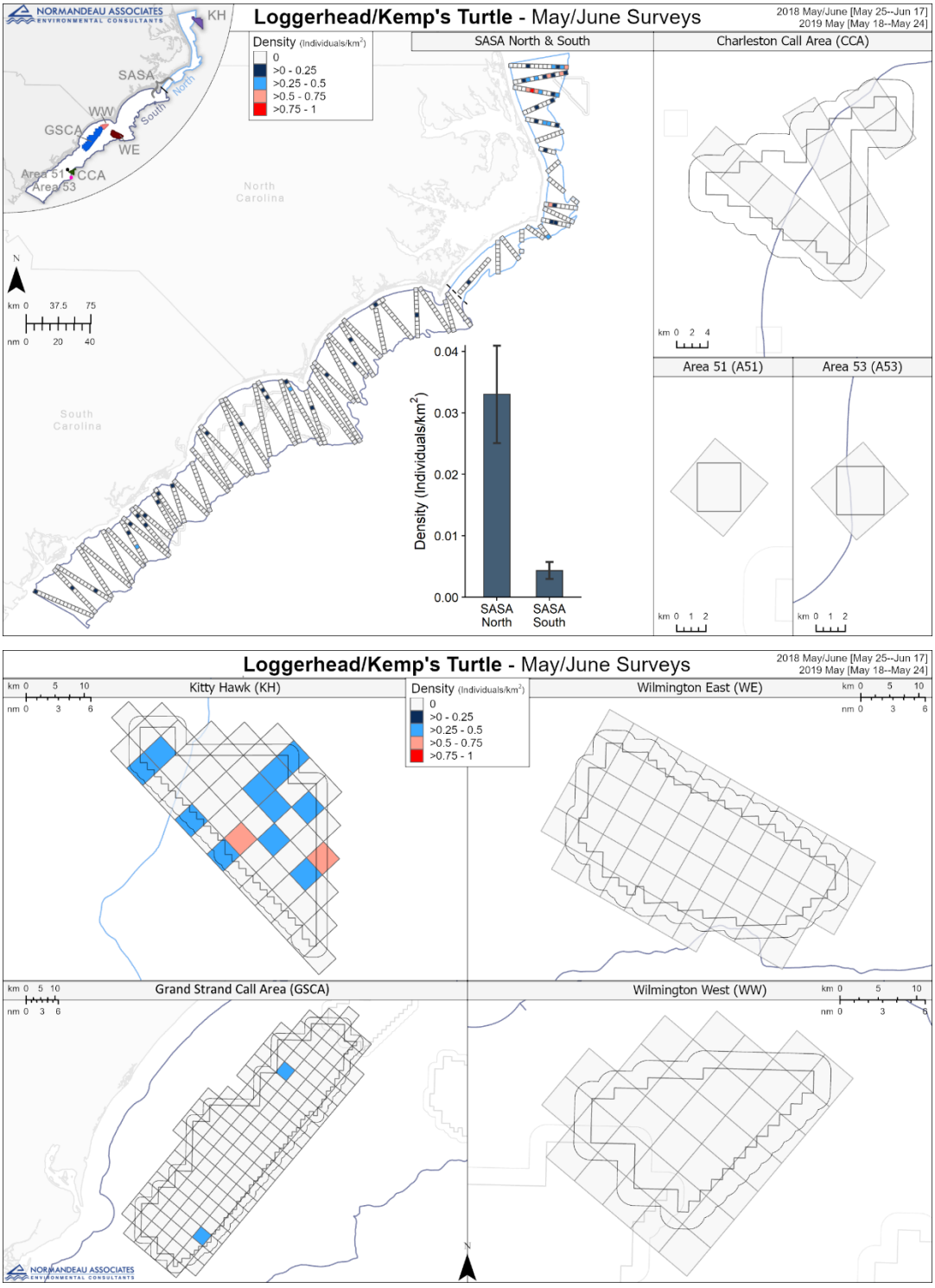


Figure D–11. Spatial distribution of loggerhead/Kemp's turtles during the May/June surveys for all areas

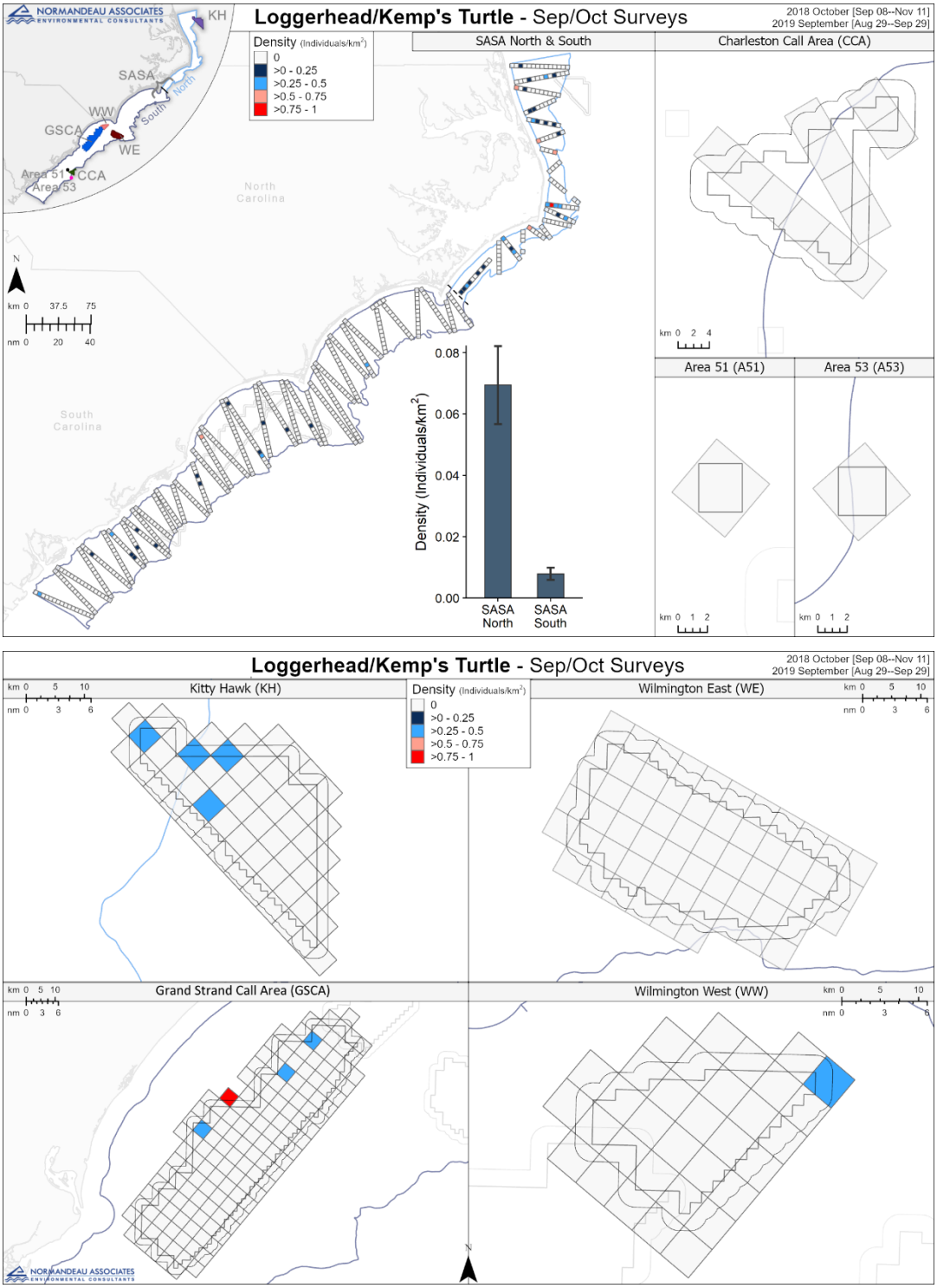


Figure D–12. Spatial distribution of loggerhead/Kemp's turtles during the September/October surveys for all areas

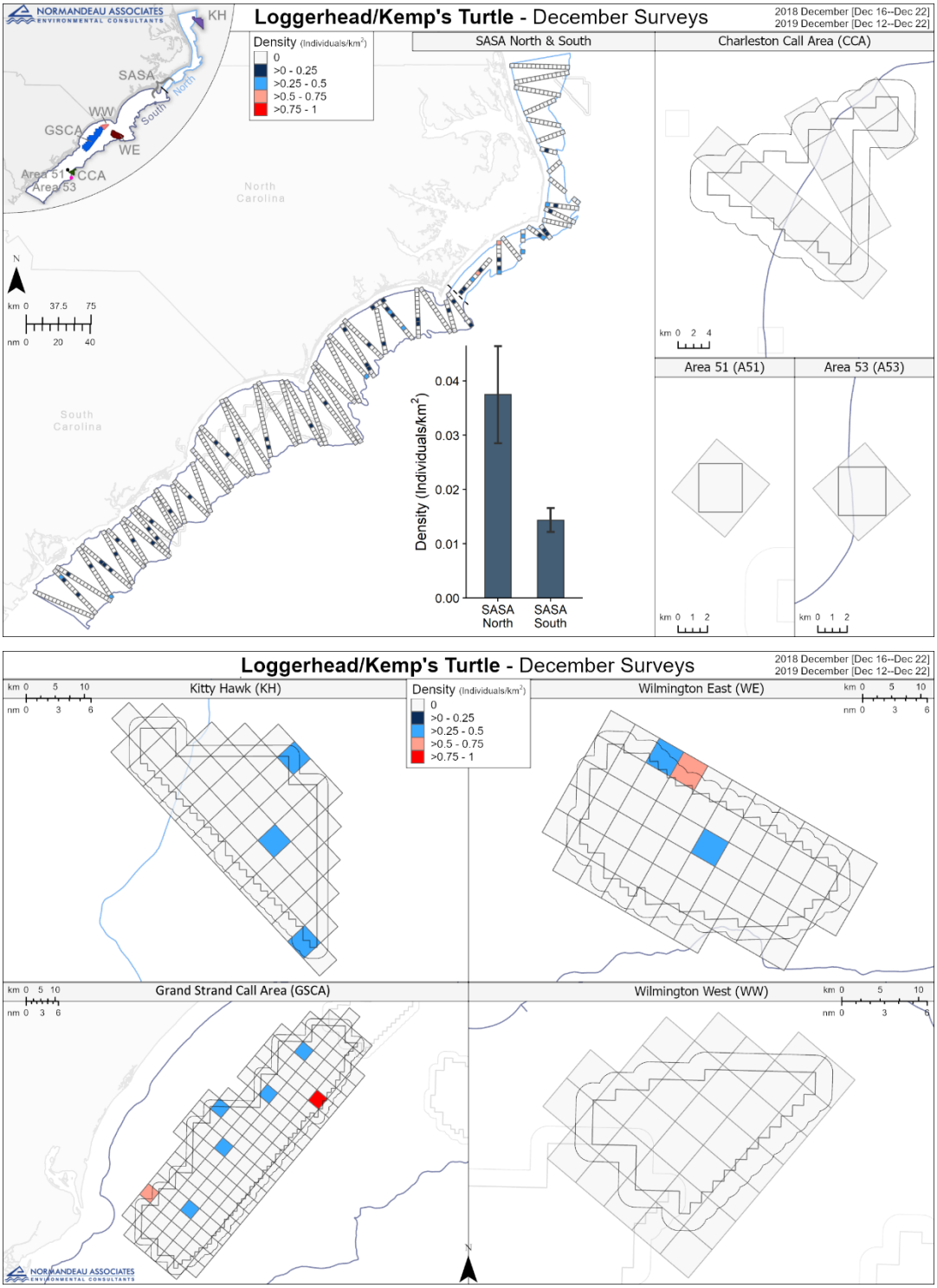


Figure D–13. Spatial distribution of loggerhead/Kemp's turtles during the December surveys for all areas

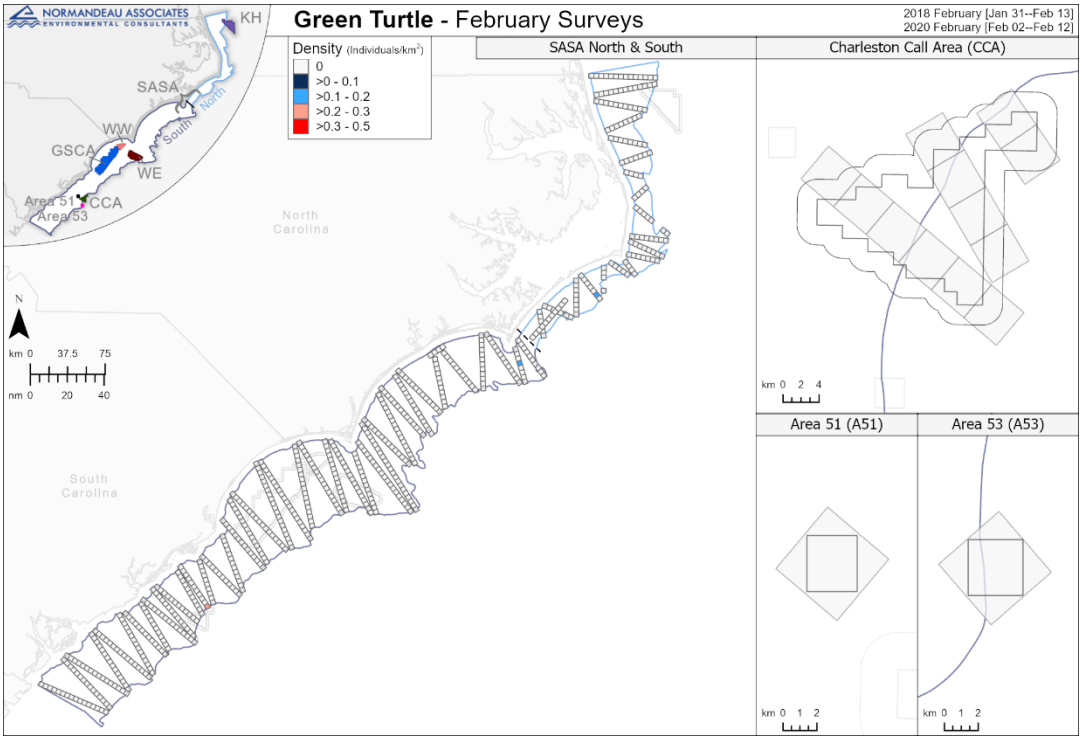


Figure D–14. Spatial distribution of green turtles during the February surveys for all areas

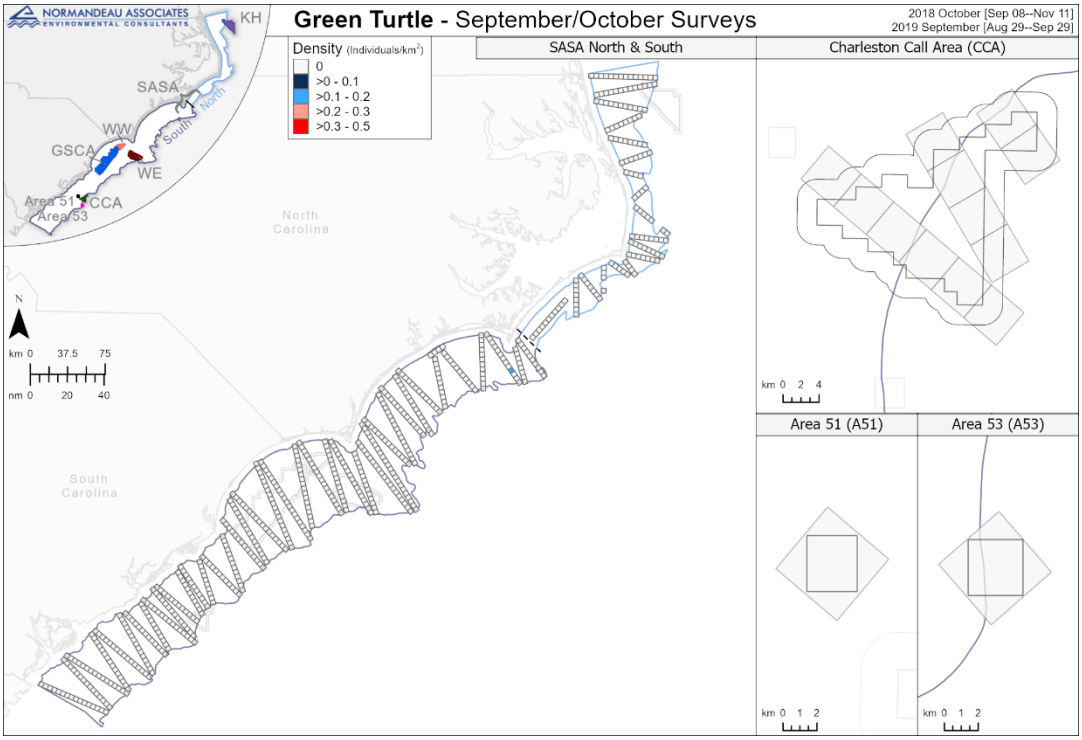


Figure D–15. Spatial distribution of green turtles during the September/October surveys for all areas

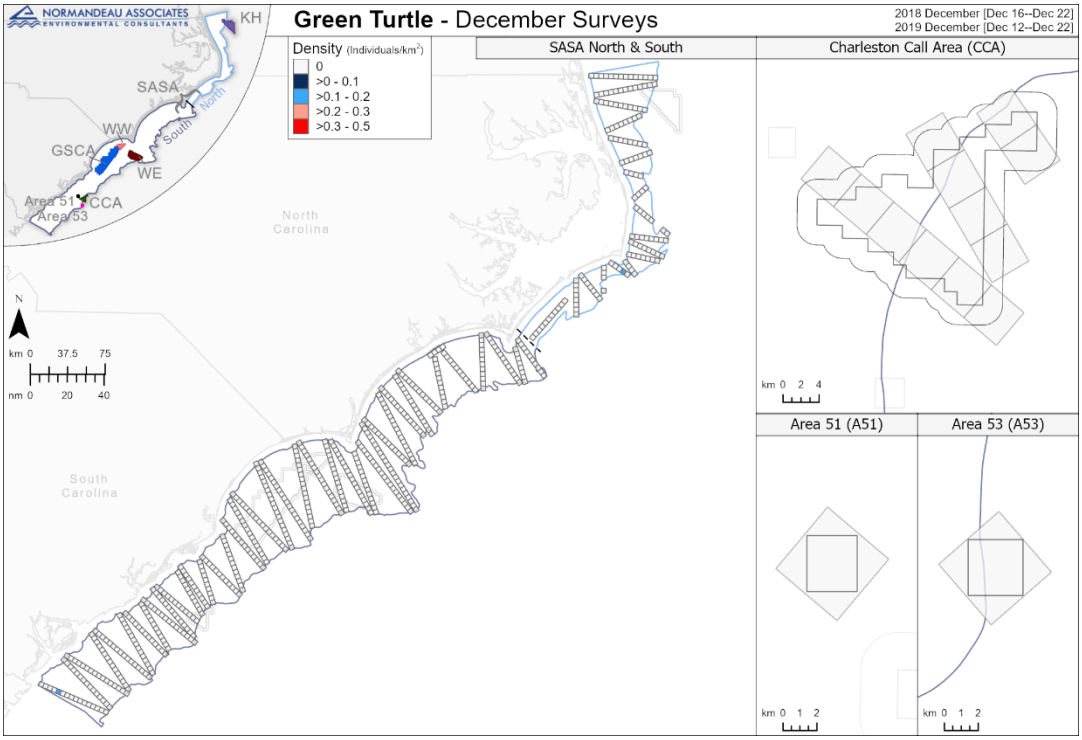


Figure D–16. Spatial distribution of green turtles during the December surveys for all areas

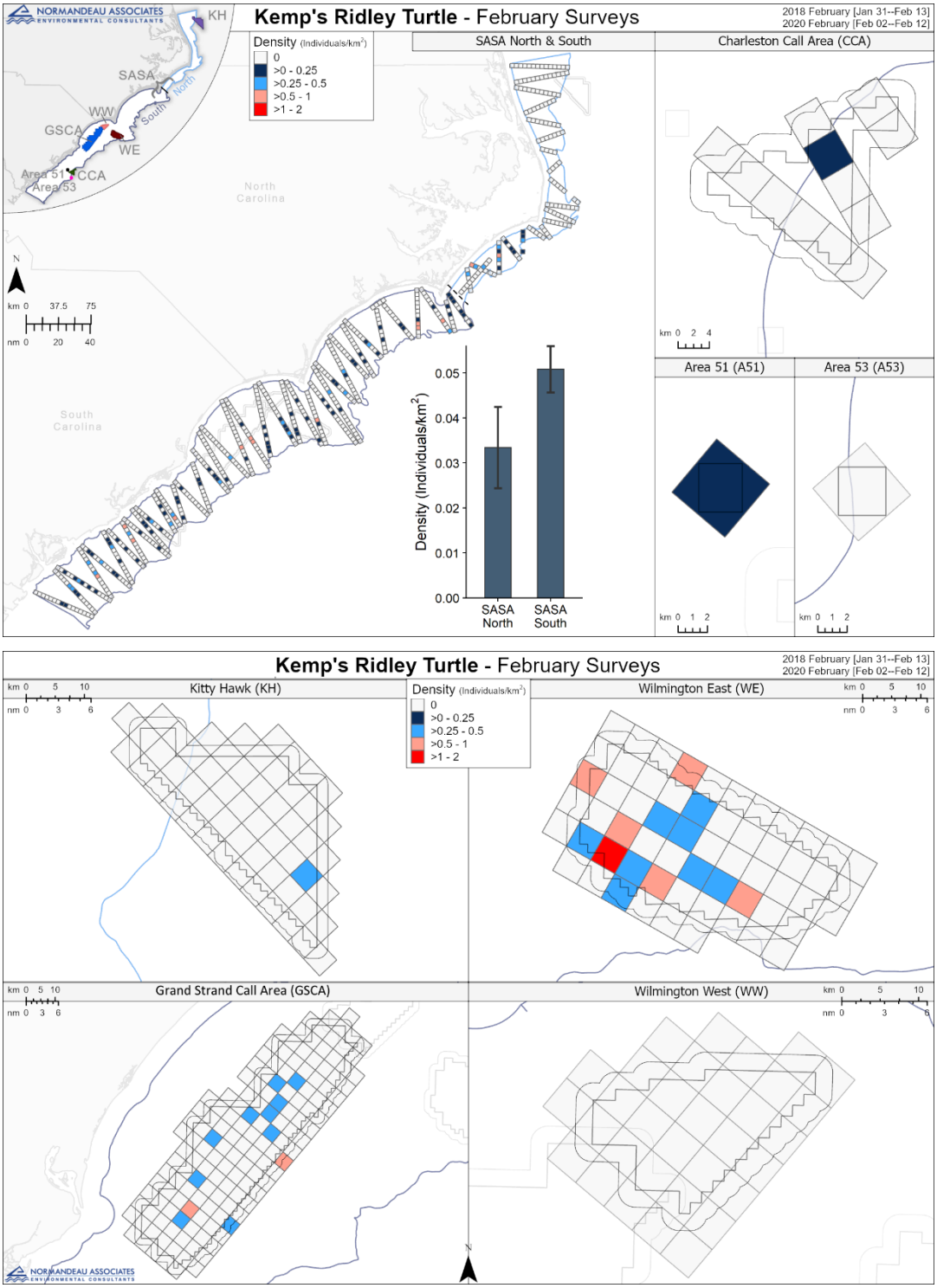


Figure D–17. Spatial distribution of Kemp's ridley turtles during the February surveys for all areas

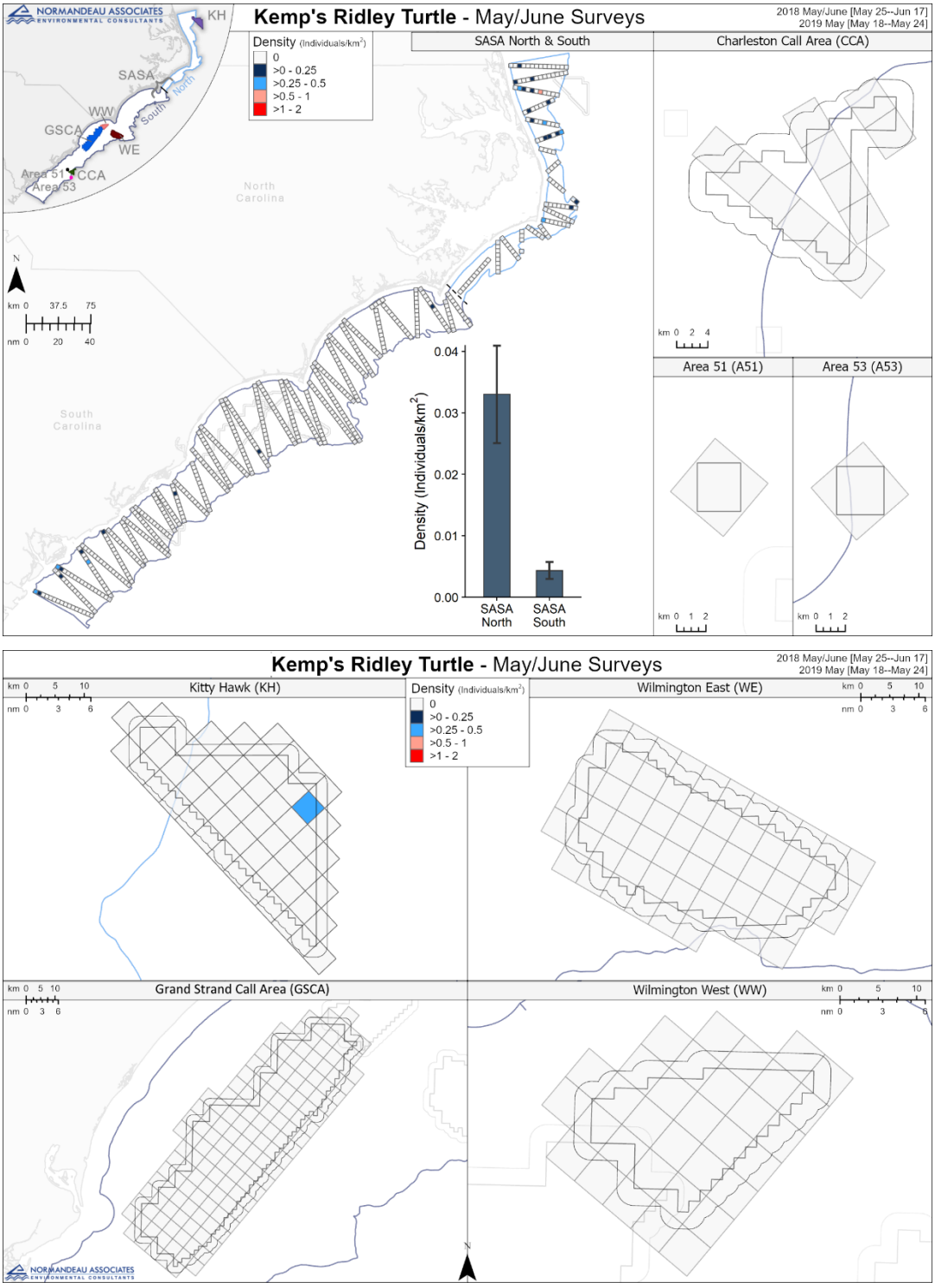


Figure D–18. Spatial distribution of Kemp's ridley turtles during the May/June surveys for all areas

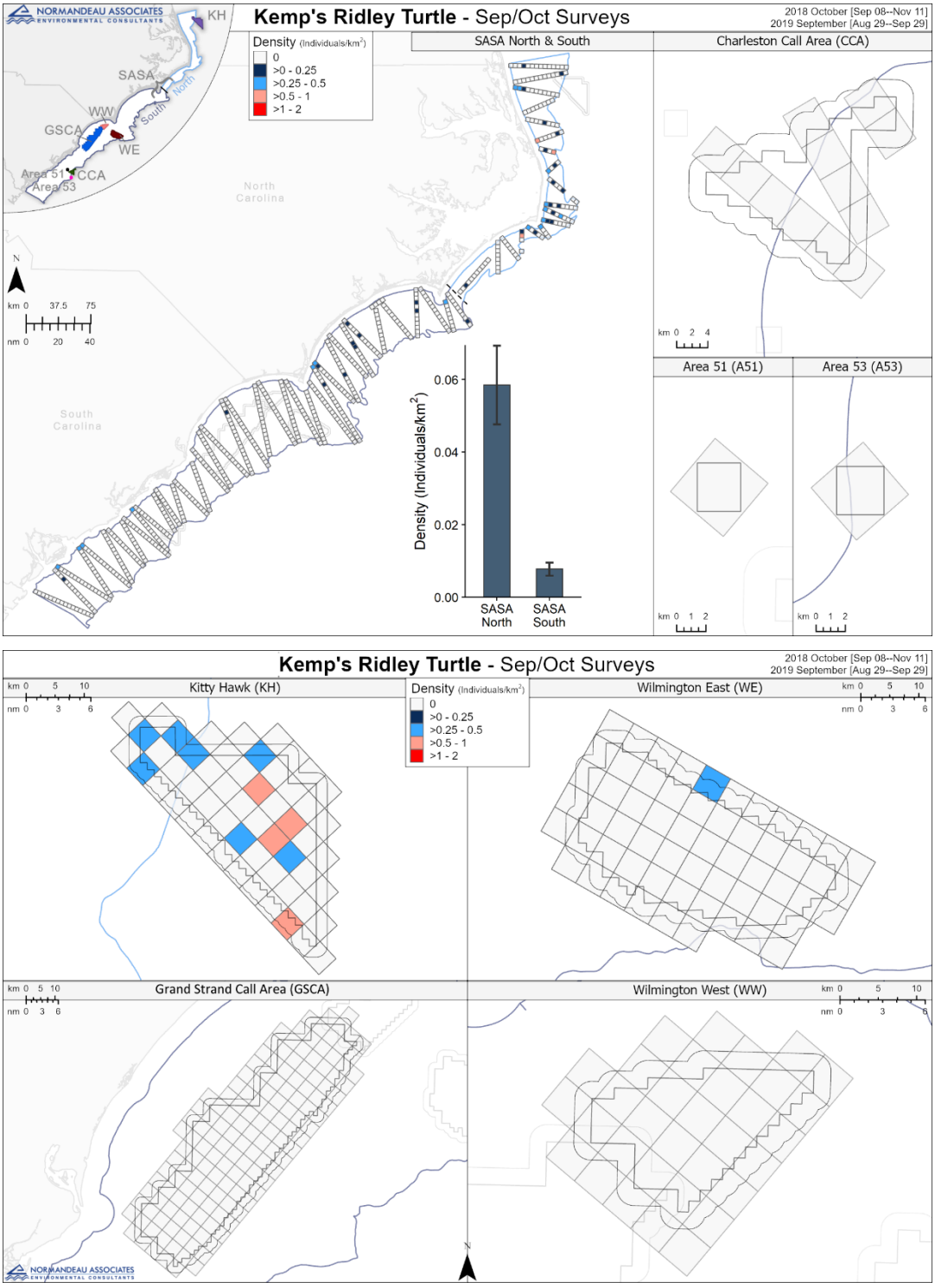


Figure D–19. Spatial distribution of Kemp's ridley turtles during the September/ October surveys for all areas

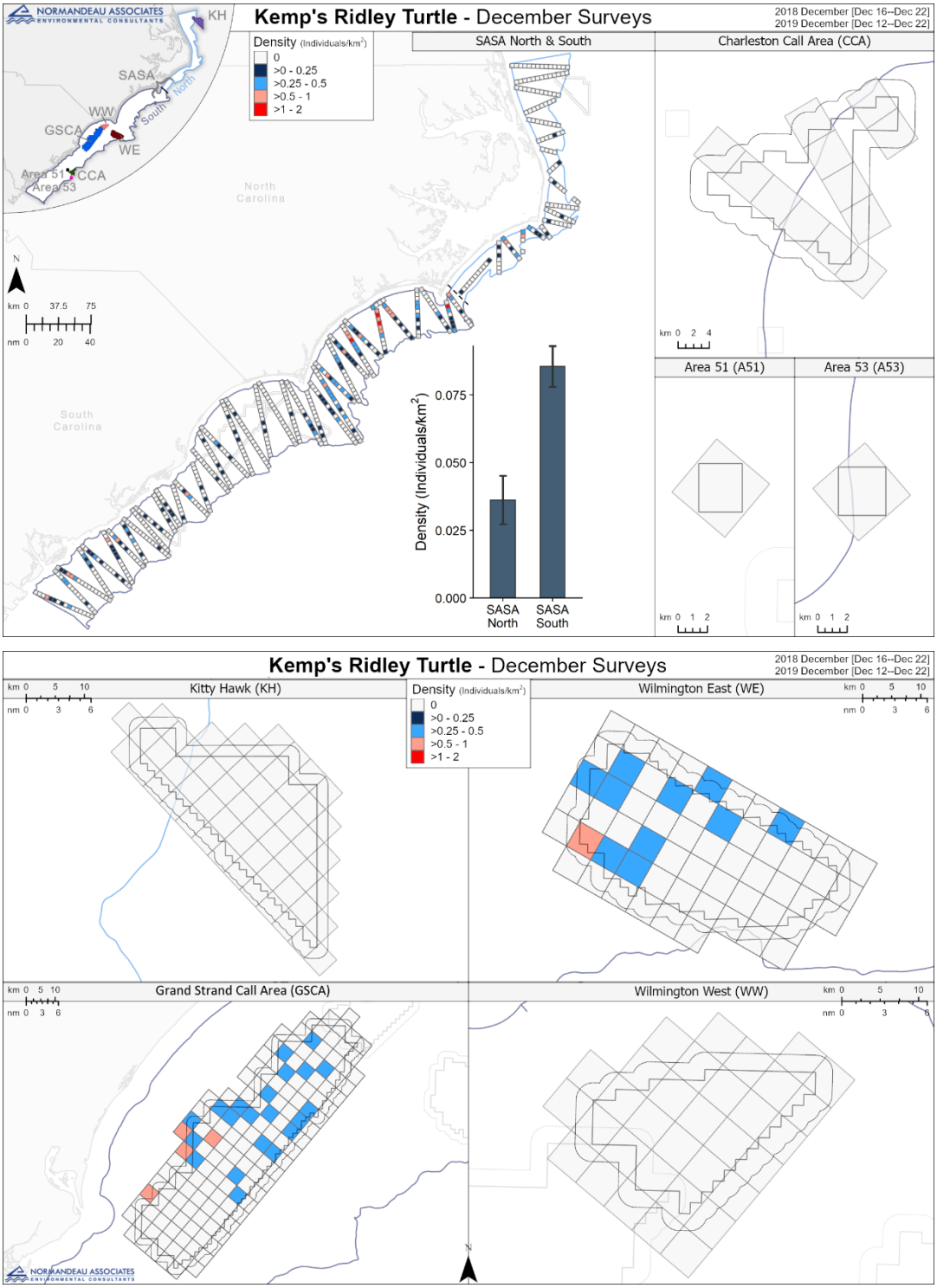


Figure D–20. Spatial distribution of Kemp's ridley turtles during the December surveys for all areas

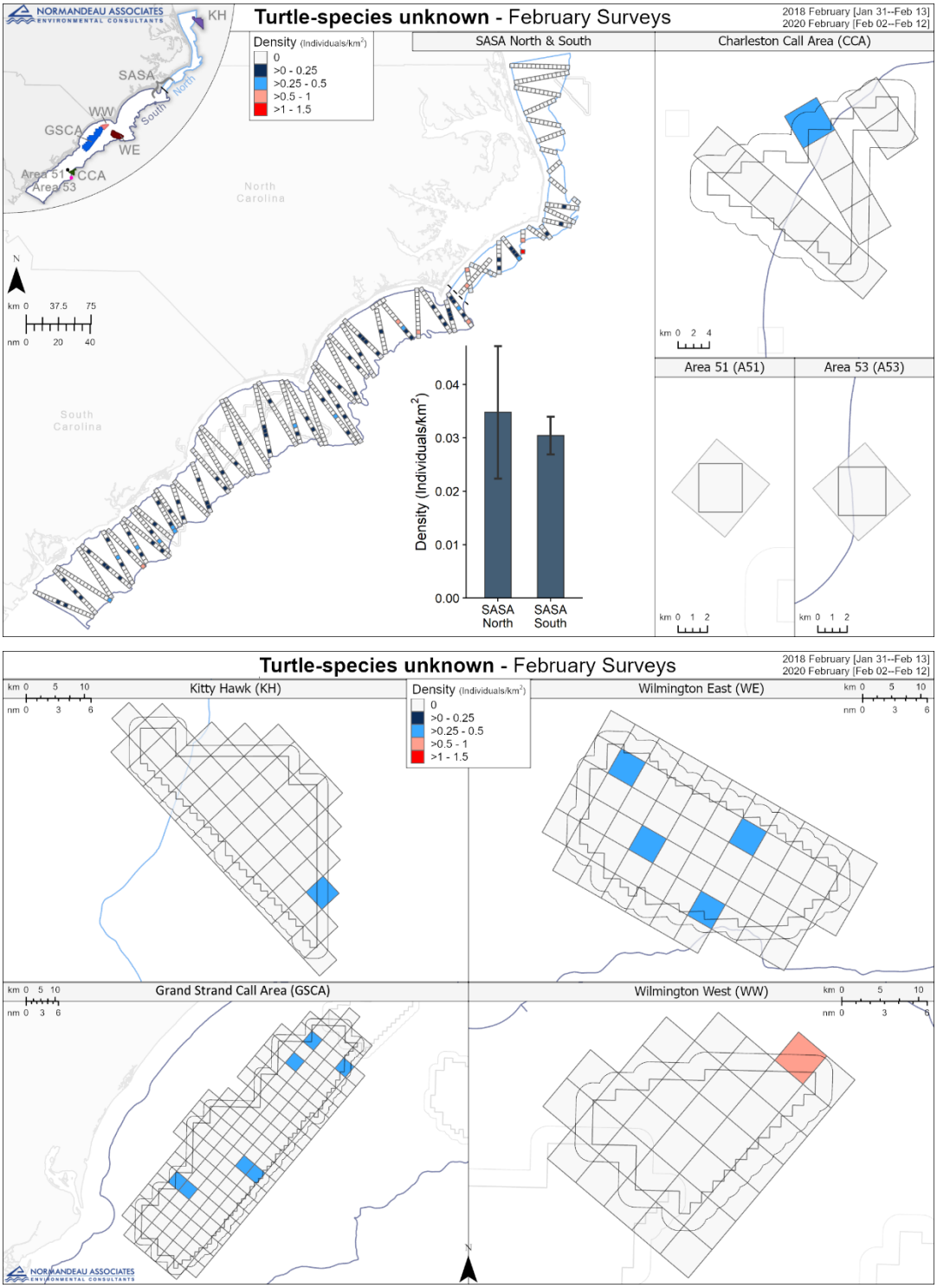


Figure D–21. Spatial distribution of turtle-species unknown during the February surveys for all areas

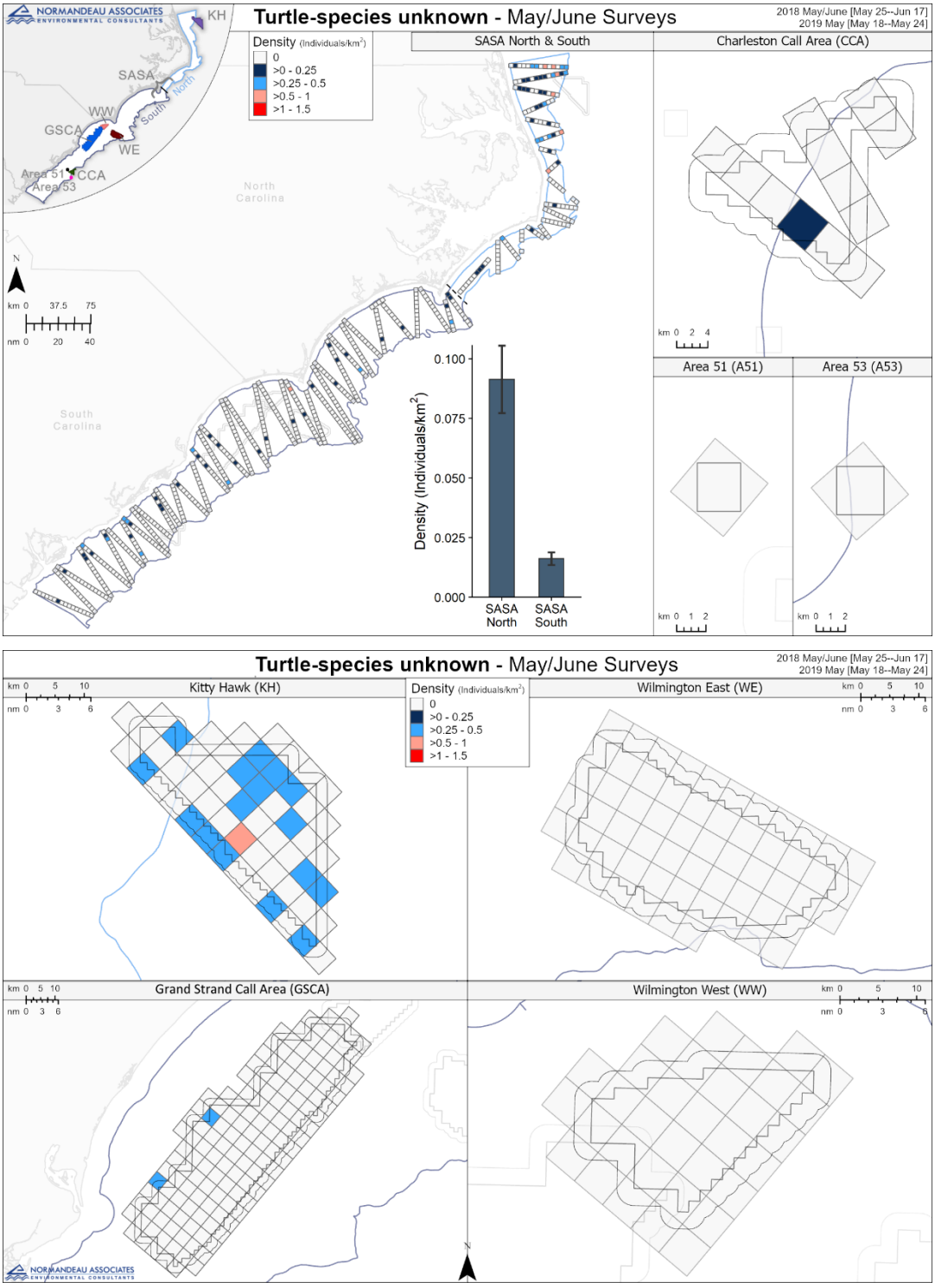


Figure D–22. Spatial distribution of turtle-species unknown during the May/June surveys for all areas

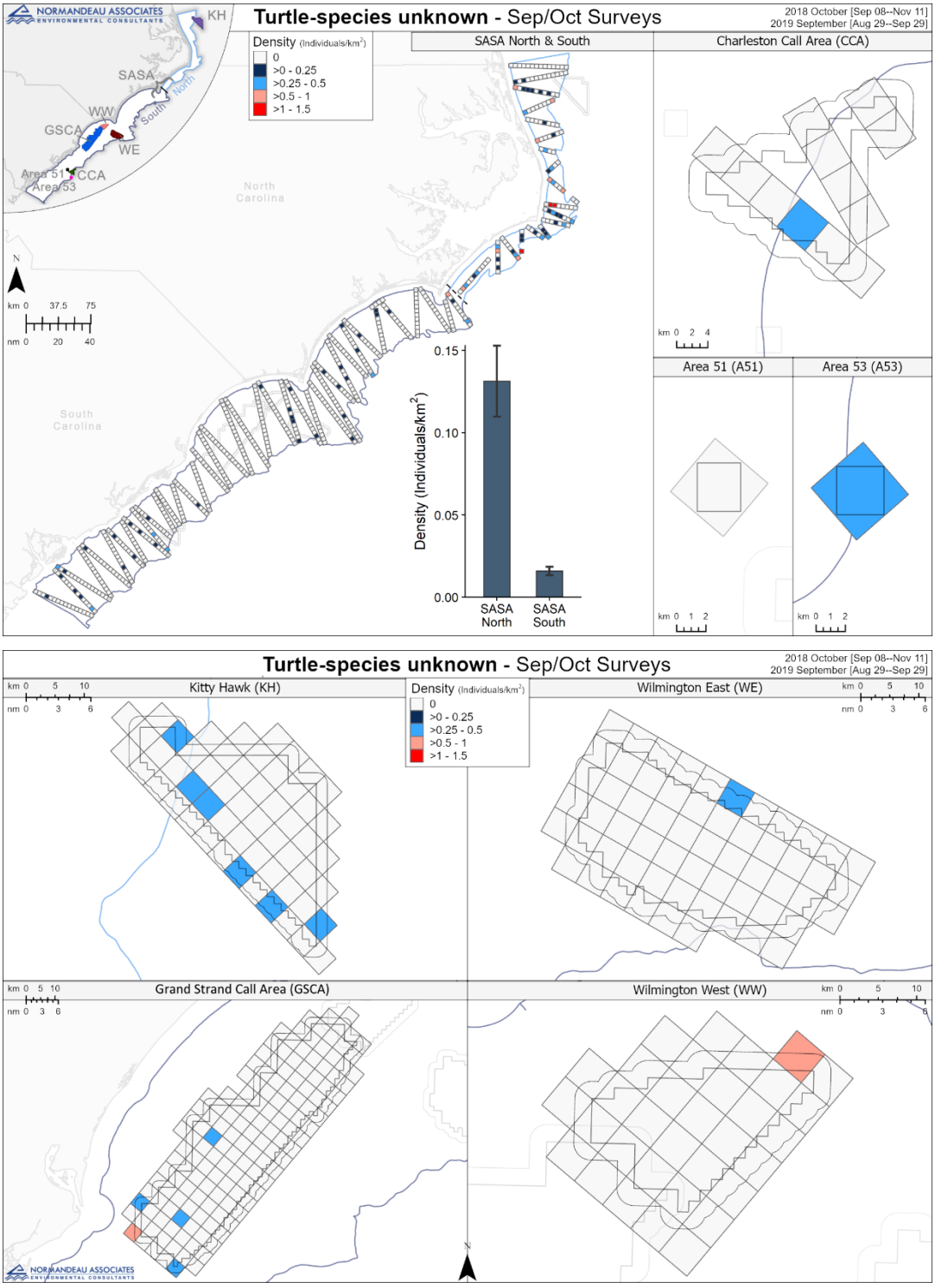
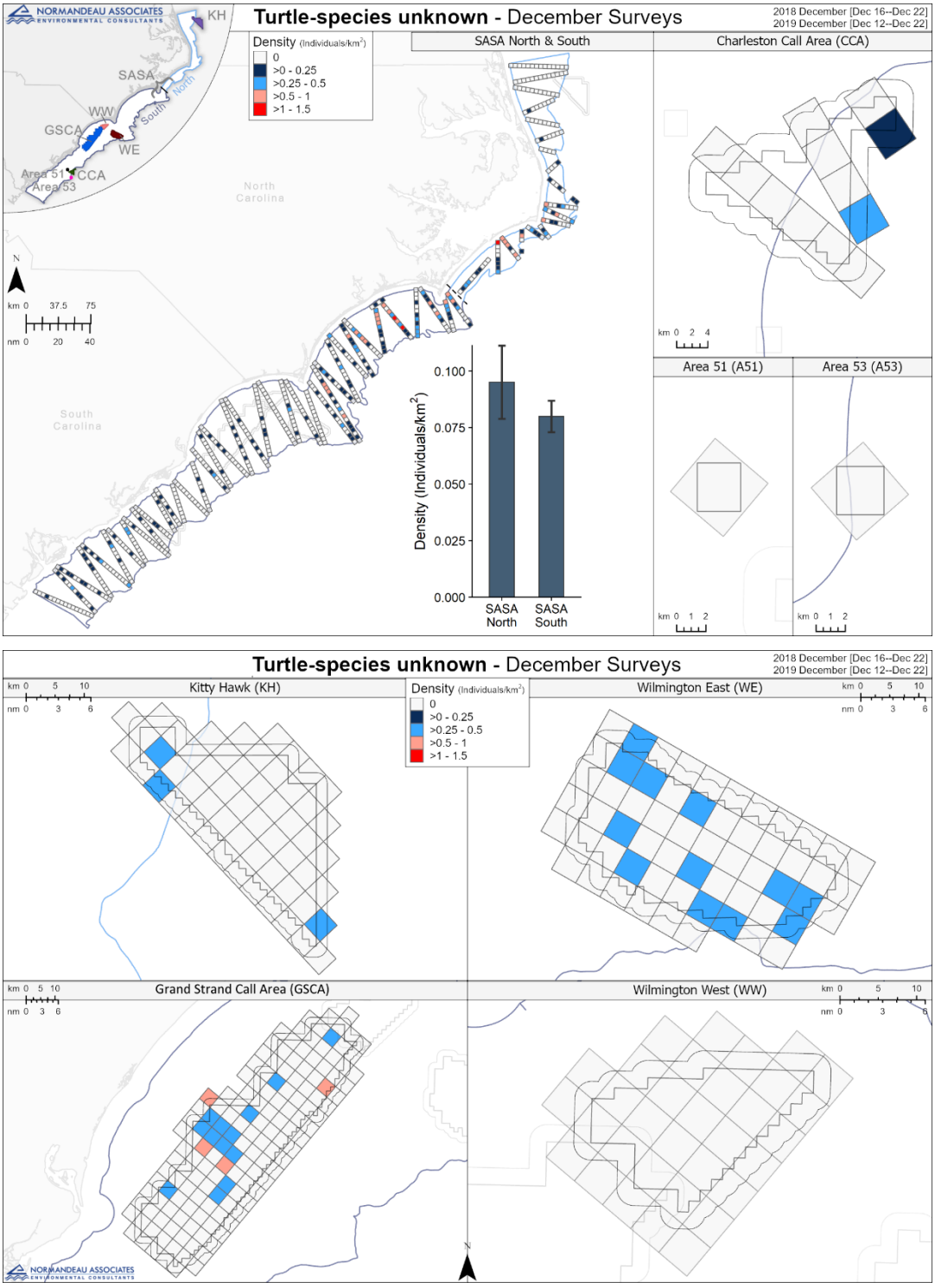


Figure D–23. Spatial distribution of turtle-species unknown during the September/ October surveys for all areas



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E.1 Raw Counts of Marine Mammal Species Identified in the February 2018 through December 2018 Surveys

Table E–1. Marine mammal species identified in the February 2018 through February 2020 surveys in all areas combined

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Seal	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**
species unknown	—	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	2
Whale	**2**	**3**	**2**	**2**	**—**	**—**	**—**	**—**	**2**	**2**	**—**	**—**	**1**	**1**	**2**	**2**	**10**
North Atlantic Right Whale*	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Common Minke Whale	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Humpback Whale*	—	1	2	2	—	—	—	—	1	1	—	—	1	1	2	2	7
species unknown	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	1
Dolphin	**275**	**497**	**652**	**1,056**	**69**	**103**	**197**	**379**	**200**	**354**	**378**	**564**	**389**	**666**	**306**	**542**	**4,161**
Common Dolphin	8	21	55	104	—	—	—	—	—	—	—	—	22	60	—	—	185
Risso's Dolphin	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	1	3
Atlantic White-sided Dolphin	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Rough-toothed dolphin	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Atlantic Spotted Dolphin	20	35	182	337	20	33	63	144	69	121	92	167	45	96	37	89	1,022
Clymene Dolphin	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Pantropical Spotted Dolphin	2	4	—	1	—	—	—	—	—	—	9	26	27	41	—	—	72
Bottlenose Dolphin	72	167	41	69	10	18	8	30	19	48	42	60	71	127	19	42	561
Harbor Porpoise	2	4	1	2	—	—	—	1	—	3	—	—	—	—	—	5	15
Bottlenose/Atlantic Spotted	11	28	97	203	—	—	18	48	23	62	26	51	14	52	26	58	502
species unknown	159	236	276	340	39	51	108	156	89	120	209	258	210	290	224	347	1,798
Unid. Mammal	**—**	**1**	**5**	**6**	**1**	**1**	**4**	**5**	**2**	**2**	**—**	**—**	**—**	**—**	**2**	**3**	**18**
species unknown	—	1	5	6	1	1	4	5	2	2	—	—	—	—	2	3	18
Totals	**277**	**501**	**659**	**1,064**	**70**	**104**	**203**	**386**	**204**	**358**	**378**	**564**	**390**	**667**	**310**	**547**	**4,191**

*Listed under the Endangered Species Act

**Significantly submerged

Table E–2. Marine mammal species identified in the February 2018 through February 2020 surveys in the South Atlantic Survey Area (SASA; counts include all of A51, part of A53, and part of CCA)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Seal	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**
species unknown	—	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	2
Whale	**—**	**1**	**2**	**2**	**—**	**—**	**—**	**—**	**1**	**1**	**—**	**—**	**1**	**1**	**1**	**1**	**6**
Humpback Whale*	—	1	2	2	—	—	—	—	1	1	—	—	1	1	1	1	6
Dolphin	**249**	**454**	**556**	**891**	**60**	**86**	**189**	**354**	**177**	**322**	**315**	**482**	**344**	**582**	**275**	**497**	**3,668**
Common Dolphin	7	17	19	31	—	—	—	—	—	—	—	—	17	34	—	—	82
Risso's Dolphin	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2
Atlantic White-sided Dolphin	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Rough-toothed dolphin	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Atlantic Spotted Dolphin	4	9	179	324	15	22	63	141	67	118	79	148	45	96	28	72	930
Clymene Dolphin	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Pantropical Spotted Dolphin	2	4	—	—	—	—	—	—	—	—	9	26	27	41	—	—	71
Bottlenose Dolphin	72	165	41	67	9	16	6	22	15	42	42	60	60	108	18	41	521
Harbor Porpoise	2	4	1	2	—	—	—	1	—	3	—	—	—	—	—	3	13
Bottlenose/Atlantic Spotted	11	28	89	185	—	—	18	45	19	55	26	51	14	51	23	54	469
species unknown	151	226	227	282	36	47	102	145	76	104	159	195	181	252	206	326	1,577
Unid. Mammal	**—**	**1**	**5**	**6**	**1**	**1**	**3**	**4**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**3**	**15**
species unknown	—	1	5	6	1	1	3	4	—	—	—	—	—	—	2	3	15
Totals	**249**	**456**	**563**	**899**	**61**	**87**	**194**	**360**	**178**	**323**	**315**	**482**	**345**	**583**	**278**	**501**	**3,691**

*Listed under the Endangered Species Act

**Significantly submerged

Table E–3. Marine mammal species identified in the February 2018 through February 2020 surveys in Areas A51 and A53

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Totals	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**

**Significantly submerged

Table E–4. Marine mammal species identified in the February 2018 through February 2020 surveys in the Charleston Call Area (CCA)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Dolphin	**—**	**—**	**—**	**—**	**—**	**—**	**8**	**21**	**—**	**—**	**2**	**7**	**—**	**1**	**3**	**7**	**36**
Atlantic Spotted Dolphin	—	—	—	—	—	—	6	13	—	—	—	1	—	—	1	3	17
Bottlenose Dolphin	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Harbor Porpoise	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2
Bottlenose/Atlantic Spotted	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	3
species unknown	—	—	—	—	—	—	2	4	—	—	2	6	—	1	2	2	13
Totals	**—**	**—**	**—**	**—**	**—**	**—**	**8**	**21**	**—**	**—**	**2**	**7**	**—**	**1**	**3**	**7**	**36**

**Significantly submerged

Table E–5. Marine mammal species identified in the February 2018 through February 2020 surveys in the Kitty Hawk (KH) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Whale	**2**	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**3**
North Atlantic Right Whale*	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Common Minke Whale	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
species unknown	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	1
Dolphin	**8**	**13**	**53**	**92**	**—**	**—**	**—**	**—**	**1**	**1**	**12**	**16**	**31**	**56**	**1**	**4**	**182**
Common Dolphin	1	4	36	73	—	—	—	—	—	—	—	—	5	26	—	—	103
Risso's Dolphin	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Atlantic Spotted Dolphin	—	—	—	—	—	—	—	—	—	—	10	14	—	—	1	4	18
species unknown	6	8	17	19	—	—	—	—	1	1	2	2	26	30	—	—	60
Totals	**10**	**15**	**53**	**92**	**—**	**—**	**—**	**—**	**2**	**2**	**12**	**16**	**31**	**56**	**1**	**4**	**185**

*Listed under the Endangered Species Act

**Significantly submerged

Table E–6. Marine mammal species identified in the February 2018 through February 2020 surveys in the Wilmington West (WW) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Dolphin	**—**	**—**	**11**	**19**	**1**	**2**	**—**	**—**	**—**	**1**	**—**	**—**	**6**	**11**	**13**	**18**	**51**
Atlantic Spotted Dolphin	—	—	2	6	—	—	—	—	—	—	—	—	—	—	7	10	16
Bottlenose Dolphin	—	—	—	—	1	2	—	—	—	—	—	—	4	7	—	—	9
Bottlenose/Atlantic Spotted	—	—	1	4	—	—	—	—	—	1	—	—	—	—	3	4	9
species unknown	—	—	8	9	—	—	—	—	—	—	—	—	2	4	3	4	17
Totals	**—**	**—**	**11**	**19**	**1**	**2**	**—**	**—**	**—**	**1**	**—**	**—**	**6**	**11**	**13**	**18**	**51**

**Significantly submerged

Table E–7. Marine mammal species identified in the February 2018 through February 2020 surveys in the Wilmington East (WE) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Dolphin	**3**	**8**	**4**	**6**	**7**	**13**	**5**	**8**	**8**	**11**	**19**	**23**	**1**	**4**	**4**	**5**	**78**
Atlantic Spotted Dolphin	2	6	1	2	5	11	—	—	2	3	3	4	—	—	—	—	26
Bottlenose Dolphin	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	1	2
Bottlenose/Atlantic Spotted	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
species unknown	1	1	3	4	2	2	5	8	6	8	16	19	1	3	3	4	49
Totals	**3**	**8**	**4**	**6**	**7**	**13**	**5**	**8**	**8**	**11**	**19**	**23**	**1**	**4**	**4**	**5**	**78**

**Significantly submerged

Table E–8. Marine mammal species identified in the February 2018 through February 2020 surveys in the Grand Strand Call Area (GSCA; counts include part of WW)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Whale	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**1**	**1**
Humpback Whale*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1
Dolphin	**15**	**22**	**28**	**48**	**1**	**2**	**2**	**7**	**14**	**19**	**30**	**36**	**7**	**14**	**10**	**11**	**159**
Atlantic Spotted Dolphin	14	20	—	5	—	—	—	—	—	—	—	—	—	—	—	—	25
Pantropical Spotted Dolphin	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Bottlenose Dolphin	—	1	—	2	—	—	2	7	4	6	—	—	7	13	—	—	29
Bottlenose/Atlantic Spotted	—	—	7	14	—	—	—	—	4	6	—	—	—	—	—	—	20
species unknown	1	1	21	26	1	2	—	—	6	7	30	36	—	1	10	11	84
Unid. Mammal	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**1**	**2**	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**3**
species unknown	—	—	—	—	—	—	1	1	2	2	—	—	—	—	—	—	3
Totals	**15**	**22**	**28**	**48**	**1**	**2**	**3**	**8**	**16**	**21**	**30**	**36**	**7**	**14**	**11**	**12**	**163**

*Listed under the Endangered Species Act

**Significantly submerged

E.2 Species Composition and Density (per km^2) by Survey Area for Each Survey

Table E–9. Density (per km^2) of marine mammal species for each area during the February 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale											
North Atlantic Right Whale*						0.0136				0.0026	0.0004
Common Minke Whale						0.0136				0.0026	0.0004
Humpback Whale*	0.0005				0.0005						0.0004
Season Total	**0.0005**				**0.0005**	**0.0272**				**0.0052**	0.0013
Dolphin											
Common Dolphin	0.0089				0.0087	0.0543				0.0104	0.0090
Risso's Dolphin	0.0005				0.0005	0.0136				0.0026	0.0009
Atlantic Spotted Dolphin	0.0047				0.0046			0.0766	0.1006	0.0674	0.0150
Pantropical Spotted Dolphin	0.0021				0.0020						0.0017
Bottlenose Dolphin	0.0861				0.0846			0.0128	0.0050	0.0052	0.0714
Harbor Porpoise	0.0021				0.0020						0.0017
Bottlenose/Atlantic Spotted	0.0146				0.0143						0.0120
species unknown	0.1179				0.1158	0.1087		0.0128	0.0050	0.0259	0.1010
Season Total	**0.2369**				**0.2327**	**0.1766**		**0.1021**	**0.1107**	**0.1114**	**0.2126**
Unid. Mammal											
species unknown	0.0005				0.0005						0.0004
Totals	**0.2380**	**—**	**—**	**—**	**0.2337**	**0.2038**	**—**	**0.1021**	**0.1107**	**0.1166**	**0.2143**

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Table E–10. Density (per km^2) of marine mammal species for each area during the February 2020 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale											
Humpback Whale*	0.0010				0.0010						0.0009
Season Total	**0.0010**				**0.0010**						**0.0009**
Dolphin											
Common Dolphin	0.0163				0.0160	0.9946				0.1895	0.0447
Atlantic Spotted Dolphin	0.1700				0.1669		0.1703	0.0256	0.0252	0.0337	0.1449
Pantropical Spotted Dolphin									0.0005	0.0026	0.0004
Bottlenose Dolphin	0.0352				0.0345				0.0101	0.0052	0.0297
Harbor Porpoise	0.0010				0.0010						0.0009
Bottlenose/Atlantic Spotted	0.0971				0.0953		0.1135		0.0705	0.0467	0.0873
species unknown	0.1480				0.1453	0.2589	0.2555	0.0512	0.1310	0.1505	0.1462
Season Total	**0.4675**				**0.4590**	**1.2534**	**0.5393**	**0.0768**	**0.2418**	**0.4283**	**0.4539**
Unid. Mammal											
species unknown	0.0031				0.0031						0.0026
Totals	**0.4717**	**—**	**—**	**—**	**0.4632**	**1.2534**	**0.5393**	**0.0768**	**0.2418**	**0.4283**	**0.4574**

*Listed under the Endangered Species Act

Table E–11. Density (per km^2) of marine mammal species for each area during the May/June 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Dolphin											
Atlantic White-sided Dolphin	0.0006				0.0006						0.0005
Atlantic Spotted Dolphin	0.0127				0.0124			0.1404		0.0282	0.0153
Bottlenose Dolphin	0.0092				0.0090		0.0568			0.0051	0.0083
species unknown	0.0271				0.0266			0.0255	0.0099	0.0103	0.0236
Season Total	**0.0496**				**0.0486**		**0.0568**	**0.1659**	**0.0099**	**0.0436**	**0.0477**
Unid. Mammal											
species unknown	0.0006				0.0006						0.0005
Totals	**0.0502**	**—**	**—**	**—**	**0.0492**	**—**	**0.0568**	**0.1659**	**0.0099**	**0.0436**	**0.0482**

Table E–12. Density (per km^2) of marine mammal species for each area during the May 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Seal											
species unknown	0.0010				0.0010						0.0009
Season Total	**0.0010**				**0.0010**						**0.0009**
Dolphin											
Atlantic Spotted Dolphin	0.0740			0.4293	0.0742						0.0613
Bottlenose Dolphin	0.0115			0.0330	0.0118				0.0317	0.0172	0.0128
Harbor Porpoise	0.0005				0.0005						0.0004
Bottlenose/Atlantic Spotted	0.0236			0.0991	0.0247						0.0204
species unknown	0.0761			0.1321	0.0762			0.1024		0.0196	0.0664
Season Total	**0.1857**			**0.6935**	**0.1875**			0.1024	0.0317	0.0368	**0.1613**
Unid. Mammal											
species unknown	0.0021				0.0021				0.0045	0.0025	0.0021
Totals	**0.1889**	**—**	**—**	**0.6935**	**0.1906**	**—**	**—**	**0.1024**	**0.0362**	**0.0392**	**0.1643**

Table E–13. Density (per km^2) of marine mammal species for each area during the October 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale											
Humpback Whale*	0.0006				0.0005						0.0004
species unknown						0.0136				0.0024	0.0004
Season Total	**0.0006**				**0.0005**	**0.1360**				**0.0024**	**0.0009**
Dolphin											
Atlantic Spotted Dolphin	0.0653				0.0640			0.0383		0.0072	0.0535
Bottlenose Dolphin	0.0232				0.0228				0.0266	0.0143	0.0212
Harbor Porpoise	0.0017				0.0016						0.0013
Bottlenose/Atlantic Spotted	0.0304				0.0298		0.0240		0.0266	0.0167	0.0274
species unknown	0.0575				0.0564	0.0136		0.1021	0.0311	0.0382	0.0531
Season Total	**0.1781**				**0.1747**	**0.0136**	**0.0240**	**0.1404**	**0.0844**	**0.0764**	**0.1565**
Unid. Mammal											
species unknown									0.0089	0.0048	0.0009
Totals	**0.1786**	**—**	**—**	**—**	**0.1752**	**0.0272**	**0.0240**	**0.1404**	**0.0933**	**0.0836**	**0.1583**

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Table E–14. Density (per km^2) of marine mammal species for each area during the September 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Dolphins											
Rough-toothed dolphin	0.0005				0.0005						0.0004
Atlantic Spotted Dolphin	0.0772			0.0330	0.0763	0.1907		0.0512		0.0468	0.0715
Clymene Dolphin	0.0005				0.0005						0.0004
Pantropical Spotted Dolphin	0.0136				0.0133						0.0111
Bottlenose Dolphin	0.0313				0.0307						0.0257
Bottlenose/Atlantic Spotted	0.0266				0.0261						0.0218
species unknown	0.1017			0.1982	0.1030	0.0272		0.2433	0.1818	0.1482	0.1104
Totals	**0.2515**	**—**	**—**	**0.2312**	**0.2505**	**0.2180**	**—**	**0.2946**	**0.1818**	**0.1949**	**0.2414**

Table E–15. Density (per km^2) of marine mammal species for each area during the December 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale											
Humpback Whale*	0.0005				0.0005						0.0004
Season Total	**0.0005**				**0.0005**						**0.0004**
Dolphin											
Common Dolphin	0.0178				0.0174	0.3534				0.0654	0.0256
Atlantic Spotted Dolphin	0.0501				0.0492						0.0409
Pantropical Spotted Dolphin	0.0214				0.0210						0.0175
Bottlenose Dolphin	0.0564				0.0554		0.1893		0.0624	0.0478	0.0541
Bottlenose/Atlantic Spotted	0.0266				0.0261			0.0128		0.0025	0.0221
species unknown	0.1316			0.0329	0.1292	0.4077	0.1082	0.0383	0.0048	0.0956	0.1235
Season Total	**0.3039**			**0.0329**	**0.2984**	**0.7611**	**0.2975**	**0.0511**	**0.0672**	**0.2114**	**0.2837**
Totals	**0.3044**	**—**	**—**	**0.0329**	**0.2989**	**0.7611**	**0.2975**	**0.0511**	**0.0672**	**0.2114**	**0.2841**

*Listed under the Endangered Species Act

Table E–16. Density (per km^2) of marine mammal species for each area during the December 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale											
Humpback Whale	0.0005				0.0005				0.0096	0.0037	0.0009
Season Total	**0.0005**				**0.0005**				0.0096	0.0037	**0.0009**
Dolphin											
Risso's Dolphin	0.0005				0.0005						0.0005
Atlantic Spotted Dolphin	0.0377			0.0991	0.0386	0.0545	0.6435			0.0516	0.0402
Bottlenose Dolphin	0.0215				0.0211			0.0128		0.0037	0.0190
Harbor Porpoise	0.0016			0.0661	0.0026						0.0023
Bottlenose/Atlantic Spotted	0.0283				0.0278		0.2574			0.0147	0.0262
species unknown	0.1708			0.0661	0.1688		0.2574	0.0512	0.1057	0.0701	0.1567
Season Total	**0.2605**			0.2312	**0.2593**	0.0545	1.1583	0.0640	0.1057	**0.1401**	**0.2447**
Unid. Mammal											
species unknown	0.0016				0.0015						0.0014
Totals	**0.2626**	**—**	**—**	**0.2312**	**0.2614**	**0.0545**	**1.1583**	**0.0640**	**0.1153**	**0.1438**	**0.2470**

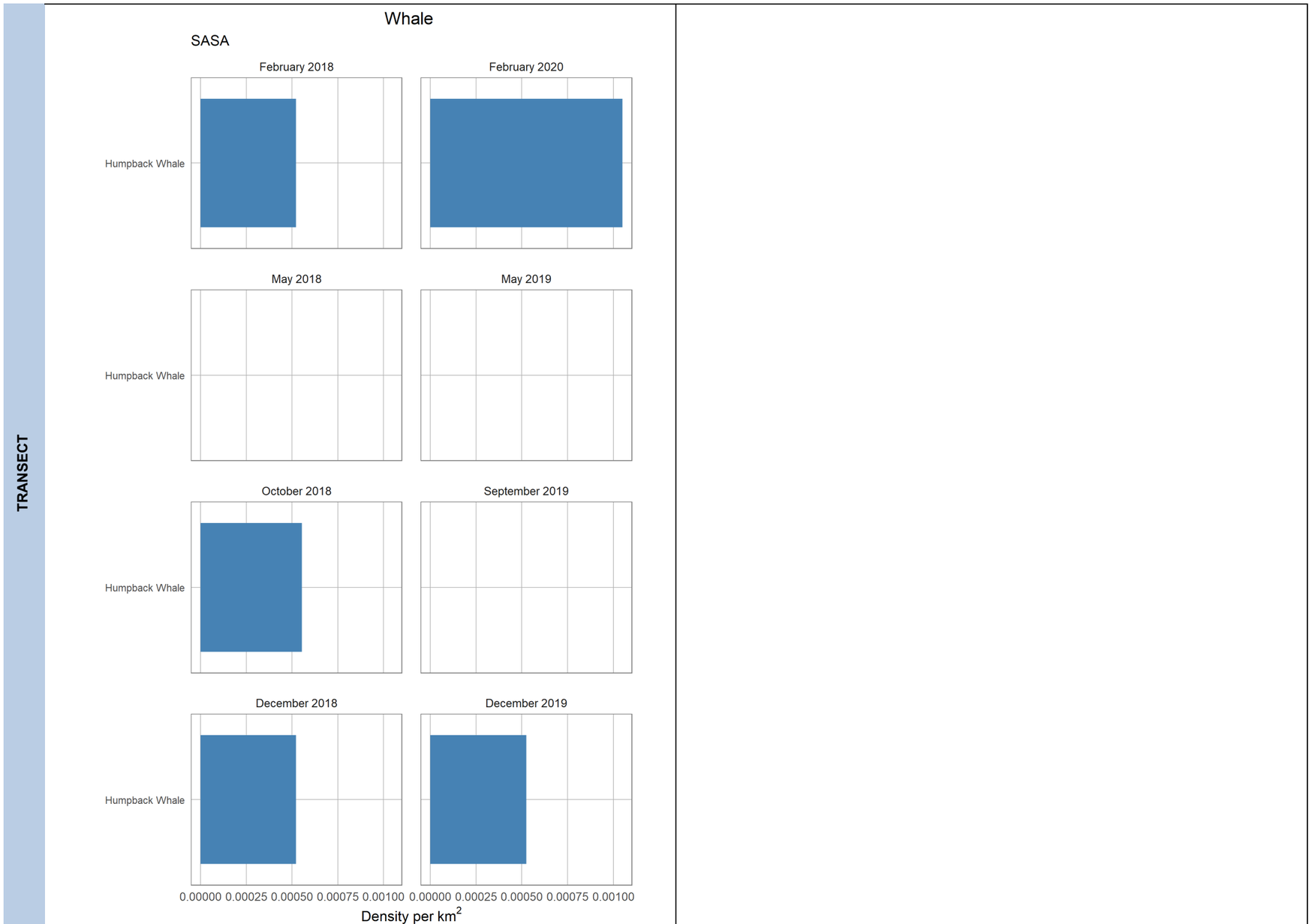

Figure E–1. **Density (per km^2) of whale species encountered during the February 2018 through February 2020 surveys for each area by survey (figure continued below)**
Note: X-axes are scaled according to the maximum density for each area.

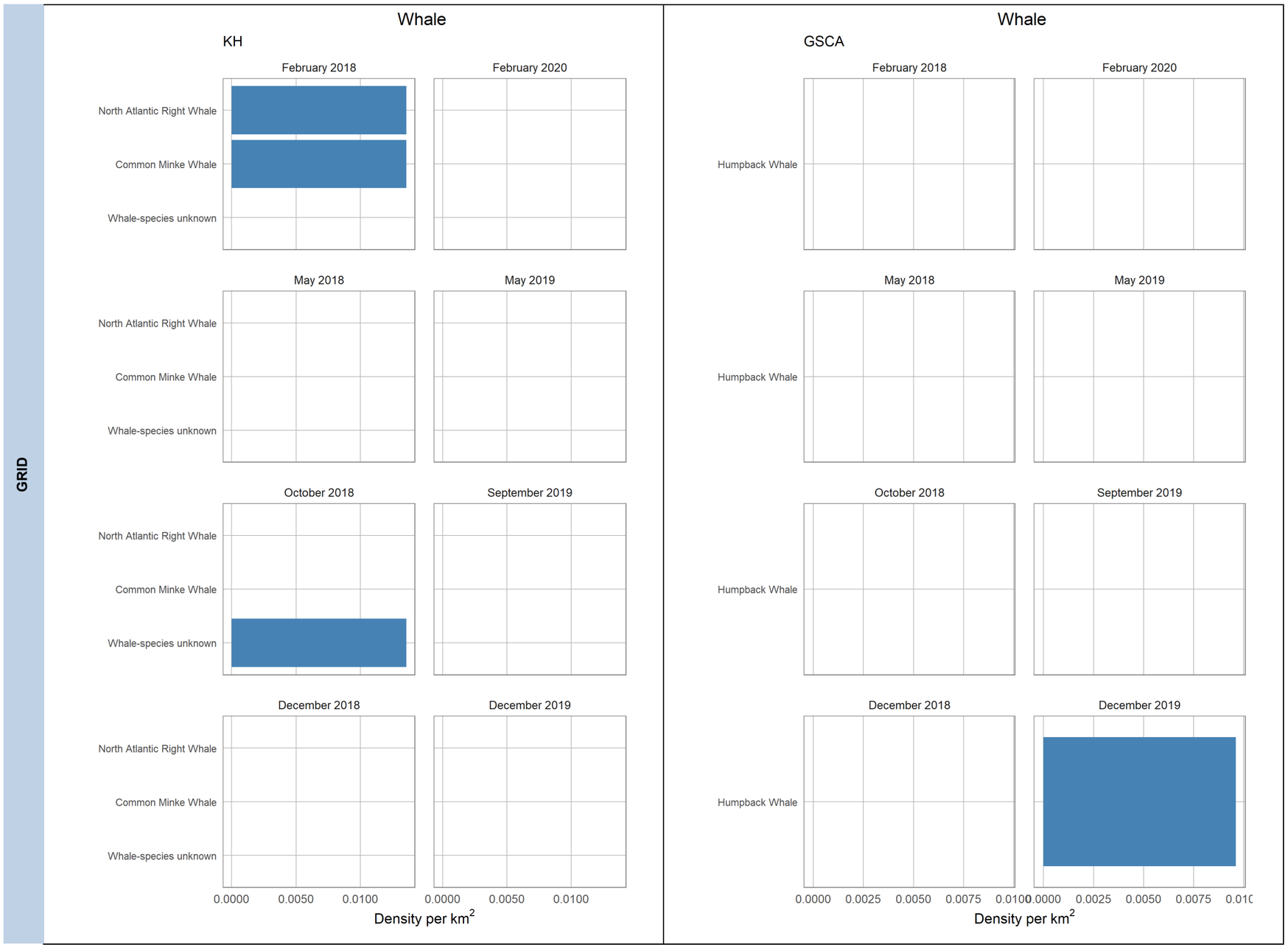

Figure E–1. (Continued)



Figure E–2. **Density (per km^2) of dolphin species encountered during the February 2018 through February 2020 surveys for each area by survey (figure continued below)**
Note: X-axes are scaled according to the maximum density for each area.

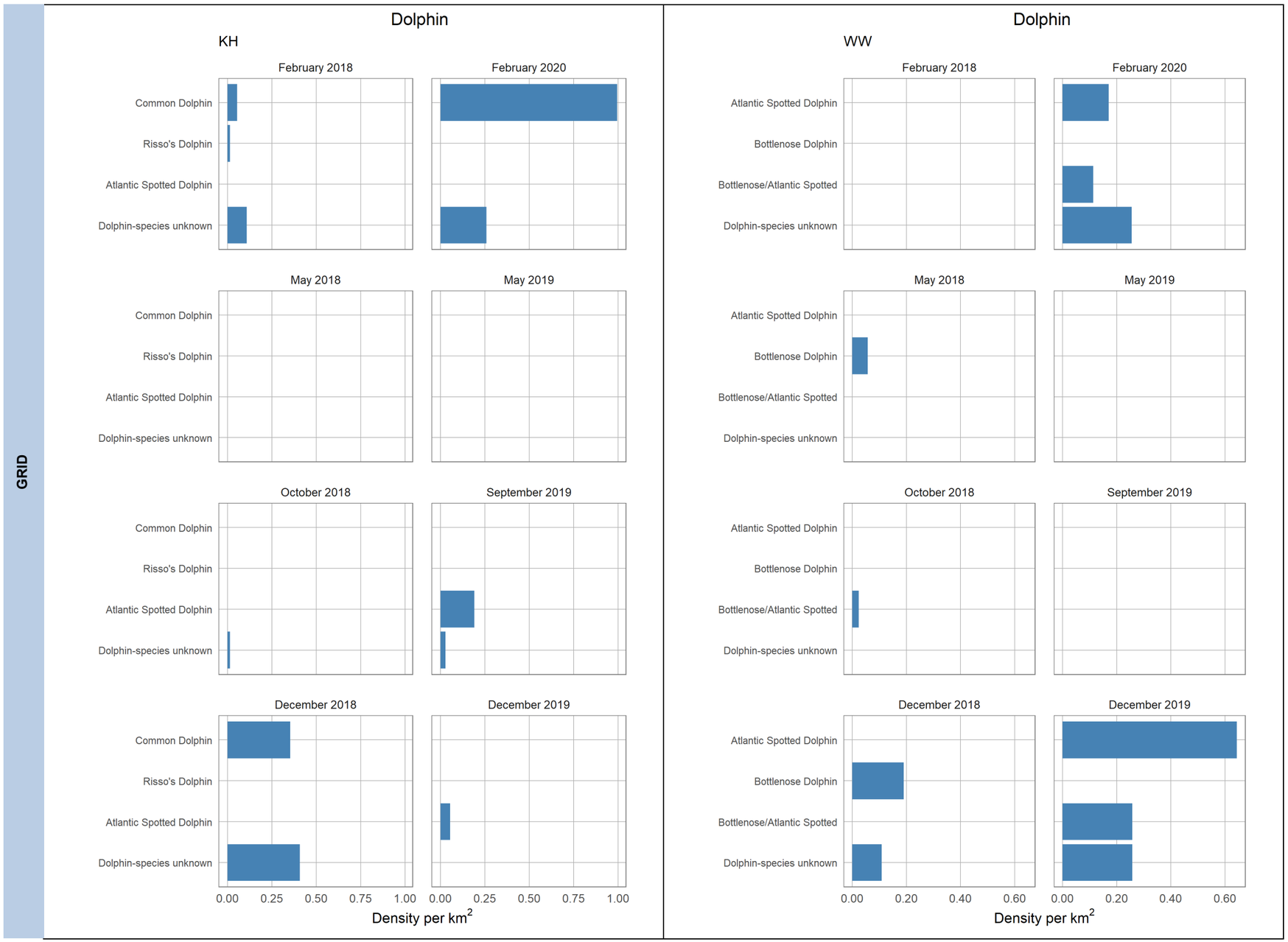

Figure E–2. (Continued)

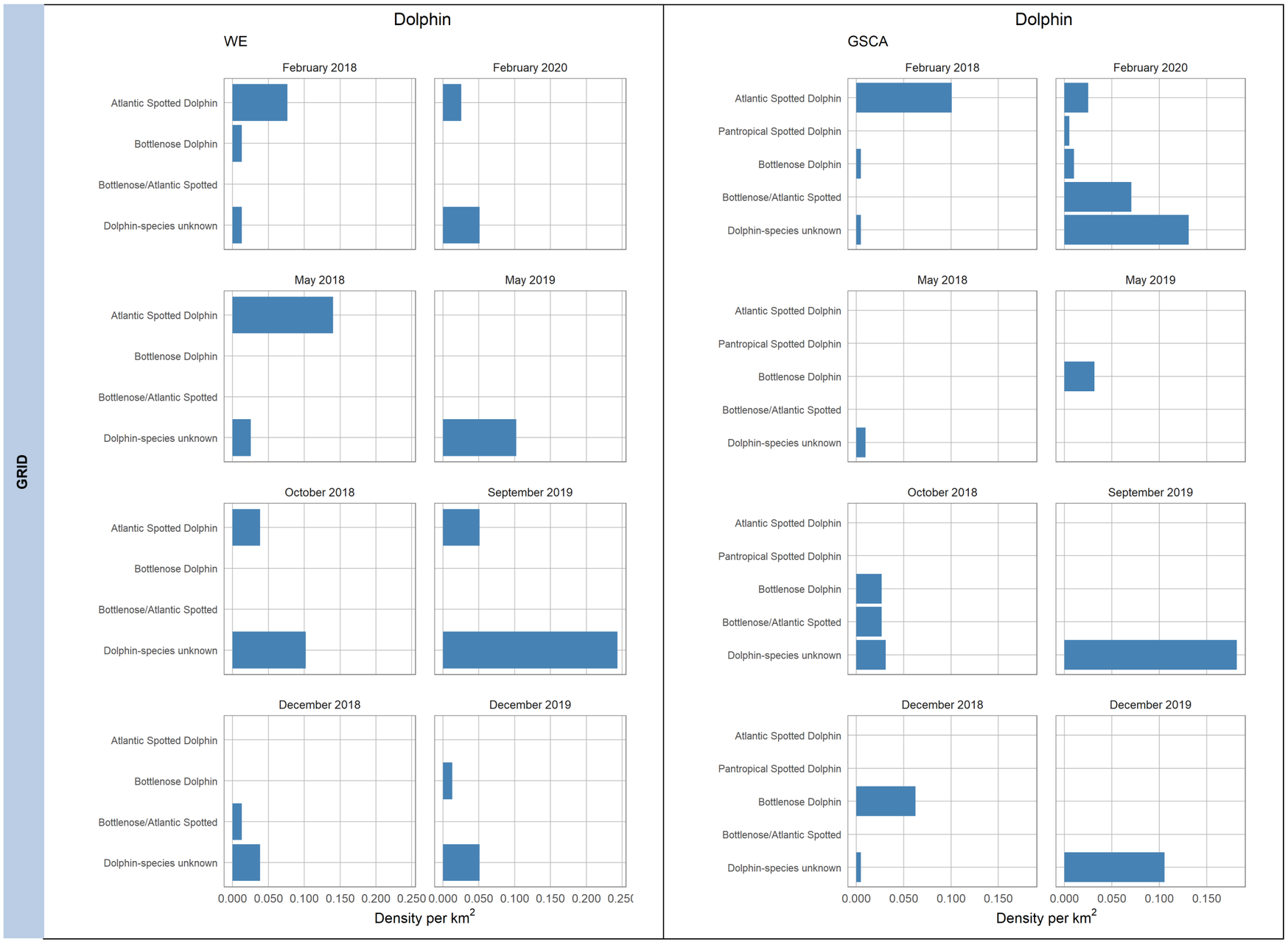

Figure E–2. (Continued)

E.3 Marine Mammal Spatial Distribution Maps

E.3.1 Seals

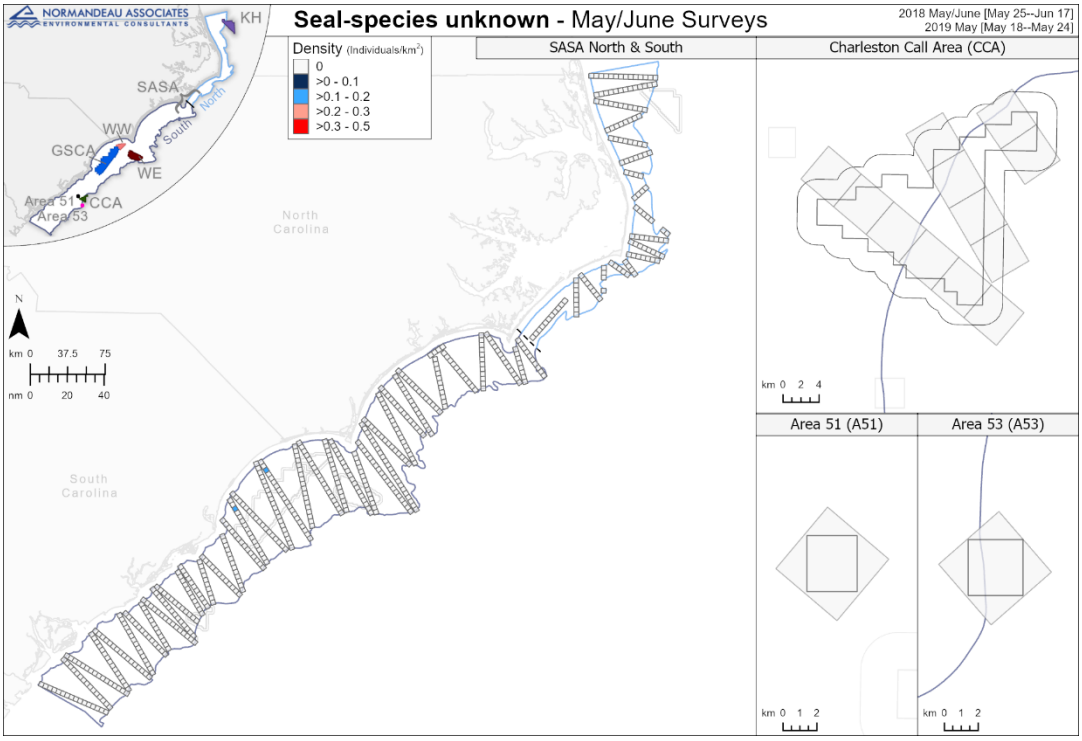

Figure E–3. Spatial distribution of seal-species unknown during the May/June surveys in all areas

E.3.2 Whales

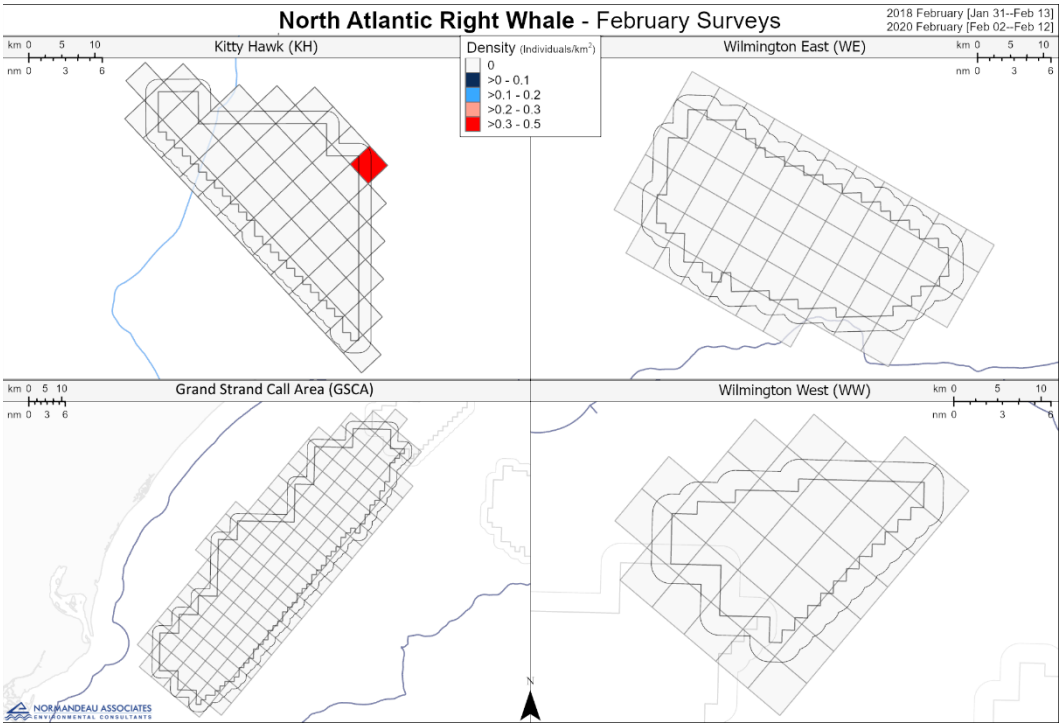

Figure E–4. Spatial distribution of North Atlantic right whales during the February surveys in all areas

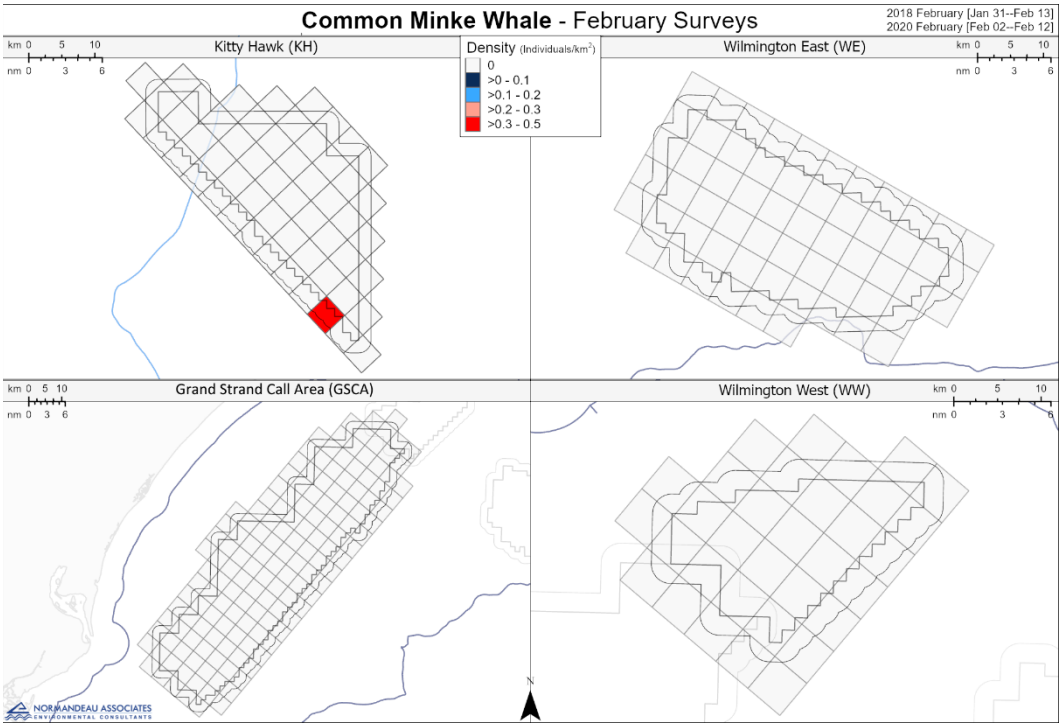

Figure E–5. Spatial distribution of common minke whales during the February surveys in all areas

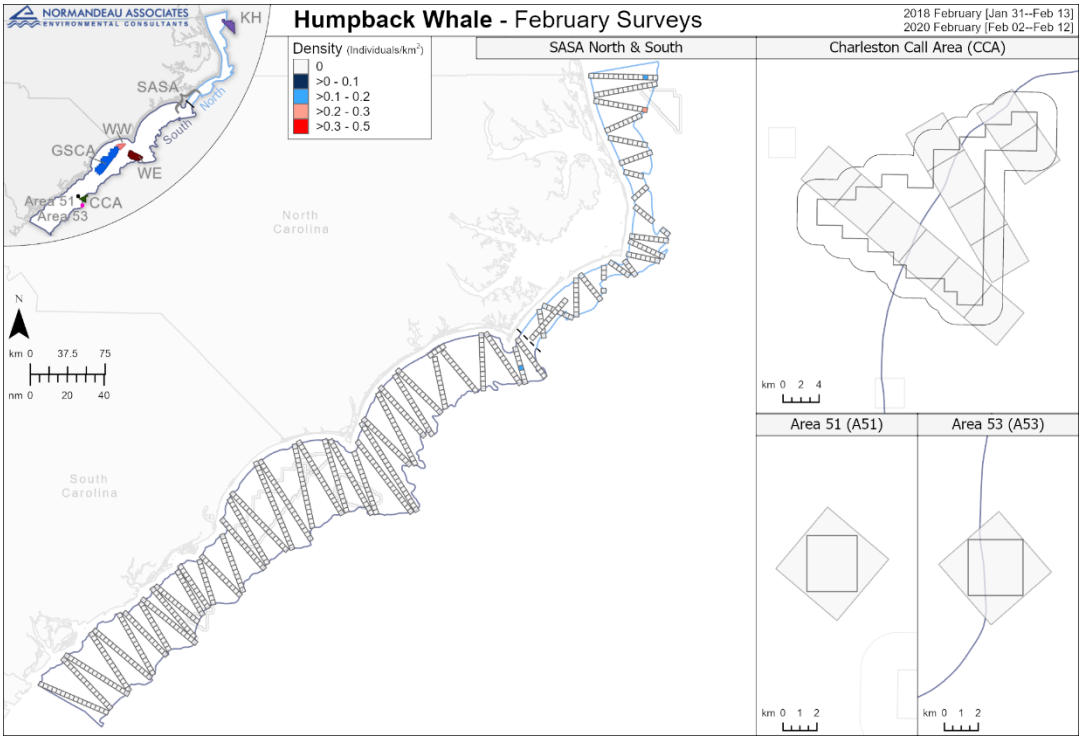

Figure E–6. Spatial distribution of humpback whales during the February surveys in all areas

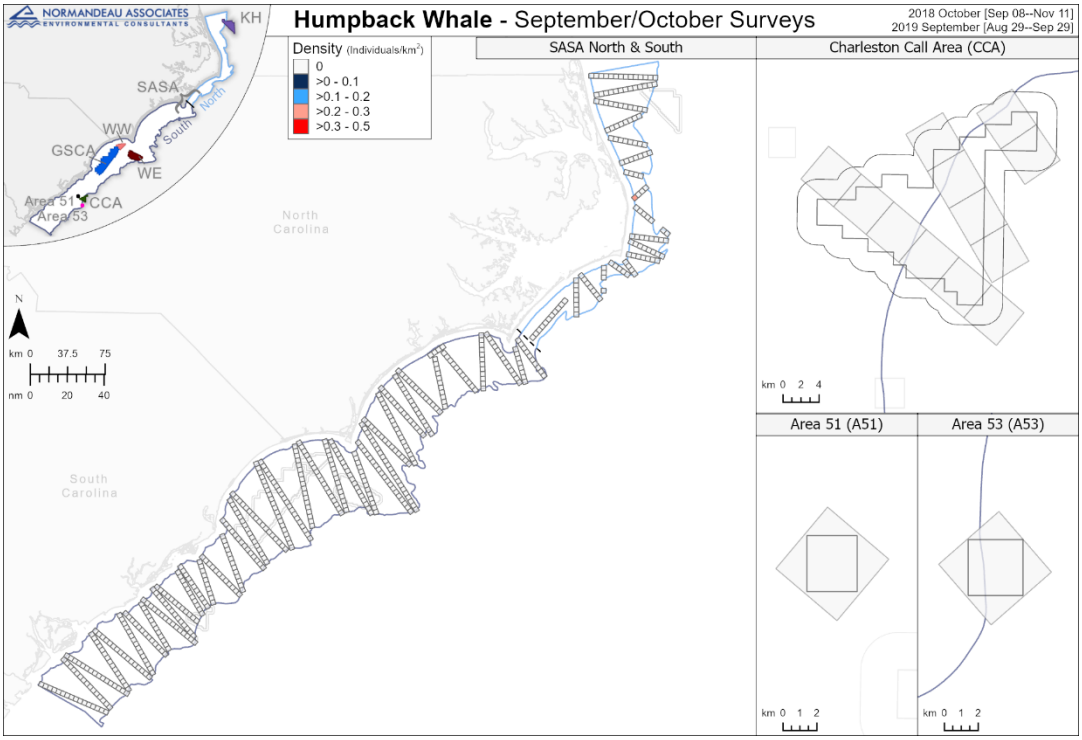

Figure E–7. Spatial distribution of humpback whales during the September/ October surveys in all areas

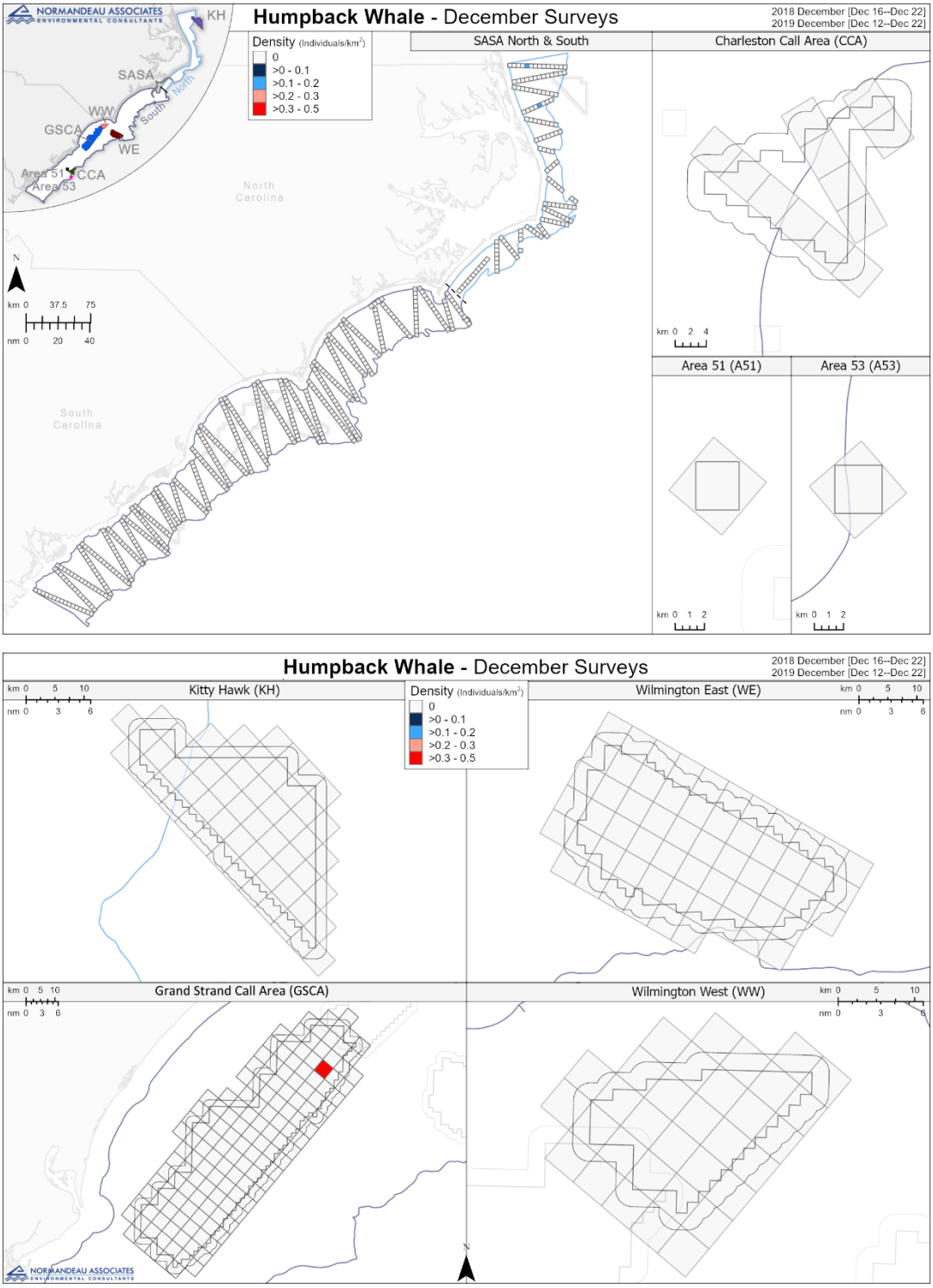

Figure E–8. Spatial distribution of humpback whales during the December surveys in all areas

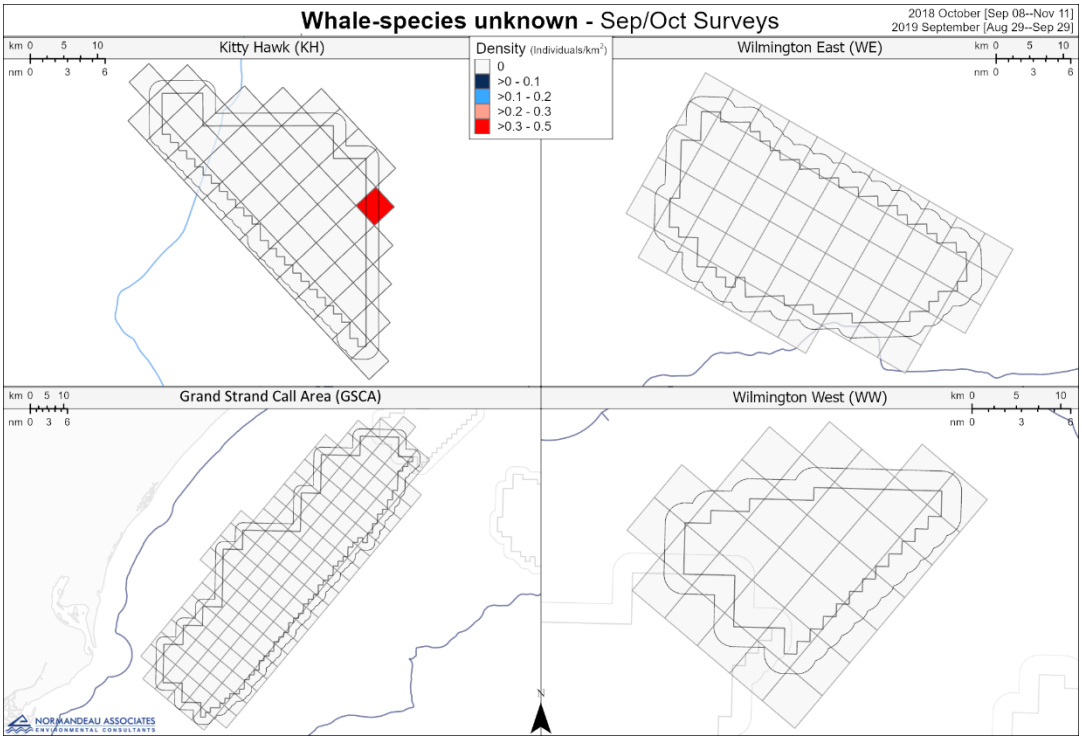

Figure E–9. Spatial distribution of whale-species unknown during the September/ October surveys in all areas

E.3.3 Dolphins

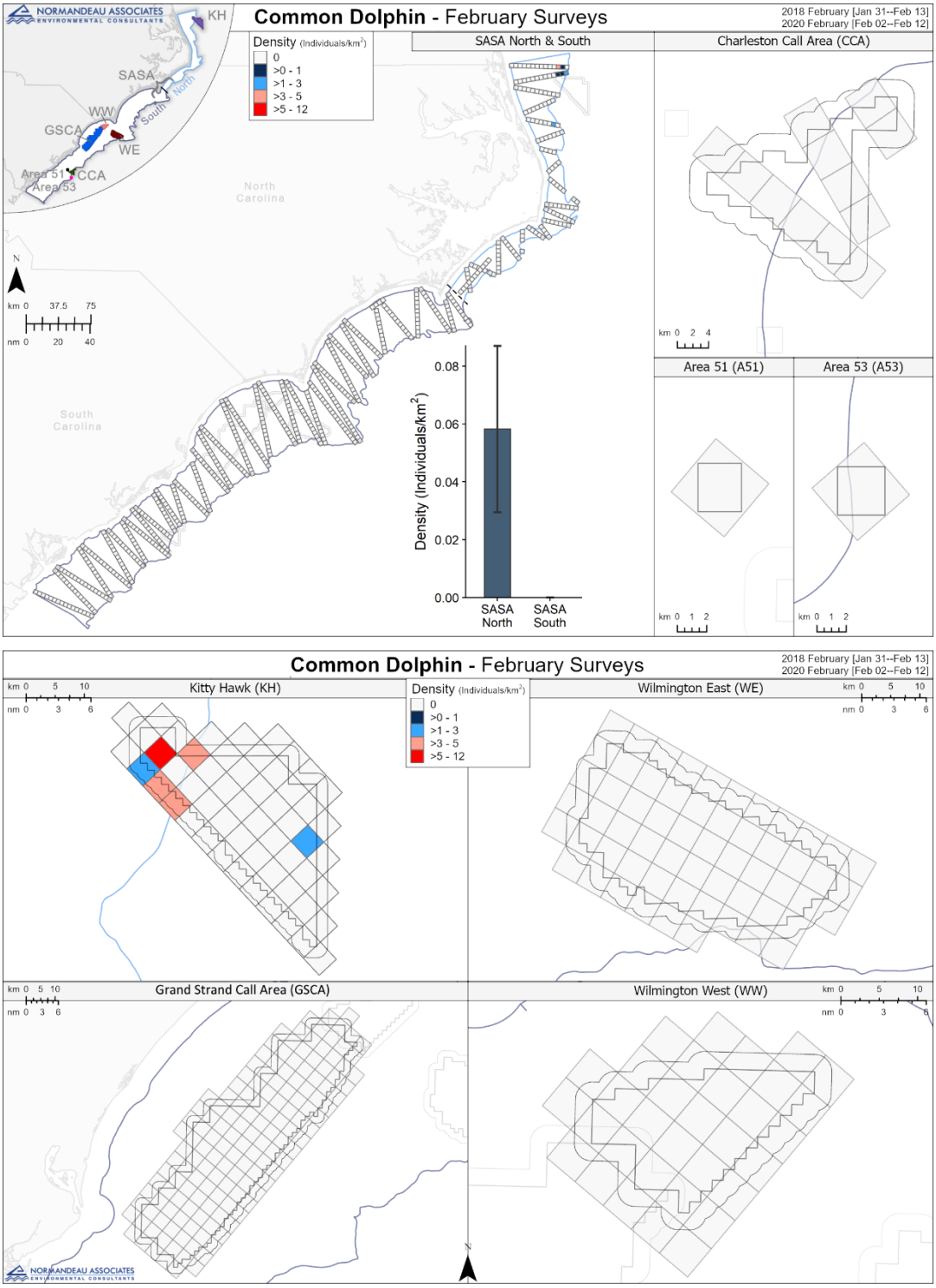

Figure E–10. Spatial distribution of common dolphins during the February surveys in all areas

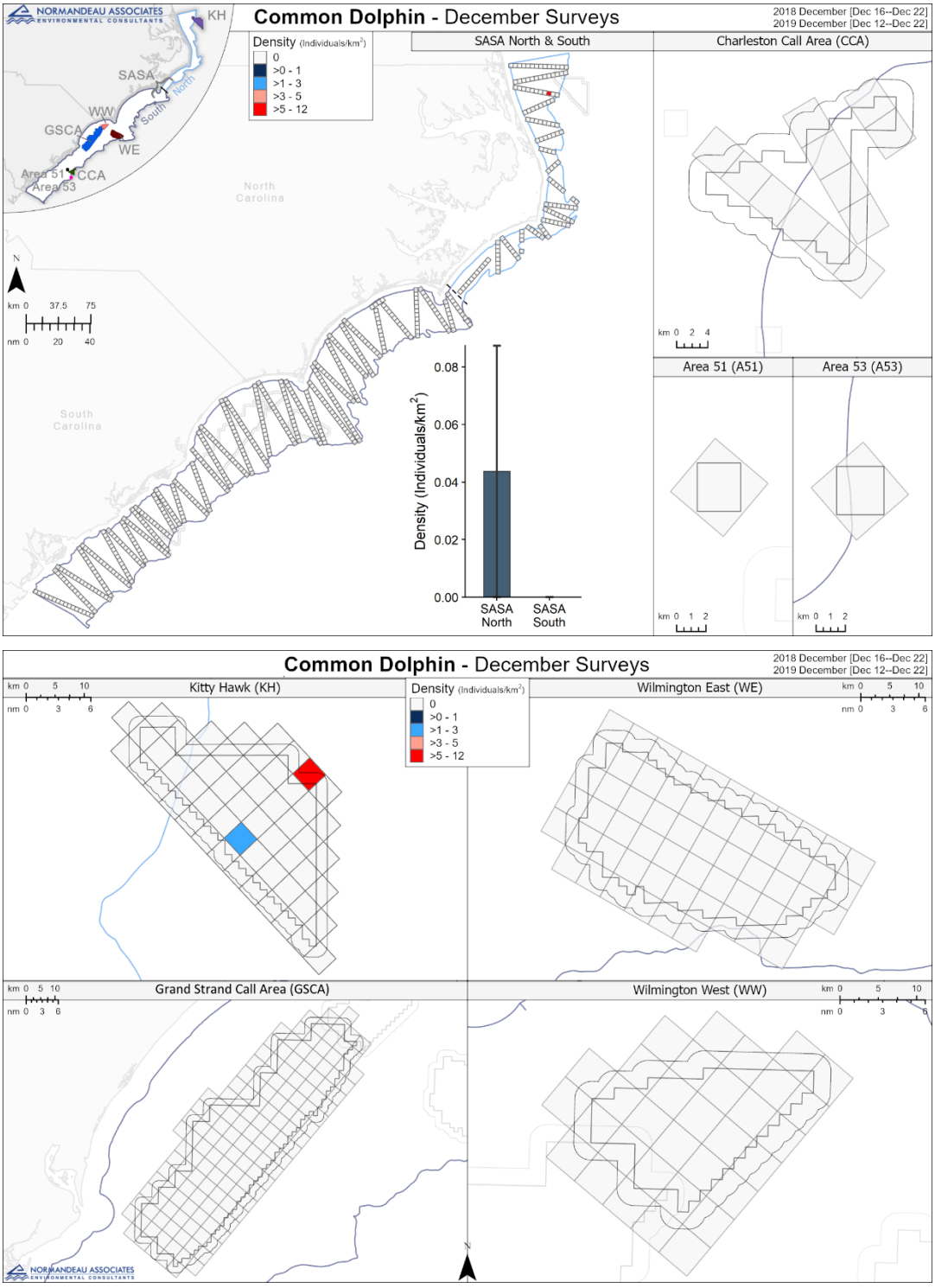

Figure E–11. Spatial distribution of common dolphins during the December surveys in all areas

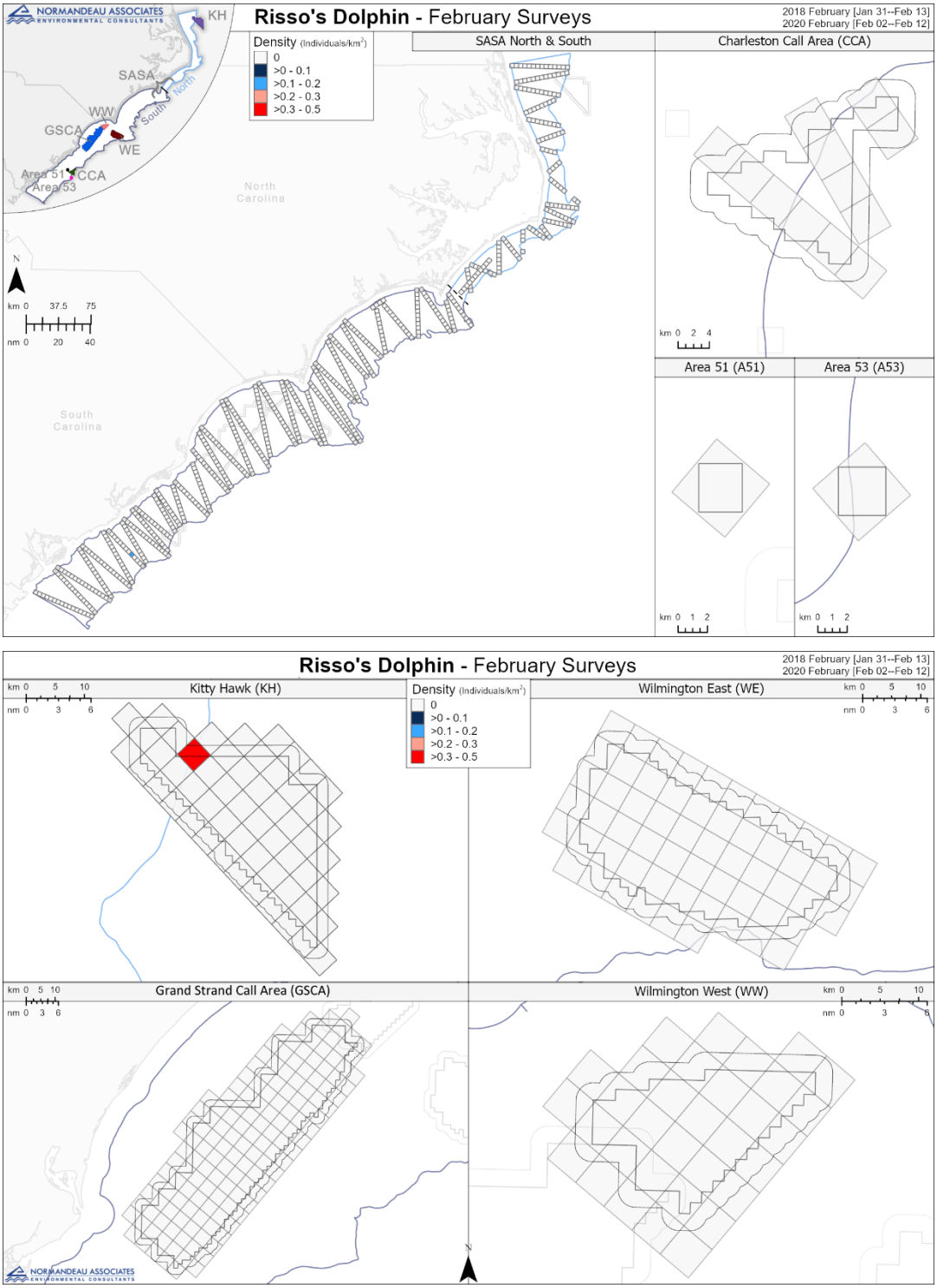

Figure E–12. Spatial distribution of Risso's dolphins during the February surveys in all areas

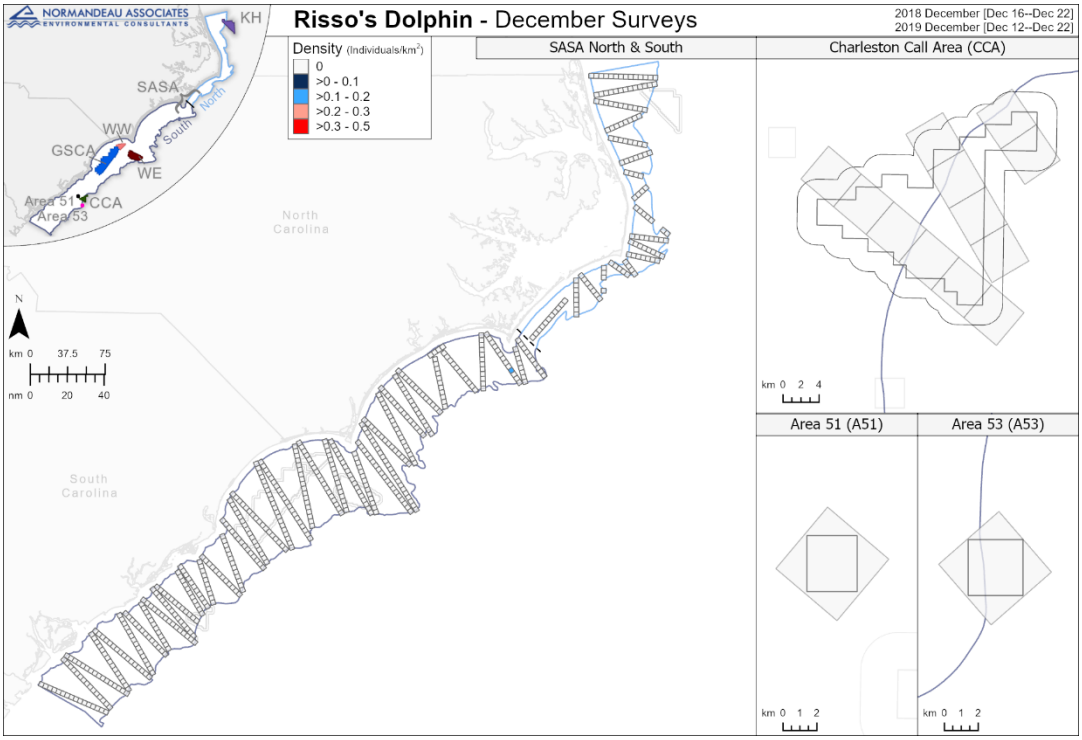

Figure E–13. Spatial distribution of Risso's dolphins during the December surveys in all areas

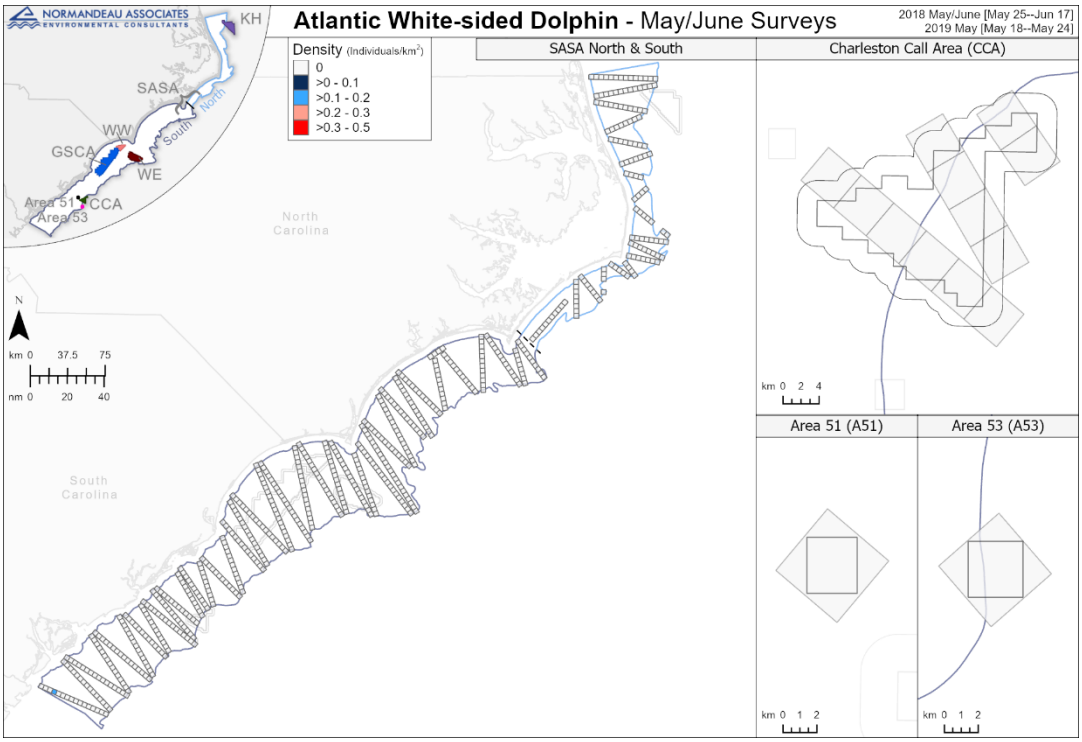

Figure E–14. Spatial distribution of Atlantic white-sided dolphins during the May/June surveys in all areas

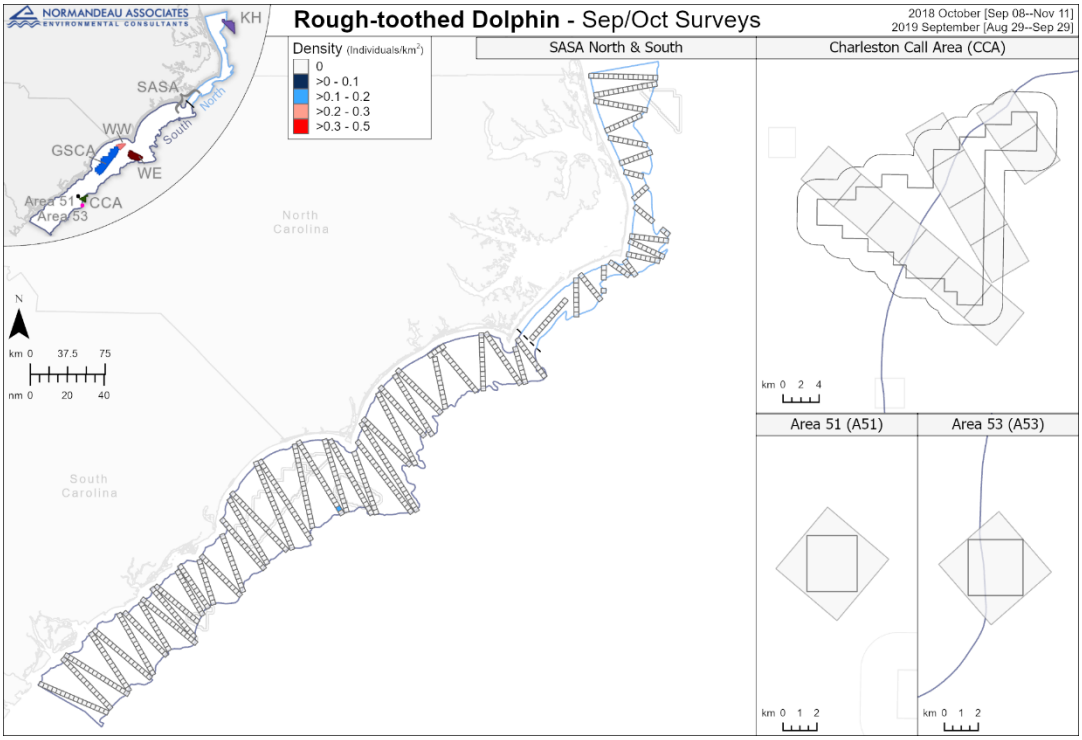

Figure E–15. Spatial distribution of rough-toothed dolphins during the September/ October surveys in all areas

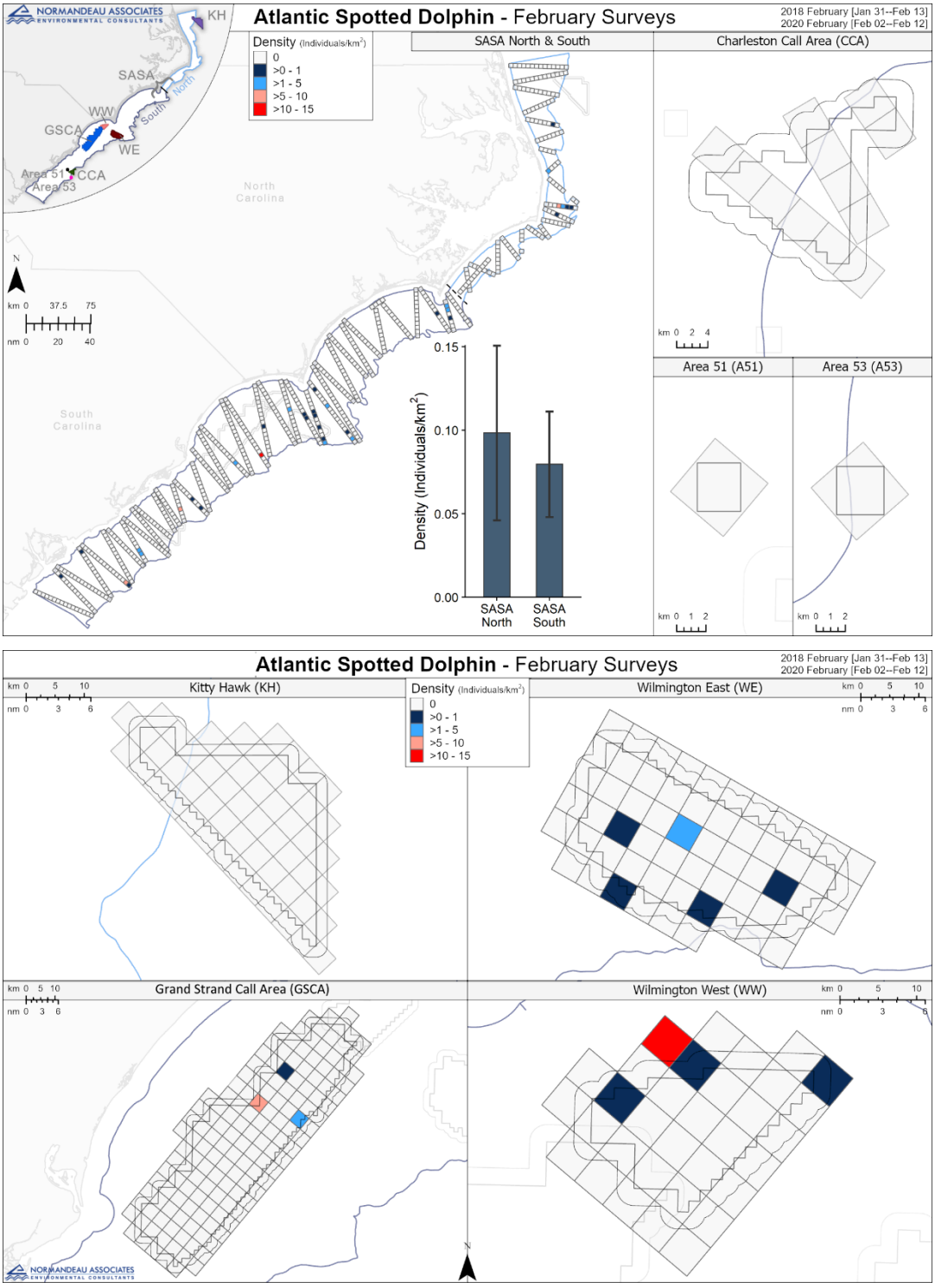

Figure E–16. Spatial distribution of Atlantic spotted dolphins during the February surveys in all areas

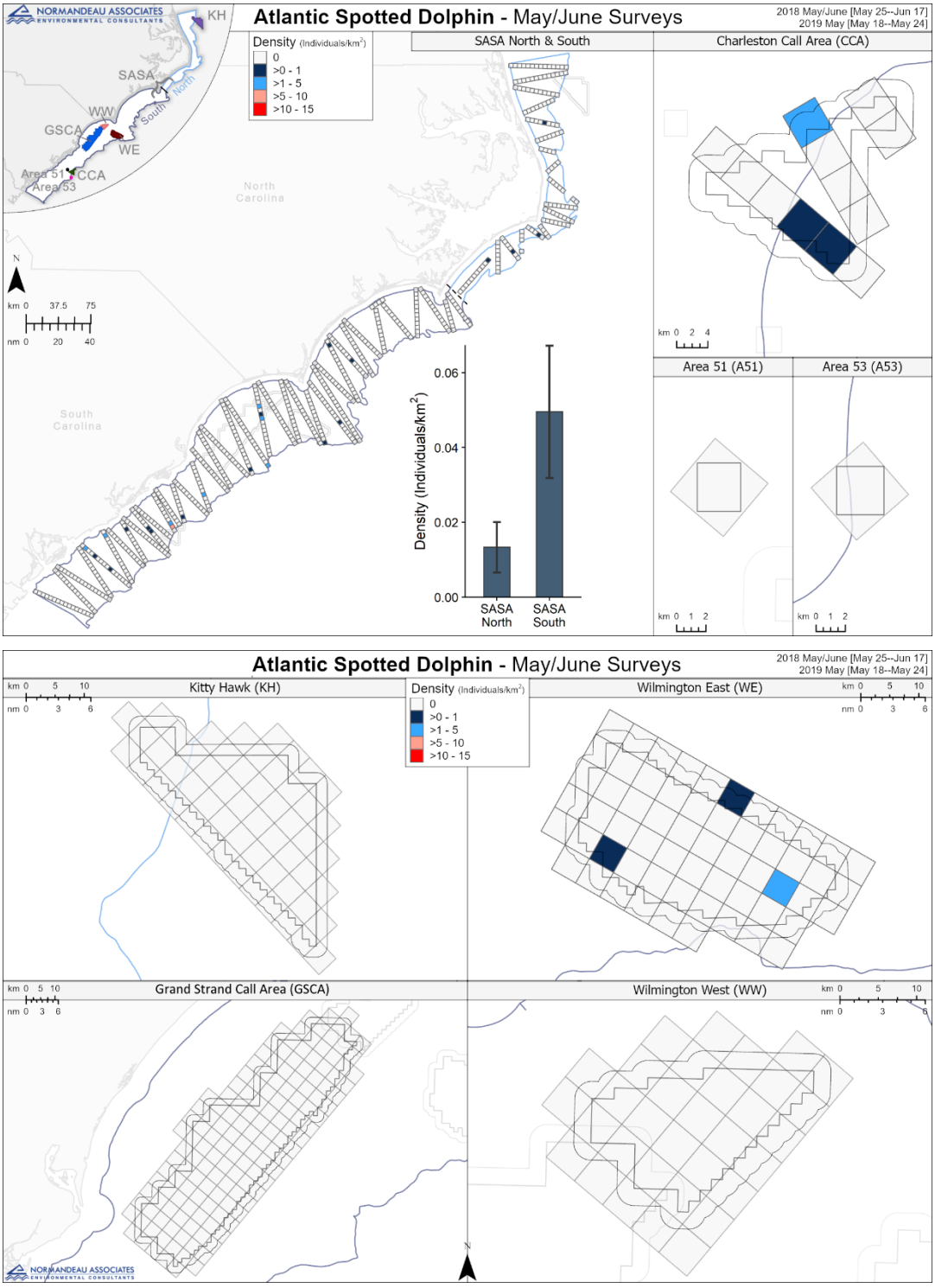

Figure E–17. Spatial distribution of Atlantic spotted dolphins during the May/June surveys in all areas

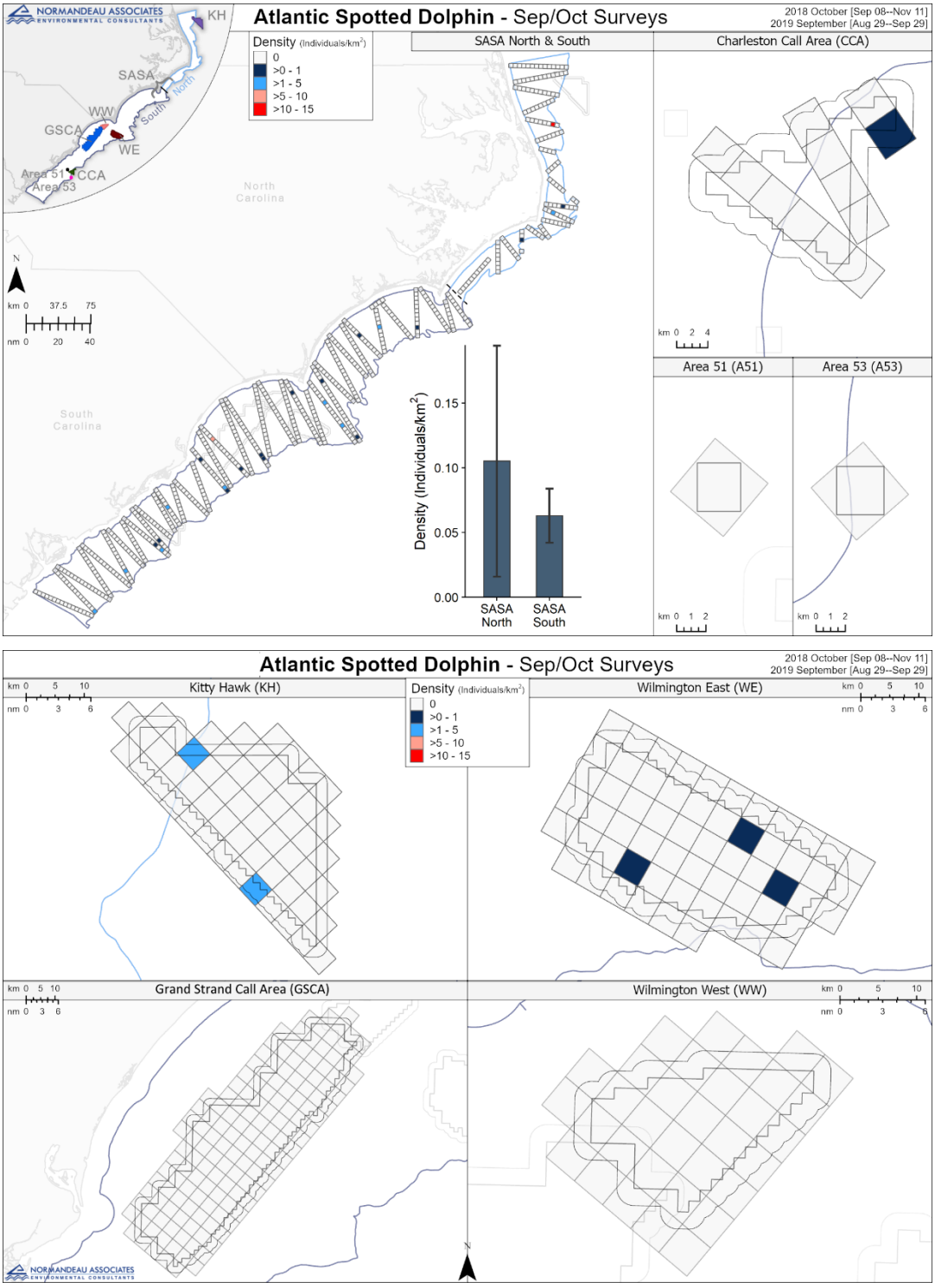

Figure E–18. Spatial distribution of Atlantic spotted dolphins during the September/December surveys in all areas

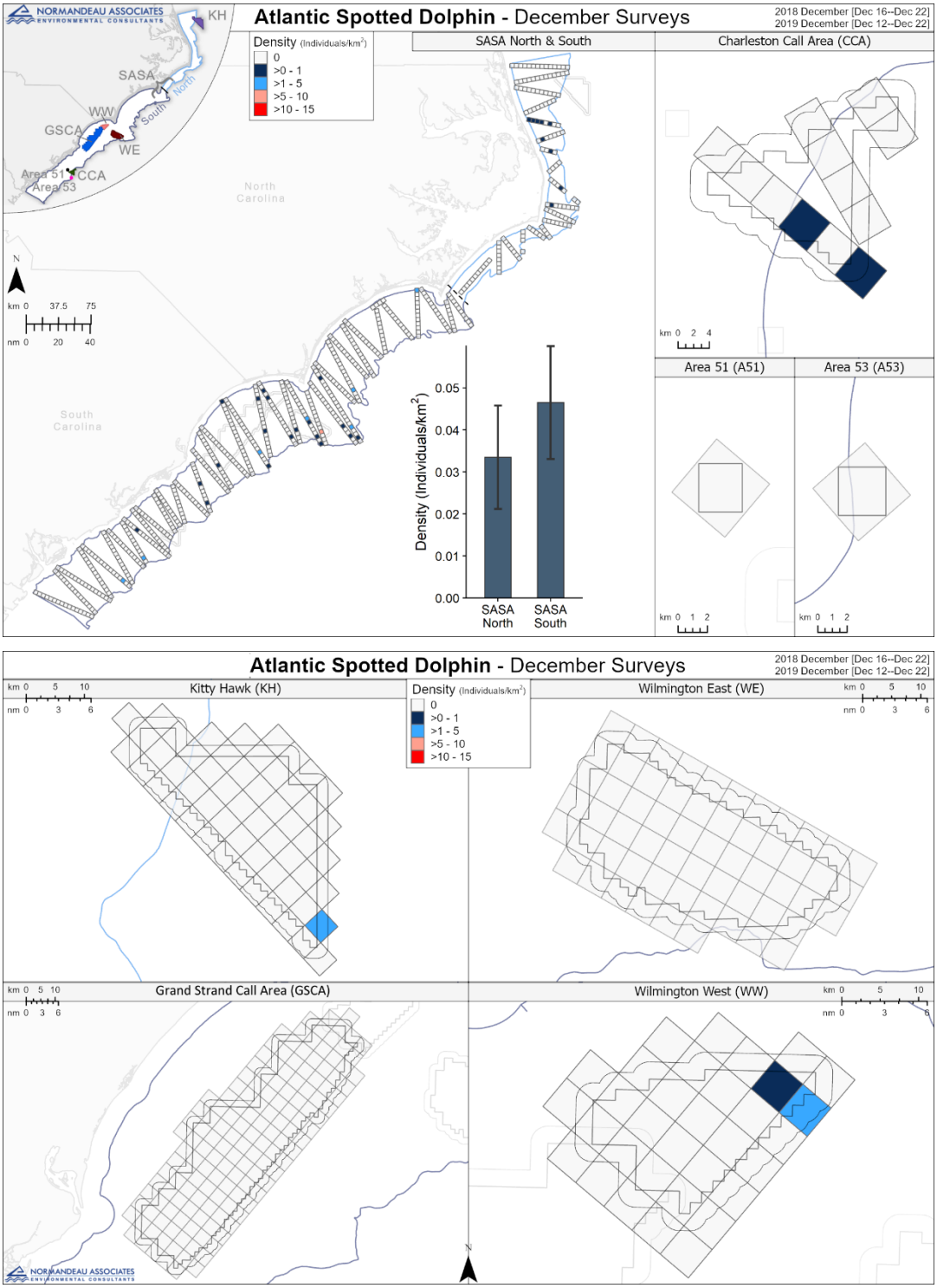

Figure E–19. Spatial distribution of Atlantic spotted dolphins during the December surveys in all areas

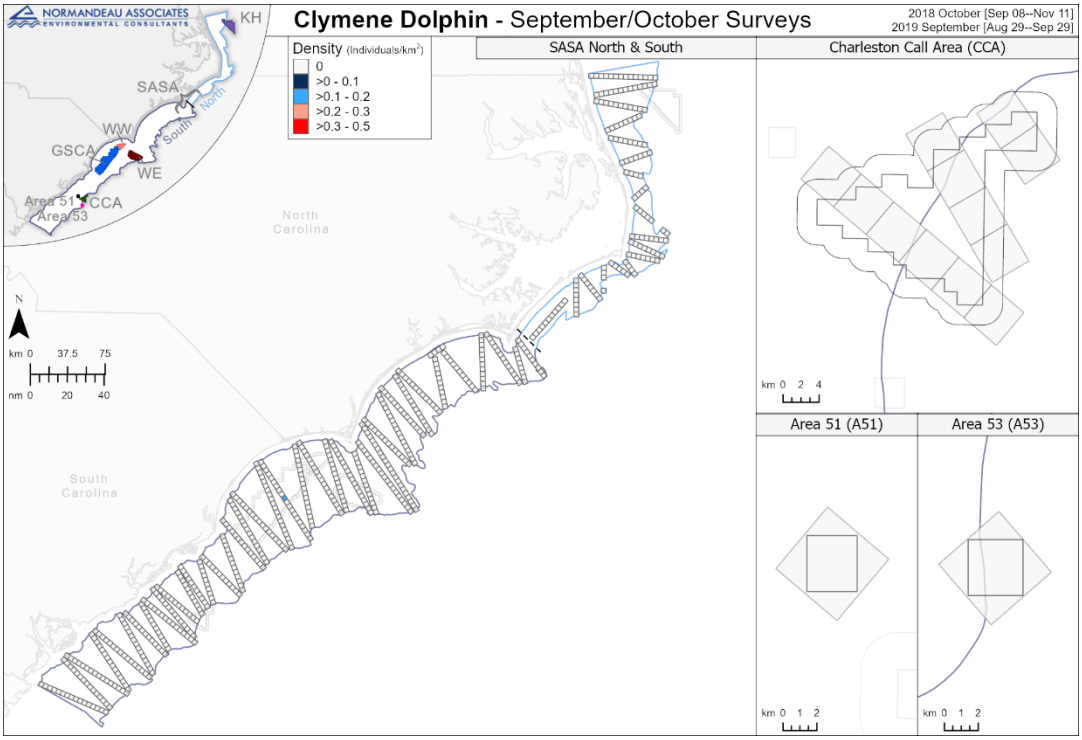

Figure E–20. Spatial distribution of clymene dolphins during the September/ October surveys in all areas

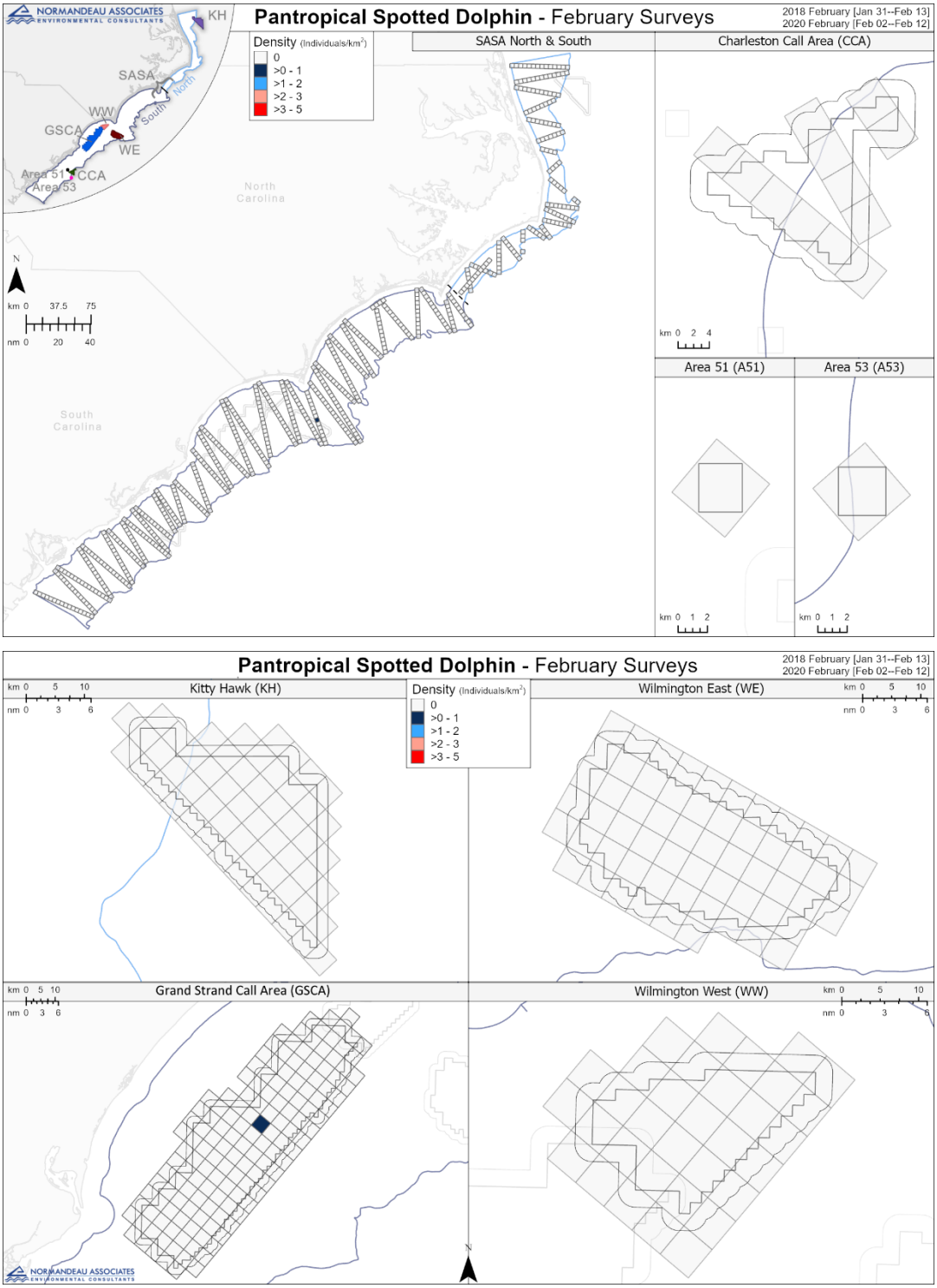

Figure E–21. Spatial distribution of pantropical spotted dolphins during the February surveys in all areas

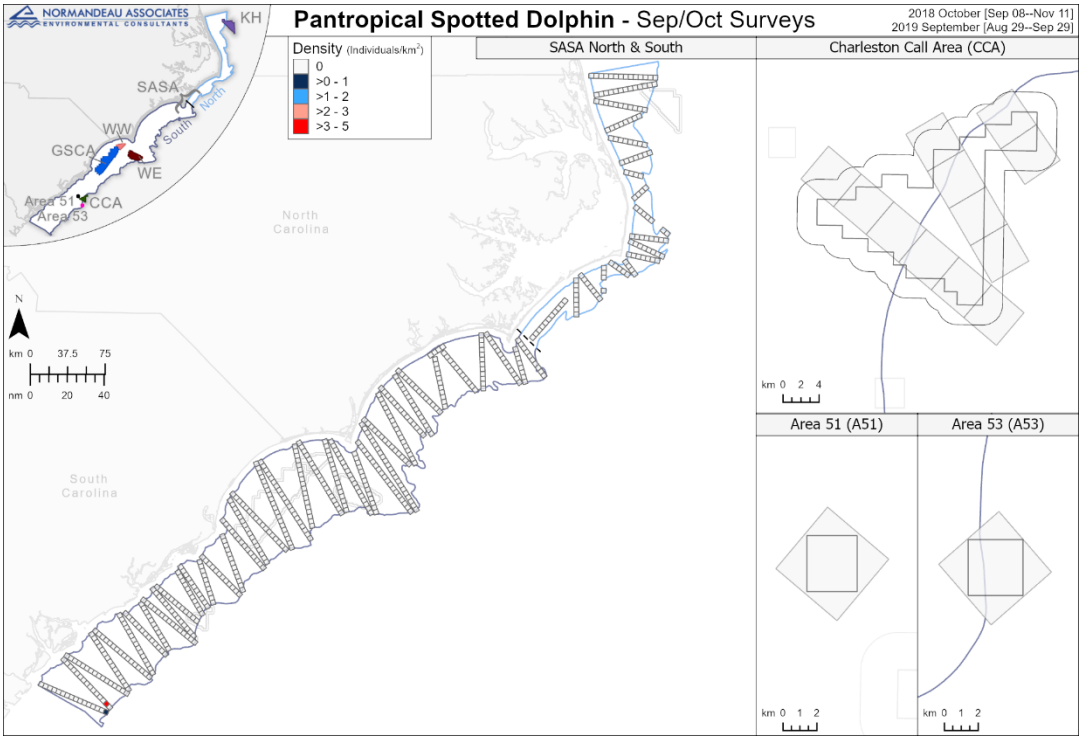

Figure E–22. Spatial distribution of pantropical spotted dolphins during the September/October surveys in all areas

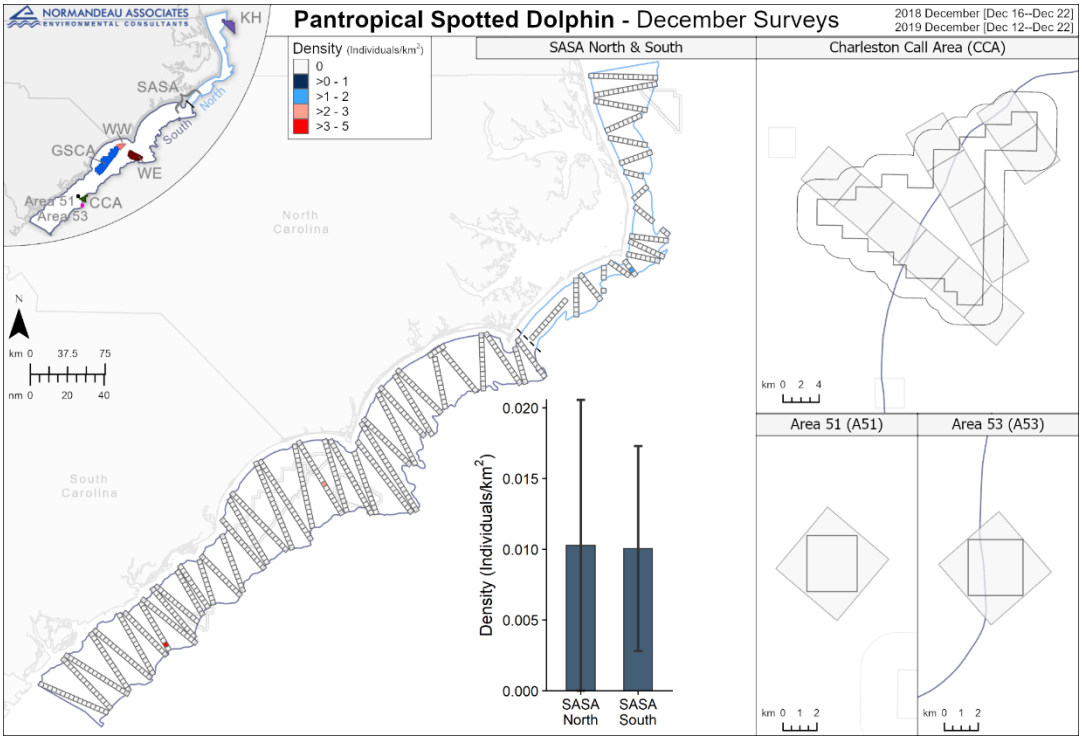

Figure E–23. Spatial distribution of pantropical spotted dolphins during the December surveys in all areas

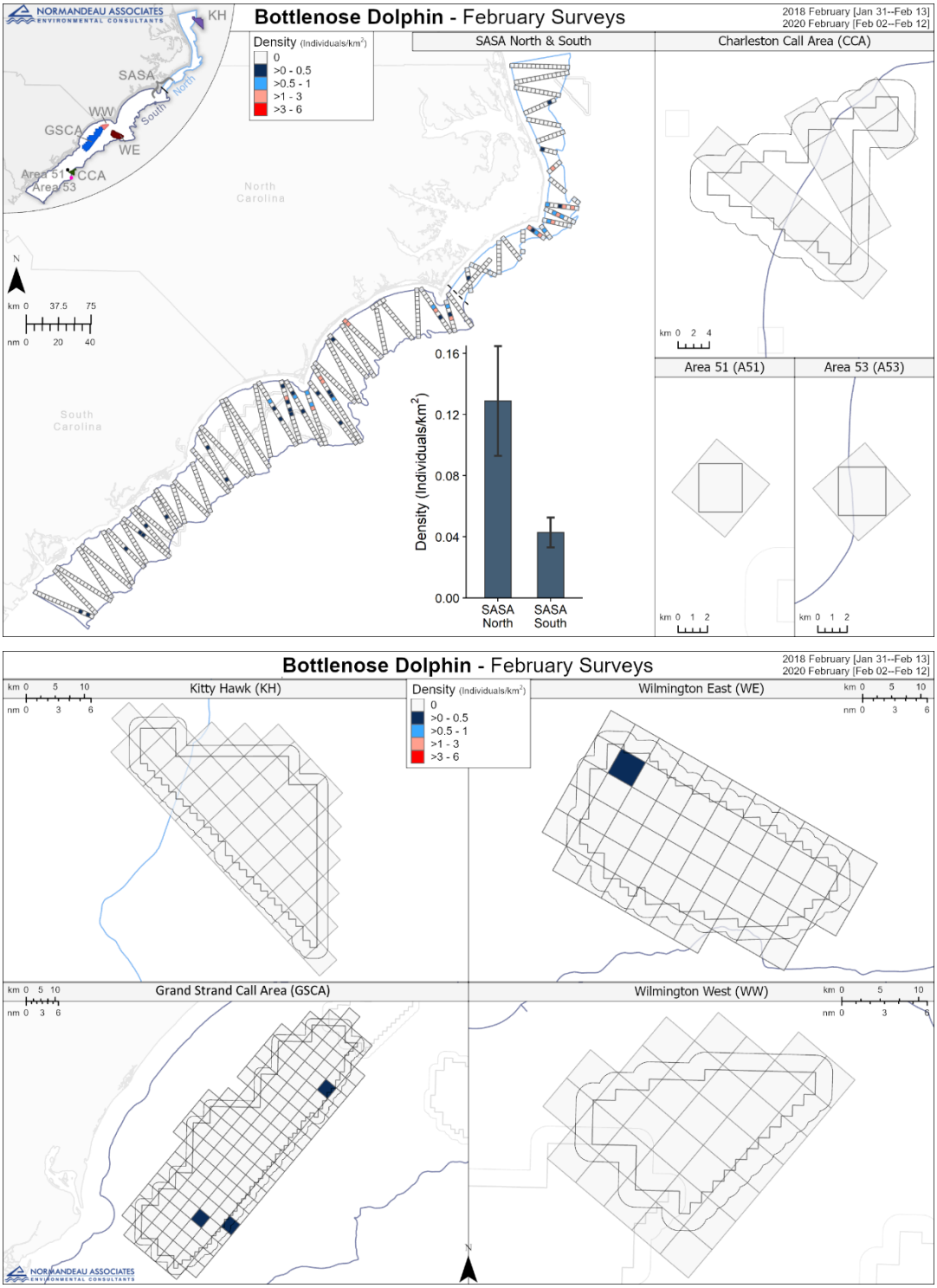

Figure E–24. Spatial distribution of bottlenose dolphins during the February surveys in all areas

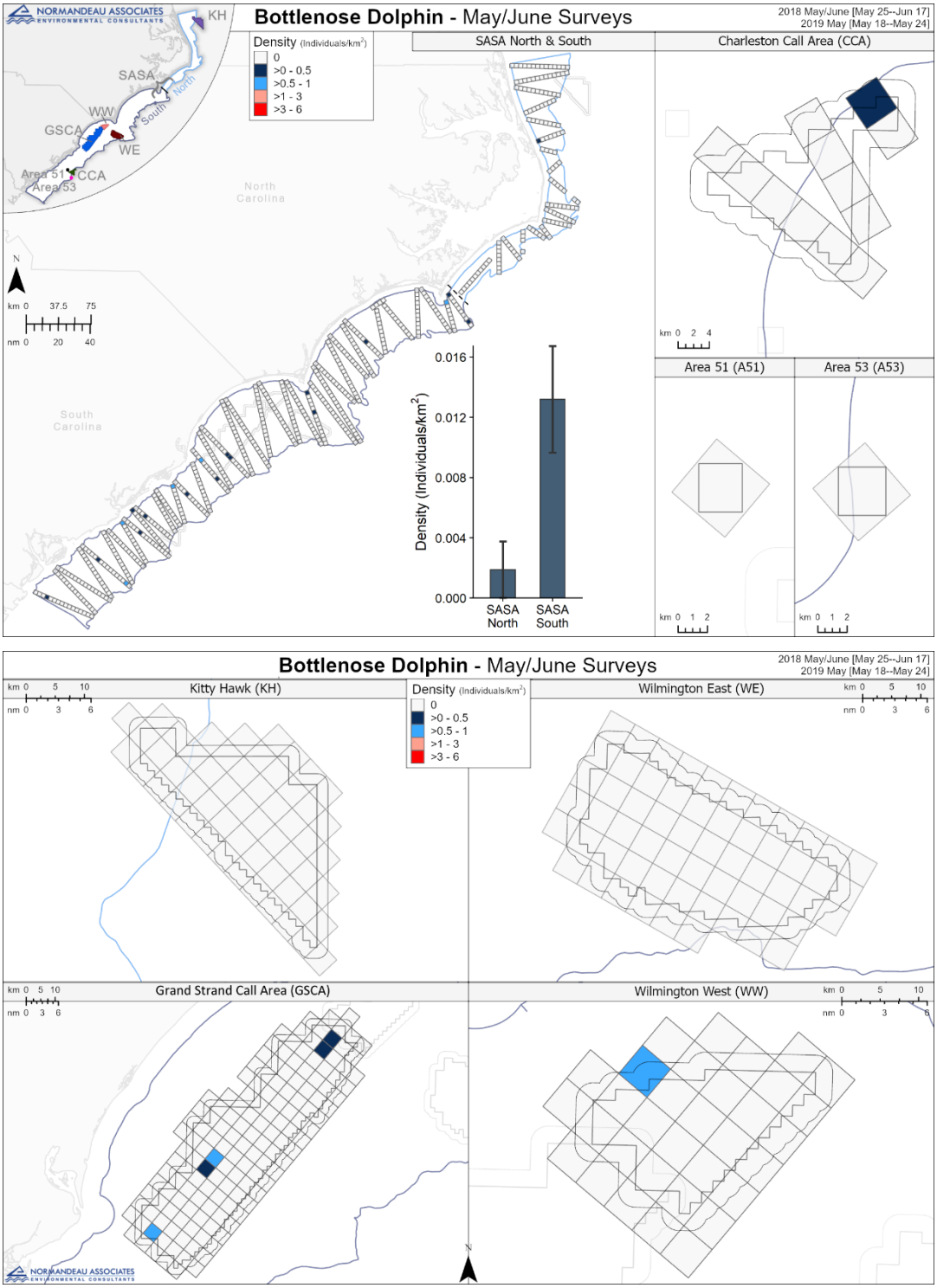

Figure E–25. Spatial distribution of bottlenose dolphins during the May/June surveys in all areas

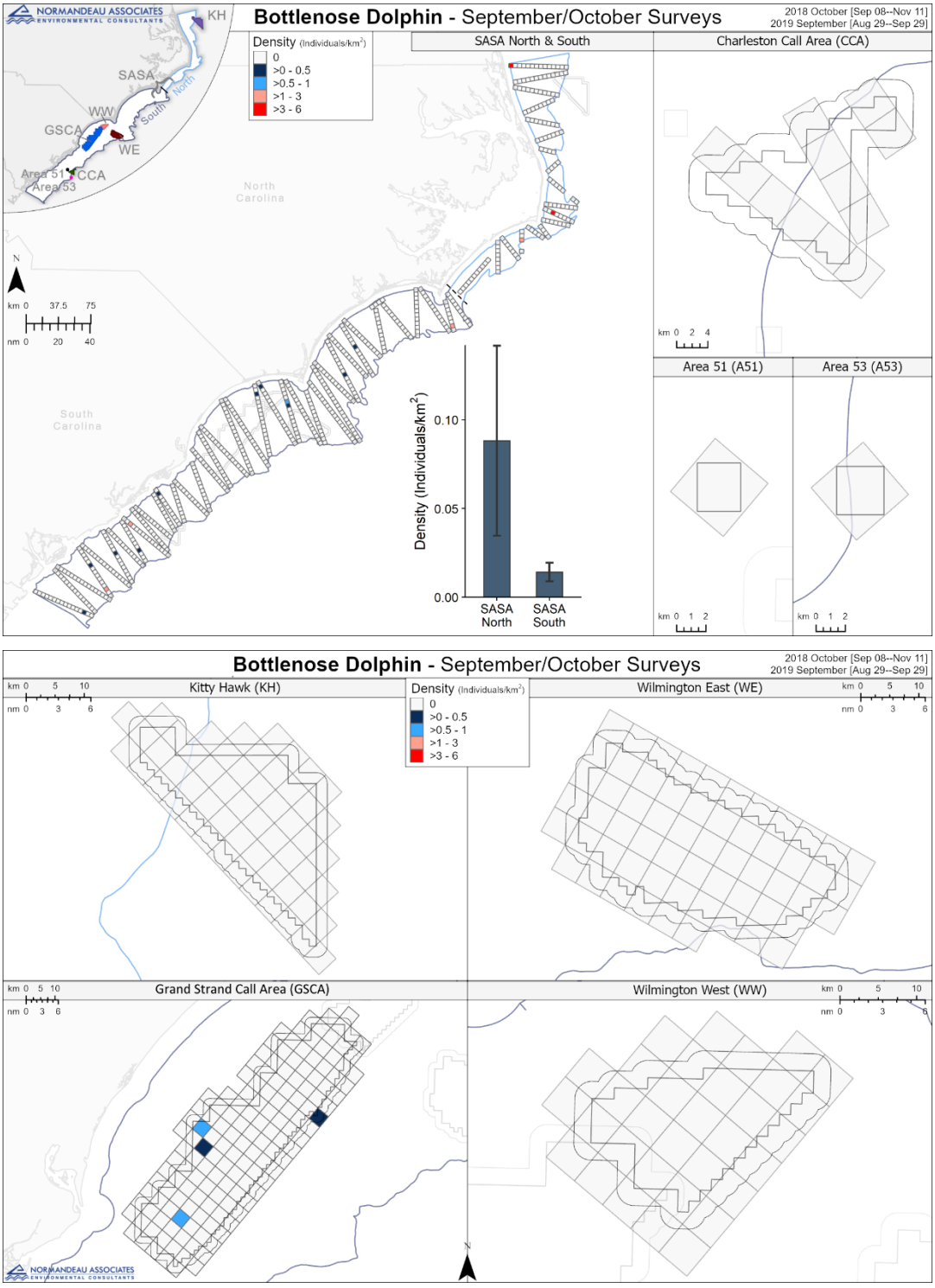

Figure E–26. Spatial distribution of bottlenose dolphins during the September/ October surveys in all areas

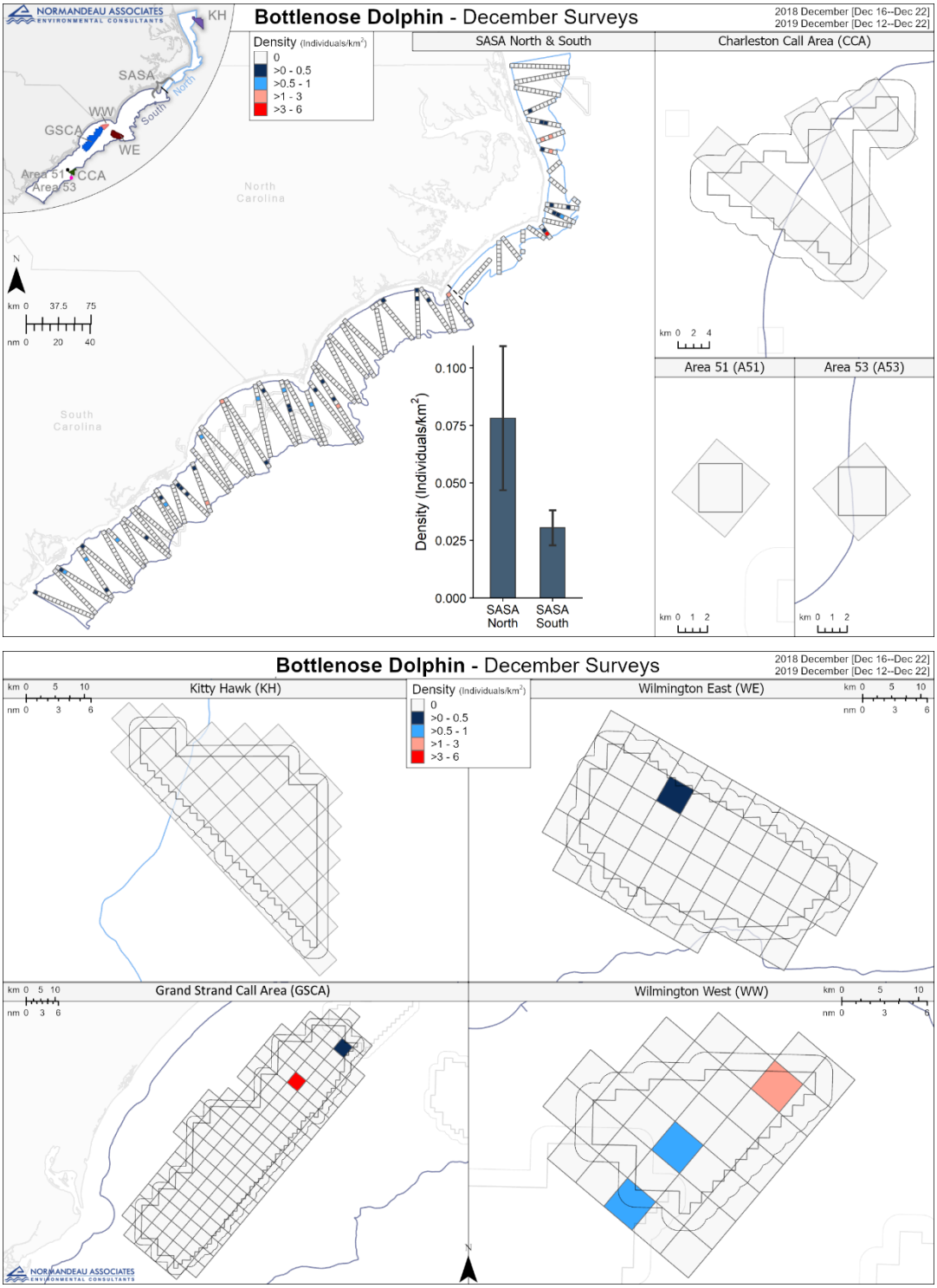

Figure E–27. Spatial distribution of bottlenose dolphins during the December surveys in all areas

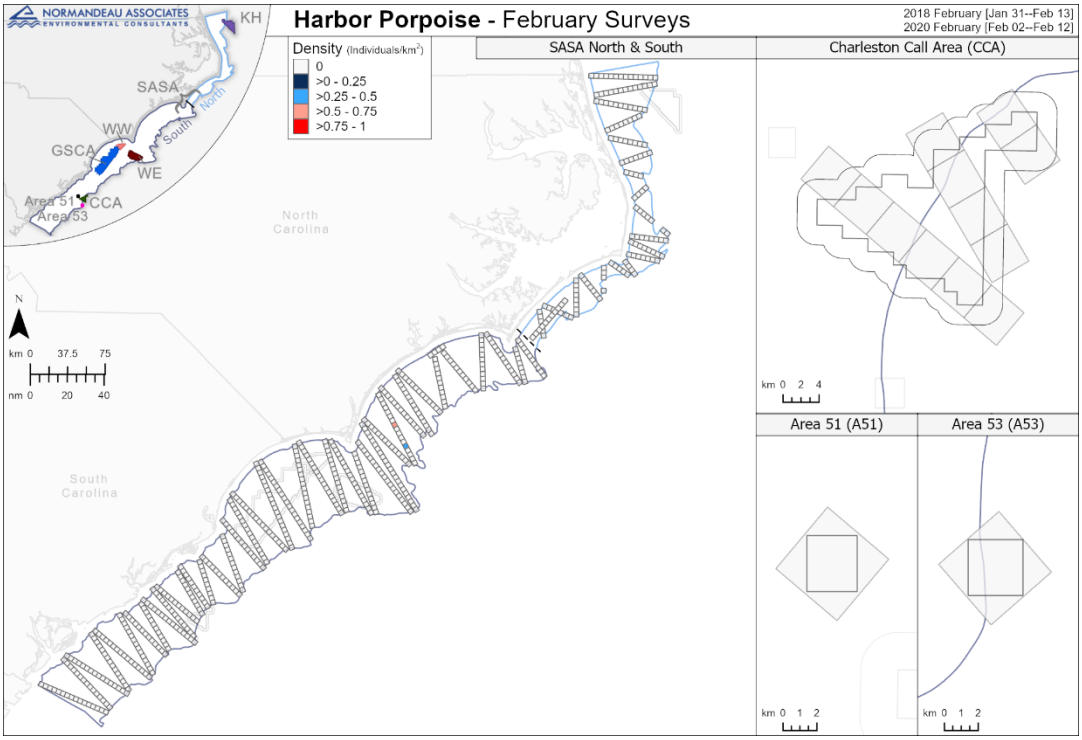

Figure E–28. Spatial distribution of harbor porpoise during the February surveys in all areas

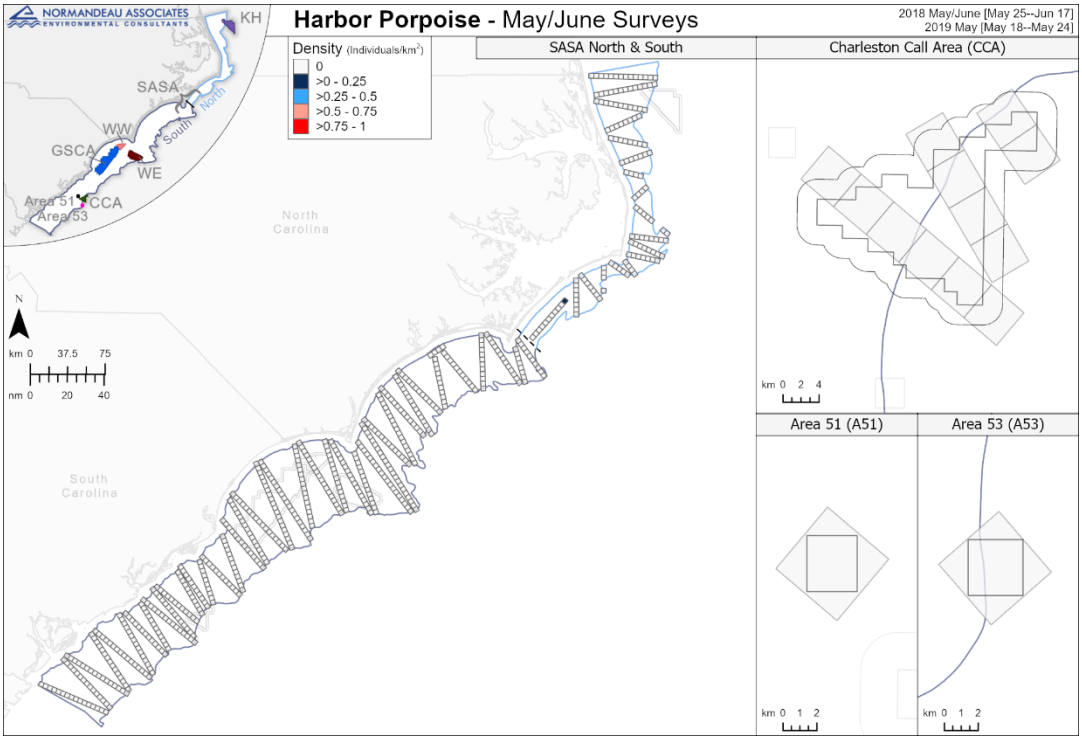

Figure E–29. Spatial distribution of harbor porpoise during the May/June surveys in all areas

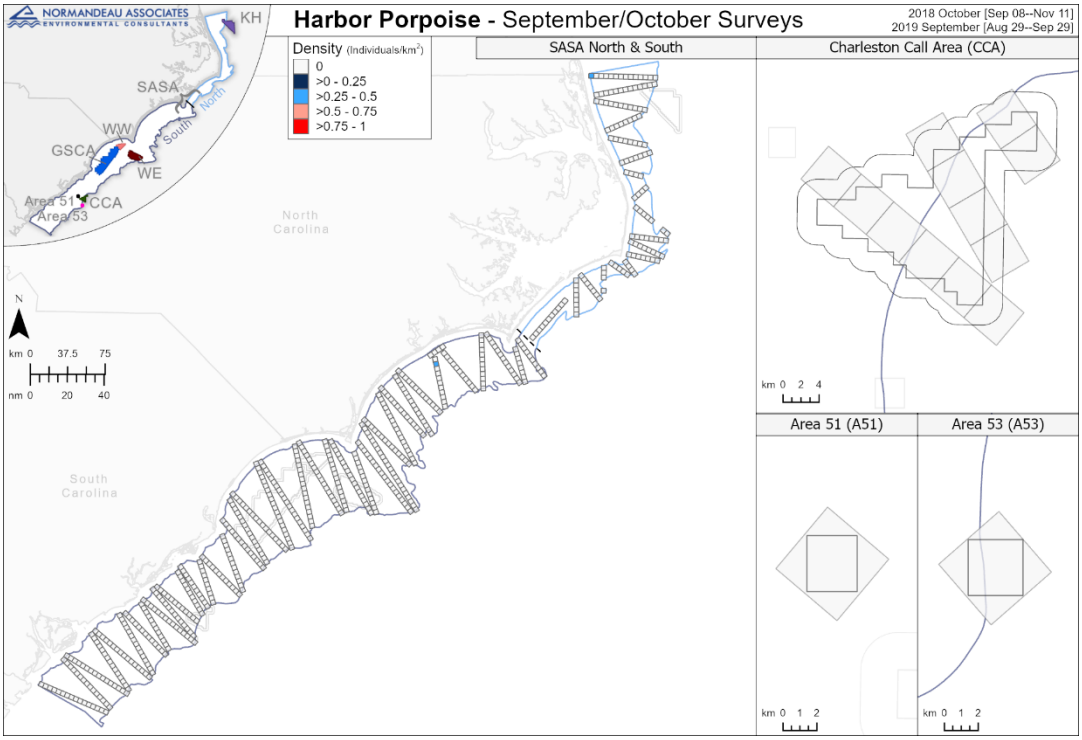

Figure E–30. Spatial distribution of harbor porpoise during the September/October surveys in all areas

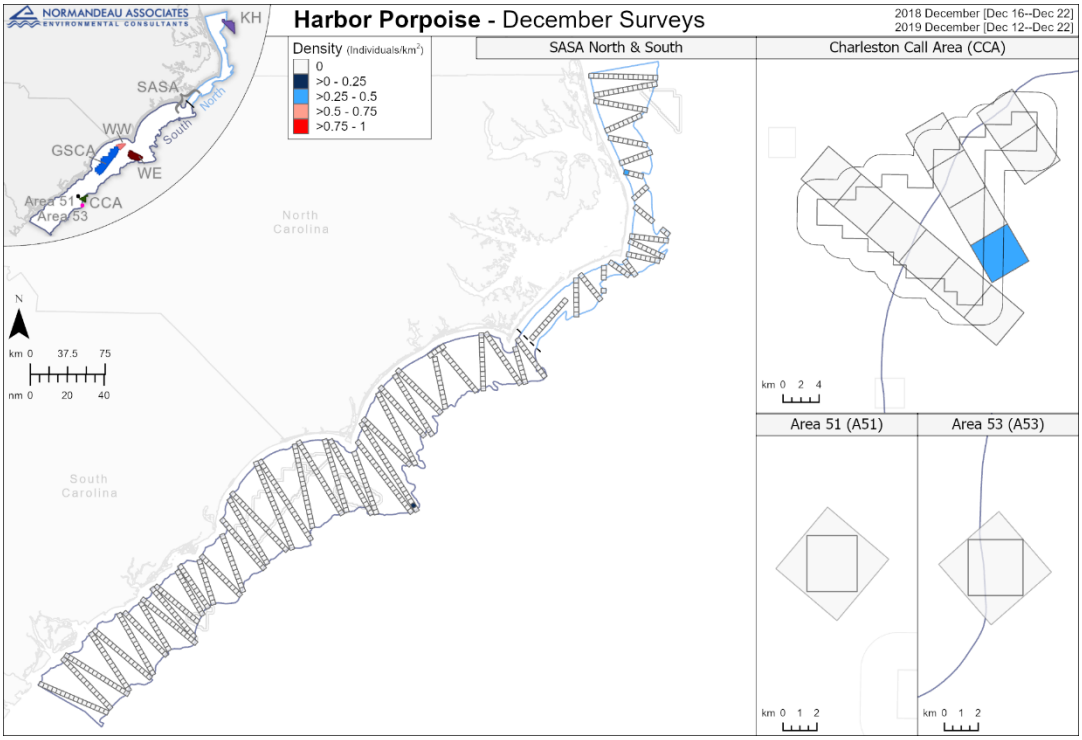

Figure E–31. Spatial distribution of harbor porpoise during the December surveys in all areas

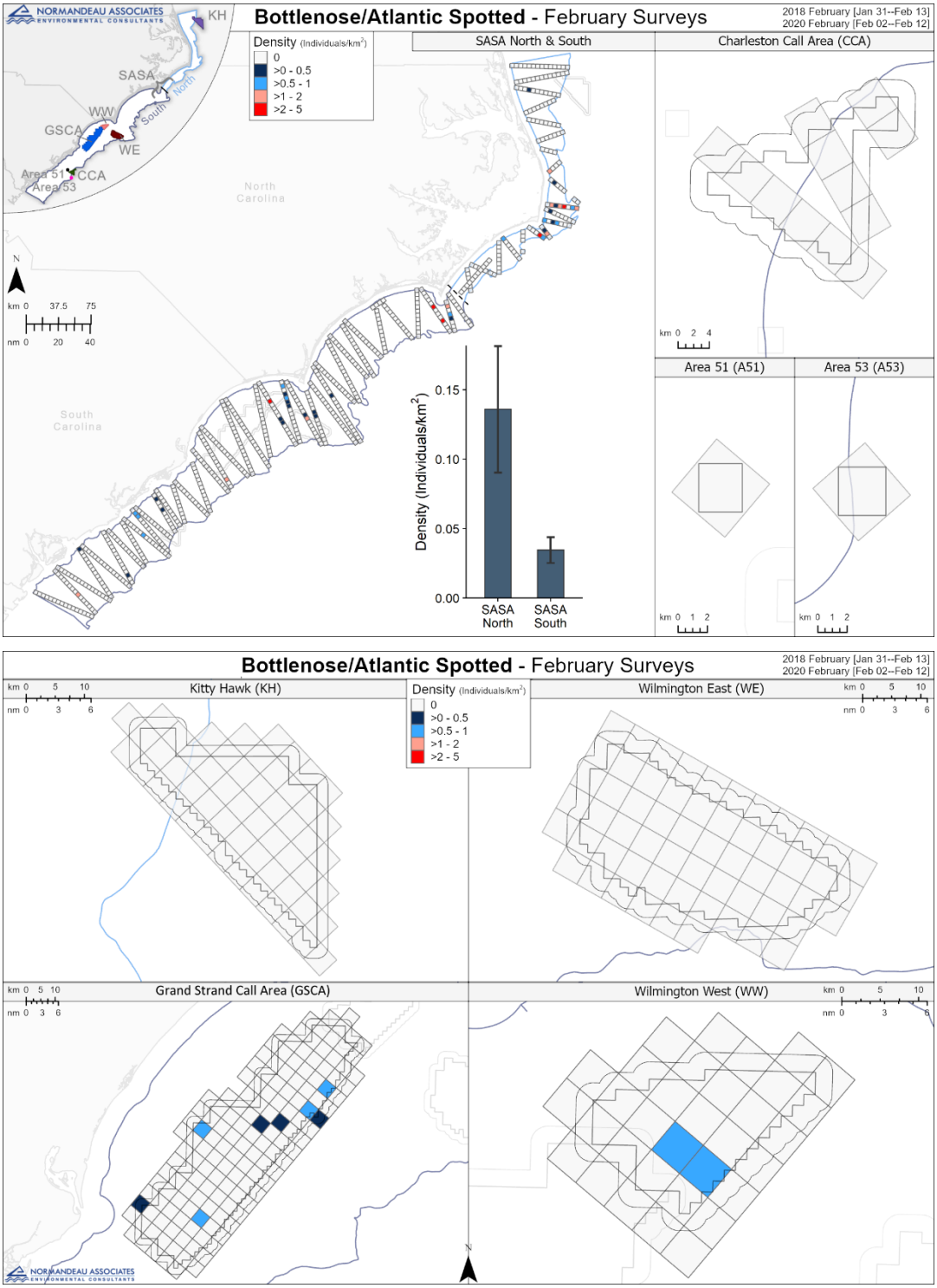

Figure E–32. Spatial distribution of bottlenose/Atlantic spotted dolphins during the February surveys in all areas

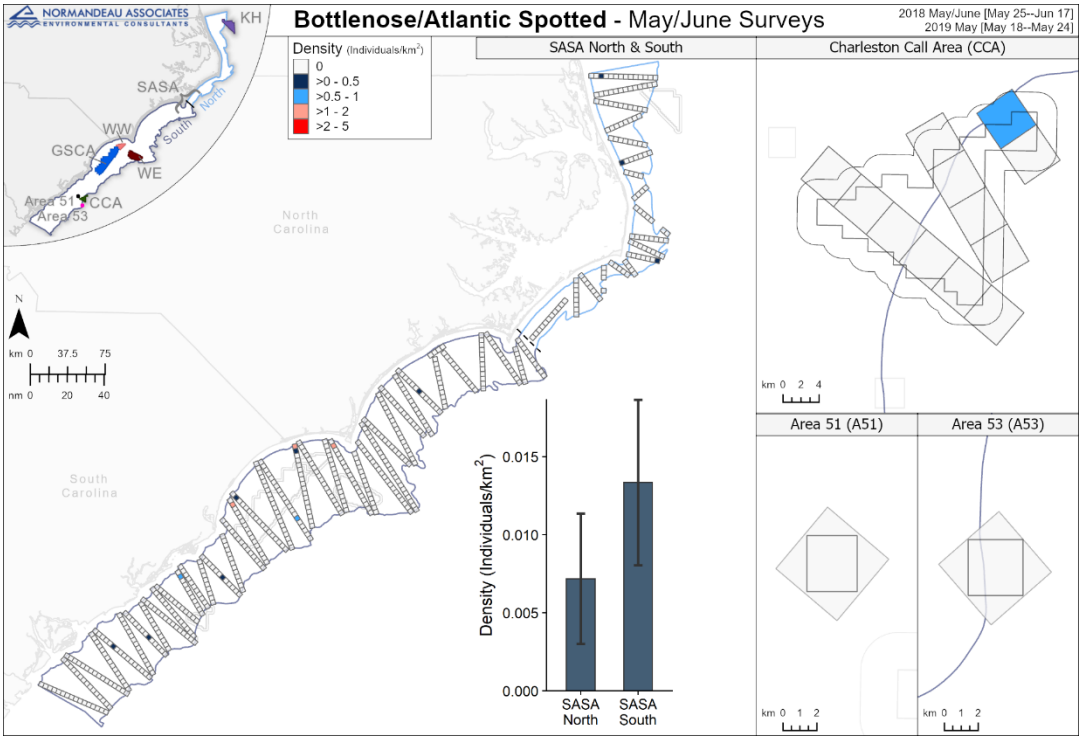

Figure E–33. Spatial distribution of bottlenose/Atlantic spotted dolphins during the May/June surveys in all areas

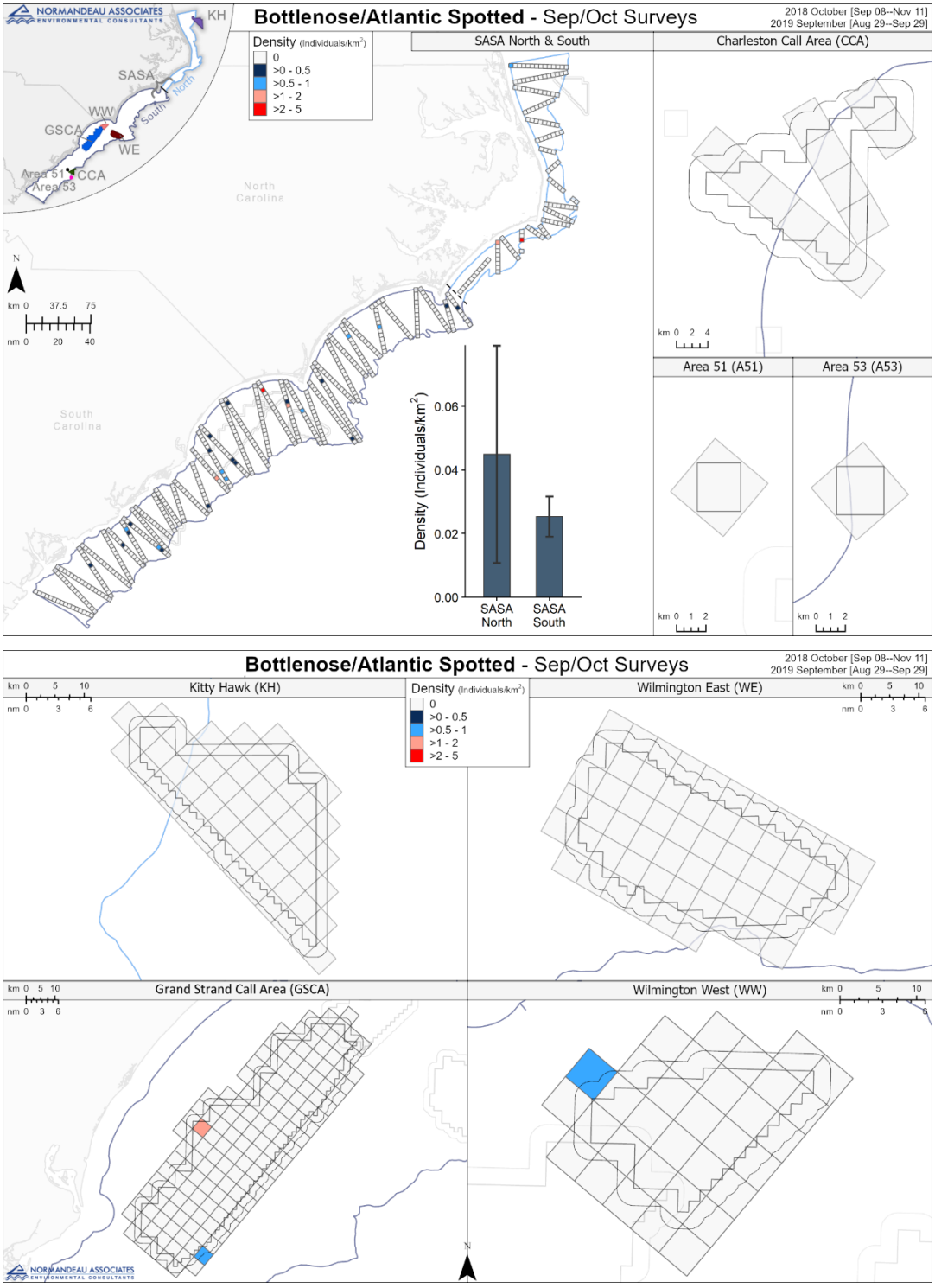

Figure E–34. Spatial distribution of bottlenose/Atlantic spotted dolphins during the September/October surveys in all areas

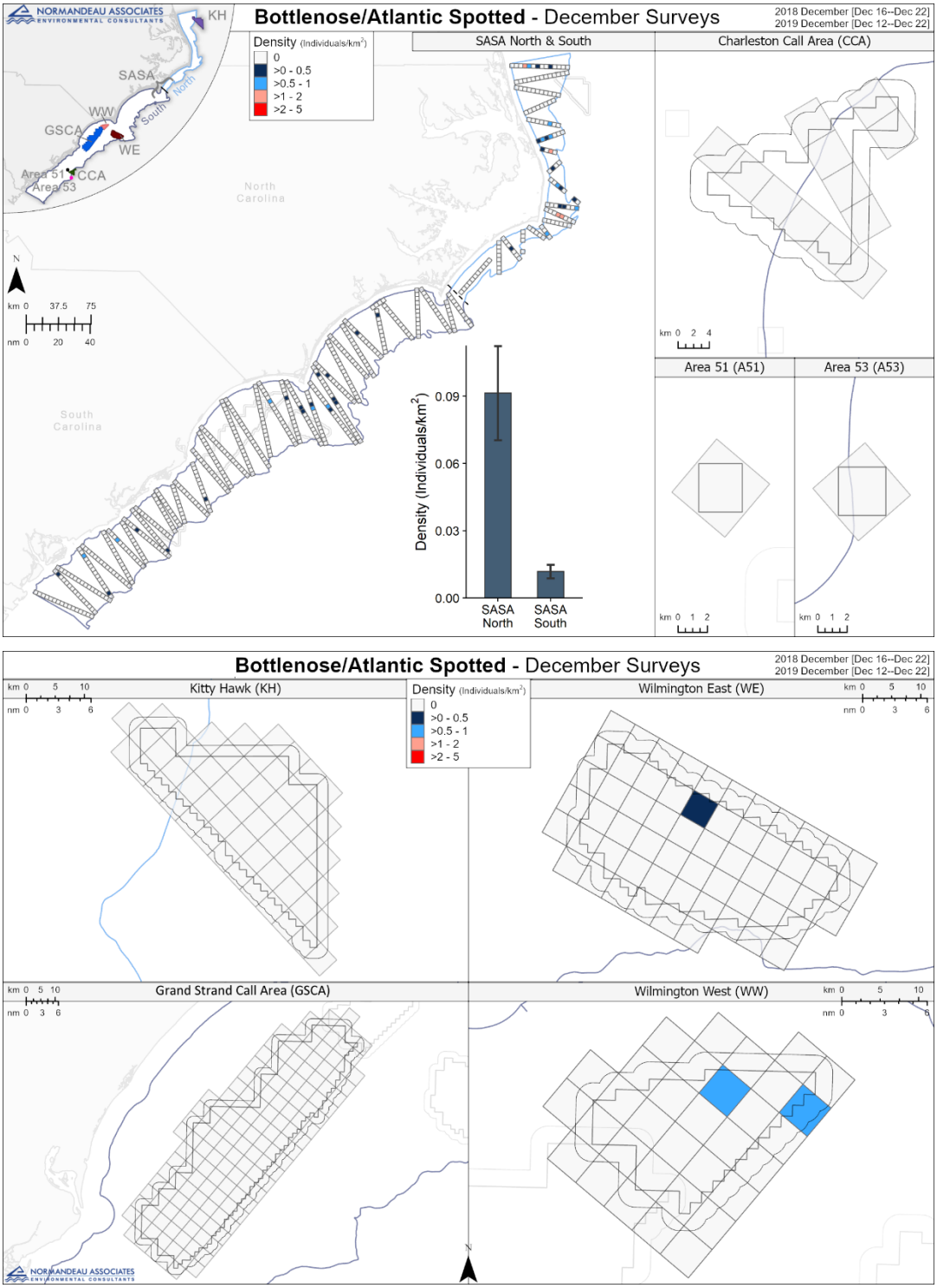

Figure E–35. Spatial distribution of bottlenose/Atlantic spotted dolphins during the December surveys in all areas

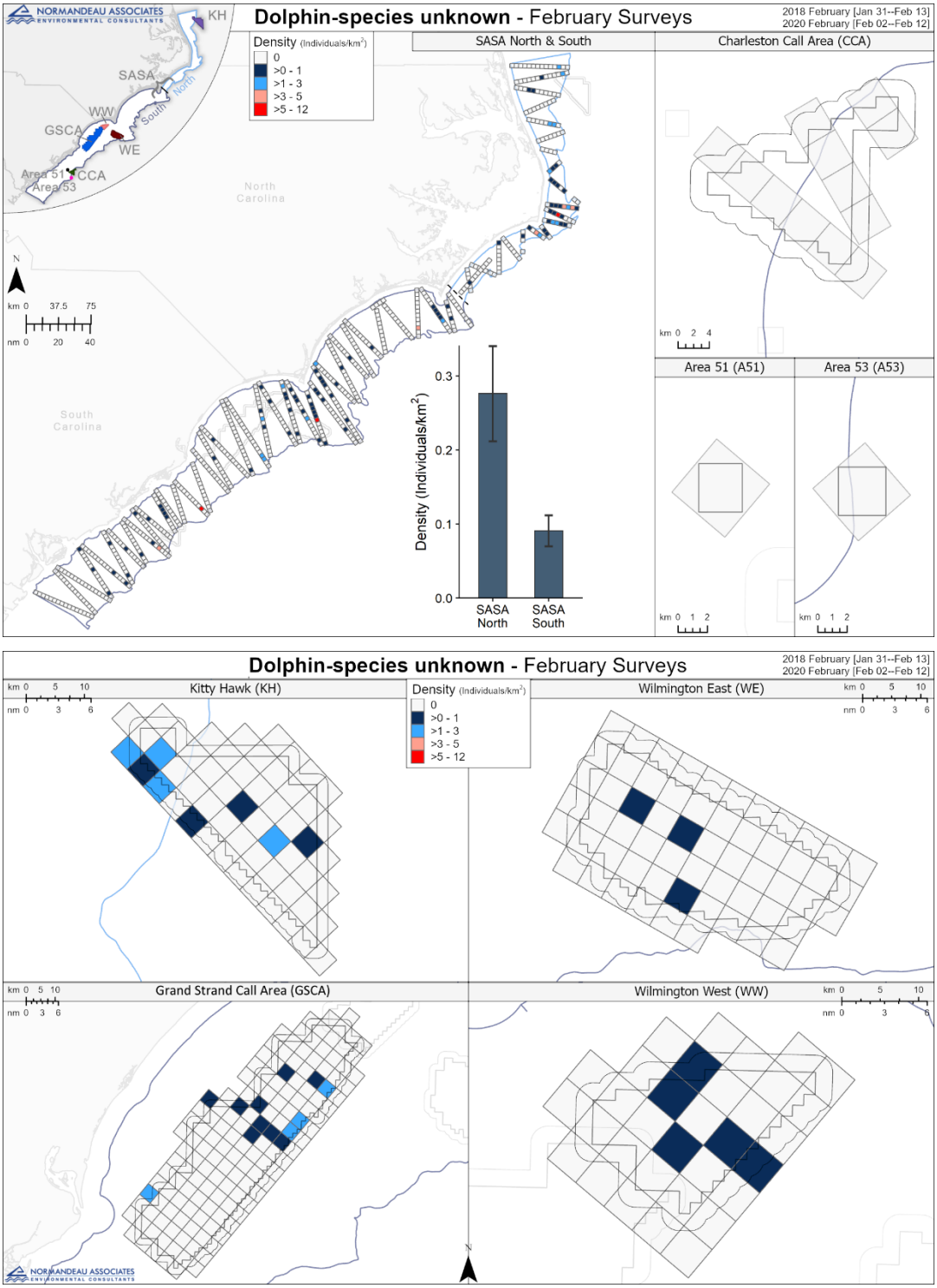

Figure E–36. Spatial distribution of dolphin-species unknown during the February surveys for all areas

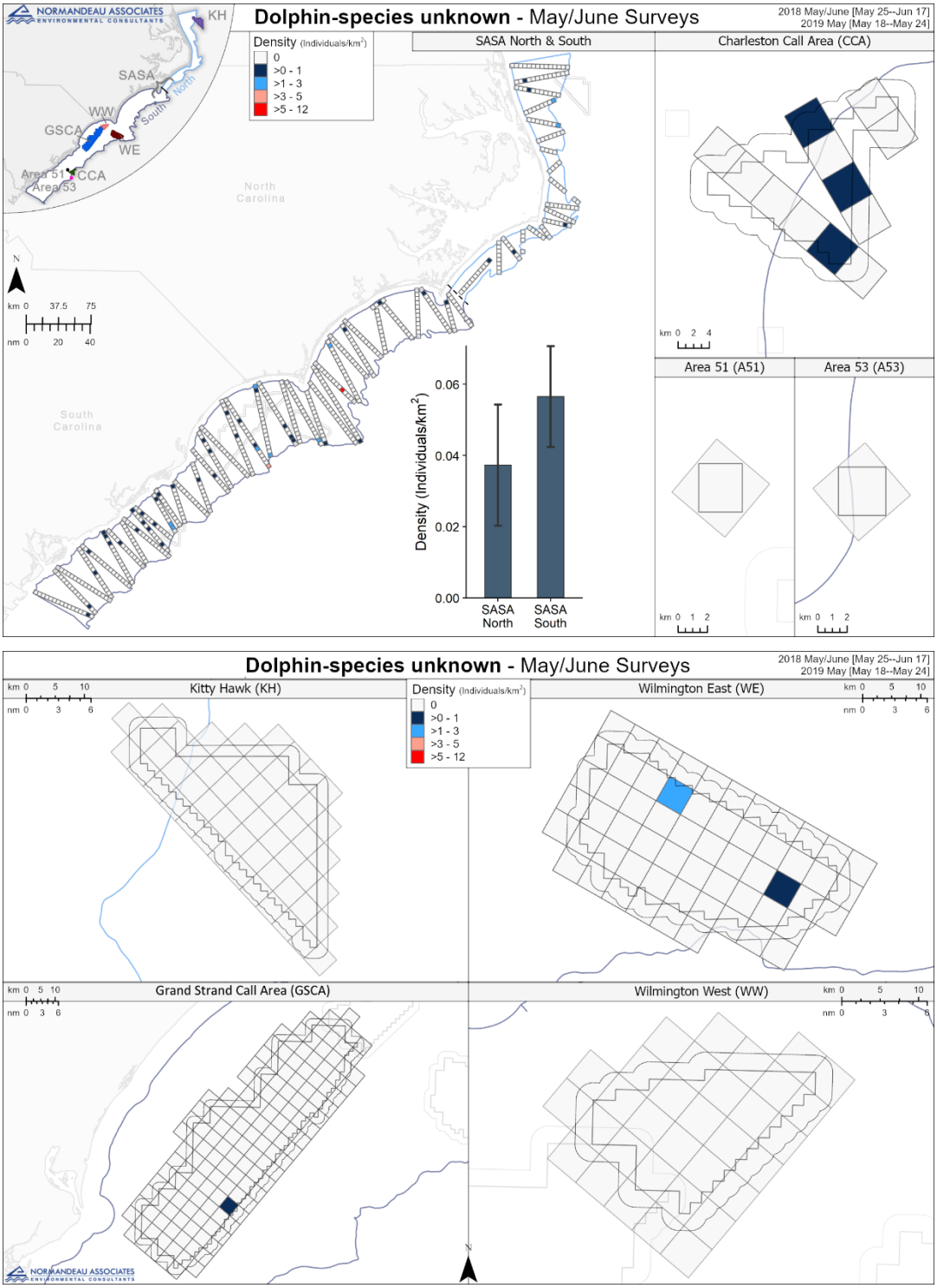

Figure E–37. Spatial distribution of dolphin-species unknown during the May/June surveys for all areas

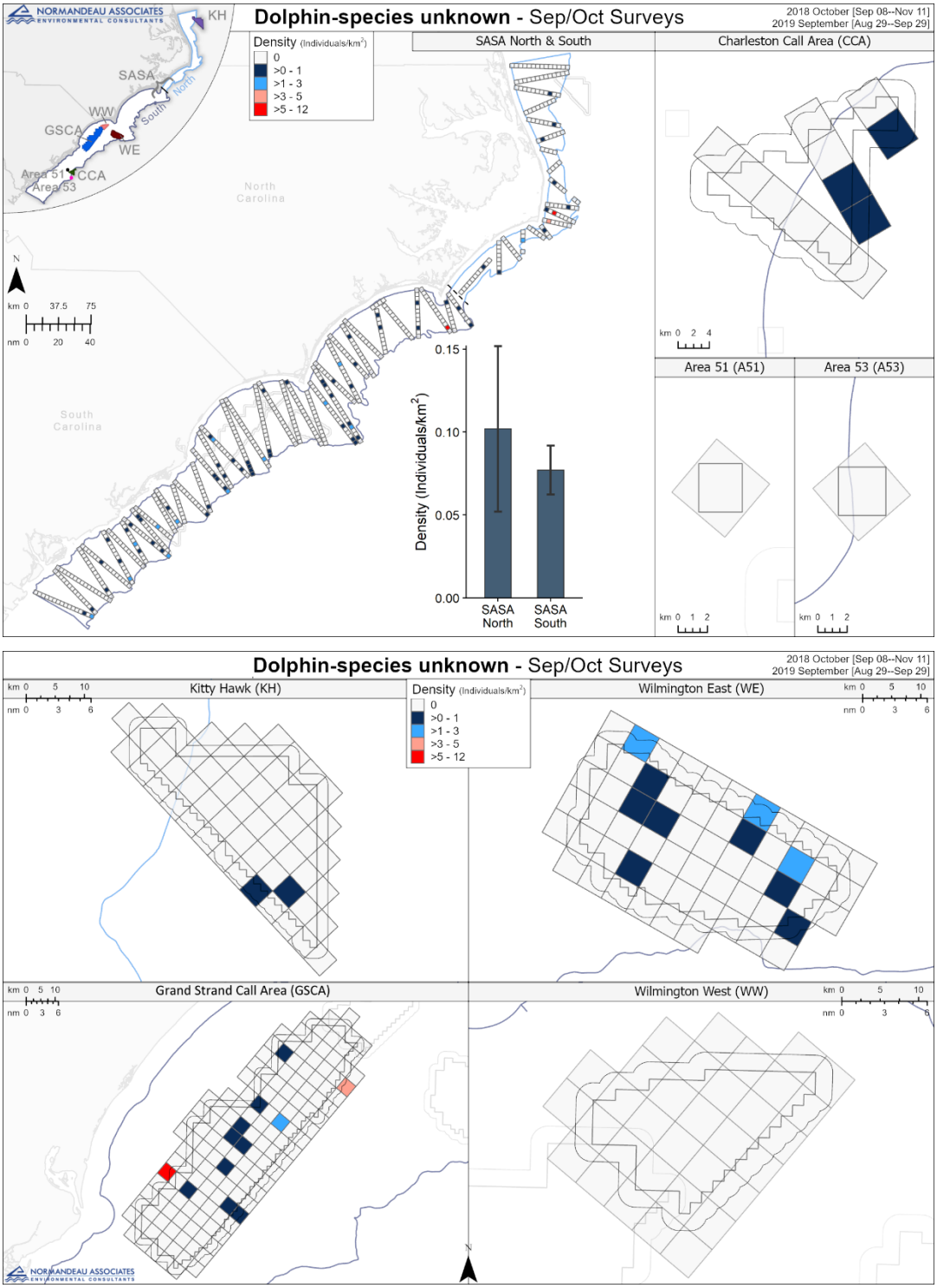

Figure E–38. Spatial distribution of dolphin-species unknown during the September/October surveys for all areas

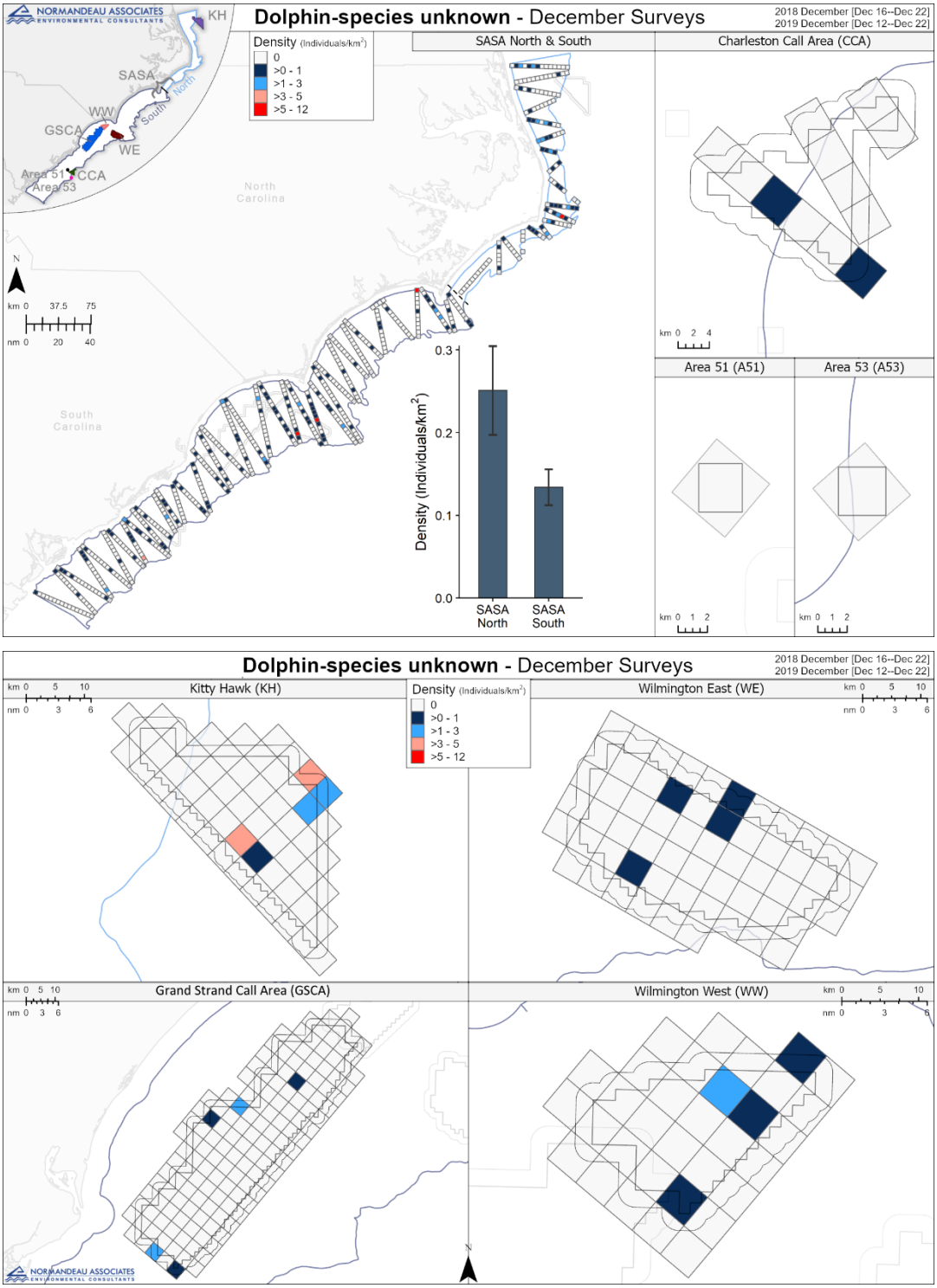

Figure E–39. Spatial distribution of dolphin-species unknown during the December surveys for all areas

Appendix F: Ray and Shark Species

Contents

F.1 Raw Counts of Ray and Shark Species Identified in the February 2018 through February 2020 Surveys F–6
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F.1 Raw Counts of Ray and Shark Species Identified in the February 2018 through February 2020 Surveys

Table F–1. Ray and shark species identified in the February 2018 through February 2020 surveys in all areas combined

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Shark	**97**	**278**	**62**	**101**	**89**	**608**	**431**	**1,115**	**139**	**269**	**76**	**351**	**30**	**41**	**78**	**271**	**3,034**
Whale Shark*	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	2
Thresher Shark	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	2
Basking Shark	24	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
White Shark	3	8	1	10	—	10	1	8	2	5	—	7	3	5	4	21	74
Blacktip Shark	—	—	—	—	—	—	95	179	—	—	—	—	—	—	—	9	188
Blue Shark	—	—	—	—	—	—	1	4	—	—	—	—	—	—	—	—	4
Carcharhinidae (unid.)	2	4	16	31	12	92	170	332	98	177	14	41	1	1	5	125	803
Dusky Shark	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Silky Shark	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Tiger Shark	—	1	—	1	—	—	—	1	—	—	—	3	—	—	—	—	6
Bonnethead Shark	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Great Hammerhead	—	—	—	1	—	—	—	7	—	—	—	2	—	—	—	1	11
Smooth Hammerhead	1	7	—	—	1	7	—	7	—	1	—	2	—	1	—	—	25
Scalloped Hammerhead*	2	6	—	—	3	6	3	36	—	7	—	3	—	2	—	21	81
Hammerhead (unid.)*	22	181	2	3	20	45	45	118	5	30	10	24	5	9	31	47	457
Spurdog	—	—	32	32	1	356	37	324	1	6	16	222	1	2	—	—	942
species unknown	43	45	11	23	52	90	79	97	33	43	36	46	20	21	38	46	411

(continued)

Table F–1. (Continued)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Ray	**1**	**3**	**1**	**8**	**2,254**	**3,795**	**8,029**	**14,486**	**56**	**812**	**3,380**	**3,532**	**9**	**603**	**136**	**141**	**23,380**
Atlantic Stingray	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	1
Giant Manta Ray*	—	1	—	—	2	5	1	6	—	2	3	10	—	—	—	—	24
Giant Devil Ray	—	1	—	1	—	6	1	2	—	4	2	5	—	—	—	—	19
Chilean Devil Ray	—	—	—	—	—	5	5	5	1	1	—	1	—	—	—	—	12
Atlantic Devil Ray	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Spotted Eagle Ray	—	—	—	—	—	1	7	9	—	2	2	4	—	—	—	2	18
Bullnose Ray	—	—	—	—	1	7	—	—	—	—	—	—	—	—	—	—	7
Cownose/Bullnose Ray	1	1	1	1	452	523	6	7	44	120	557	604	1	1	134	135	1,392
Cownose Ray	—	—	—	2	1,793	3,239	7,986	14,433	6	674	2,784	2,796	—	593	—	—	21,737
species unknown	—	—	—	4	6	9	23	23	5	9	31	111	8	9	2	4	169
Totals	**98**	**281**	**63**	**109**	**2,343**	**4,403**	**8,460**	**15,601**	**195**	**1,081**	**3,456**	**3,883**	**39**	**644**	**214**	**412**	**26,414**

*Listed under the Endangered Species Act

**Significantly submerged

Table F–2. Ray and shark species identified in the February 2018 through February 2020 surveys in the South Atlantic Survey Area (SASA; counts include all of A51, part of A53, and part of CCA)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Shark	**97**	**278**	**14**	**36**	**83**	**598**	**403**	**958**	**134**	**247**	**51**	**262**	**29**	**40**	**70**	**259**	**2,676**
Whale Shark*	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	2
Thresher Shark	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	2
Basking Shark	24	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
White Shark	3	8	—	6	—	10	1	8	2	4	—	4	3	5	3	18	63
Blacktip Shark	—	—	—	—	—	—	95	179	—	—	—	—	—	—	—	9	188
Blue Shark	—	—	—	—	—	—	1	3	—	—	—	—	—	—	—	—	3
Carcharhinidae (unid.)	2	4	3	14	12	90	163	297	96	162	3	21	1	1	4	124	713
Silky Shark	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Tiger Shark	—	1	—	1	—	—	—	1	—	—	—	3	—	—	—	—	6
Bonnethead Shark	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Great Hammerhead	—	—	—	1	—	—	—	6	—	—	—	2	—	—	—	1	10
Smooth Hammerhead	1	7	—	—	1	6	—	7	—	1	—	1	—	1	—	—	23
Scalloped Hammerhead*	2	6	—	—	3	5	3	31	—	6	—	2	—	2	—	21	73
Hammerhead (unid.)*	22	181	1	2	15	38	39	100	5	29	7	14	4	8	30	44	416
Spurdog	—	—	—	—	1	356	32	238	1	6	9	172	1	2	—	—	774
species unknown	43	45	10	12	51	89	69	87	30	39	32	42	20	21	33	41	376
Ray	1	3	**1**	**4**	**96**	**499**	**8,024**	**14,480**	**56**	**812**	**3,377**	**3,527**	**9**	**603**	**136**	**141**	**20,069**
Atlantic Stingray	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	1
Giant Manta Ray*	—	—	—	1	—	3	1	6	—	2	3	10	—	—	—	—	22
Giant Devil Ray	—	1	—	1	—	5	1	2	—	4	2	5	—	—	—	—	18
Chilean Devil Ray	—	—	—	—	—	3	3	3	1	1	—	1	—	—	—	—	8
Spotted Eagle Ray	—	—	—	—	—	1	6	8	—	2	1	3	—	—	—	2	16
Bullnose Ray	—	—	—	—	1	7	—	—	—	—	—	—	—	—	—	—	7

(continued)

Table F–2. (Continued)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Cownose/Bullnose Ray	1	1	1	1	39	96	5	6	44	120	557	604	1	1	134	135	964
Cownose Ray	—	—	—	—	50	375	7,985	14,432	6	674	2,784	2,795	—	593	—	—	18,869
species unknown	—	2	—	—	6	9	23	23	5	9	29	108	8	9	2	4	164
Totals	**98**	**281**	**15**	**40**	**179**	**1,095**	**8,427**	**15,438**	**190**	**1,059**	**3,428**	**3,789**	**38**	**643**	**206**	**400**	**22,745**

*Listed under the Endangered Species Act

**Significantly submerged

Table F–3. Ray and shark species identified in the February 2018 through February 2020 surveys in Areas A51 and A53

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Shark	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**3**	**—**	**—**	**—**	**5**	**1**	**1**	**1**	**1**	**11**
Carcharhinidae (unid.)	—	—	—	1	—	—	—	1	—	—	—	—	—	—	1	1	3
Smooth Hammerhead	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Hammerhead (unid.)*	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	1
Spurdog	—	—	—	—	—	—	—	1	—	—	—	5	—	—	—	—	6
Totals	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**3**	**—**	**—**	**—**	**5**	**1**	**1**	**1**	**1**	**11**

*Listed under the Endangered Species Act

**Significantly submerged

Table F–4. Ray and shark species identified in the February 2018 through February 2020 surveys in the Charleston Call Area (CCA)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Shark	**—**	**—**	**—**	**—**	**1**	**3**	**1**	**3**	**—**	**—**	**—**	**4**	**—**	**—**	**—**	**—**	**10**
Scalloped Hammerhead*	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	2
Hammerhead (unid.)*	—	—	—	—	1	1	—	—	—	—	—	3	—	—	—	—	4
Spurdog	—	—	—	—	—	2	—	—	—	—	—	1	—	—	—	—	3
species unknown	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	1
Ray	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**
Giant Devil Ray	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Totals	**—**	**—**	**—**	**—**	**1**	**3**	**1**	**4**	**—**	**—**	**—**	**4**	**—**	**—**	**—**	**—**	**11**

*Listed under the Endangered Species Act

**Significantly submerged

Table F–5. Ray and shark species identified in the February 2018 through February 2020 surveys in the Kitty Hawk (KH) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Shark	**—**	**—**	**32**	**32**	**—**	**1**	**1**	**5**	**2**	**4**	**6**	**10**	**—**	**—**	**—**	**—**	**52**
White Shark	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	2
Blue Shark	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Carcharhinidae (unid.)	—	—	—	—	—	1	—	1	2	3	5	6	—	—	—	—	11
Hammerhead (unid.)*	—	—	—	—	—	—	1	3	—	—	—	1	—	—	—	—	4
Spurdog	—	—	32	32	—	—	—	—	—	—	—	1	—	—	—	—	33
species unknown	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	1
Ray	**—**	**—**	**—**	**—**	**2,156**	**3,292**	**—**	**1**	**—**	**—**	**—**	**2**	**—**	**—**	**—**	**—**	**3,295**
Chilean Devil Ray	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	2
Atlantic Devil Ray	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Cownose/Bullnose Ray	—	—	—	—	413	427	—	—	—	—	—	—	—	—	—	—	427
Cownose Ray	—	—	—	—	1,743	2,863	—	—	—	—	—	1	—	—	—	—	2,864
species unknown	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Totals	**—**	**—**	**32**	**32**	**2,156**	**3,292**	**1**	**6**	**2**	**4**	**6**	**12**	**—**	**—**	**—**	**—**	**3,347**

*Listed under the Endangered Species Act

**Significantly submerged

Table F–6. Ray and shark species identified in the February 2018 through February 2020 surveys in the Wilmington West (WW) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Shark	**—**	**—**	**—**	**—**	**—**	**—**	**6**	**18**	**—**	**1**	**3**	**7**	**—**	**—**	**—**	**—**	**26**
Carcharhinidae (unid.)	—	—	—	—	—	—	2	11	—	—	1	2	—	—	—	—	13
Smooth Hammerhead	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
Scalloped Hammerhead*	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
Hammerhead (unid.)*	—	—	—	—	—	—	1	1	—	—	1	1	—	—	—	—	2
Spurdog	—	—	—	—	—	—	2	5	—	—	1	3	—	—	—	—	8
species unknown	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	1
Ray	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**2**	**—**	**—**	**1**	**1**	**—**	**—**	**—**	**—**	**3**
Spotted Eagle Ray	—	—	—	—	—	—	1	1	—	—	1	1	—	—	—	—	2
Cownose/Bullnose Ray	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	1
Totals	**—**	**—**	**—**	**—**	**—**	**—**	**8**	**20**	**—**	**1**	**4**	**8**	**—**	**—**	**—**	**—**	**29**

*Listed under the Endangered Species Act

**Significantly submerged

Table F–7. Ray and shark species identified in the February 2018 through February 2020 surveys in the Wilmington East (WE) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Shark	**—**	**—**	**15**	**29**	**6**	**10**	**2**	**55**	**1**	**2**	**6**	**17**	**—**	**—**	**6**	**9**	**122**
White Shark	—	—	—	1	—	—	—	—	—	—	—	1	—	—	1	2	4
Carcharhinidae (unid.)	—	—	13	16	—	1	—	2	—	—	3	5	—	—	—	—	24
Scalloped Hammerhead*	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	2
Hammerhead (unid.)*	—	—	1	1	5	7	—	6	—	1	—	1	—	—	1	3	19
Spurdog	—	—	—	—	—	—	—	44	—	—	3	10	—	—	—	—	54
species unknown	—	—	1	11	1	1	2	2	1	1	—	—	—	—	4	4	19
Ray	**—**	**—**	**—**	**4**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**2**	**—**	**—**	**—**	**—**	**6**
Cownose Ray	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	2
species unknown	—	—	—	2	—	—	—	—	—	—	2	2	—	—	—	—	4
Totals	**—**	**—**	**15**	**33**	**6**	**10**	**2**	**55**	**1**	**2**	**8**	**19**	**—**	**—**	**6**	**9**	**128**

*Listed under the Endangered Species Act

**Significantly submerged

Table F–8. Ray and shark species identified in the February 2018 through February 2020 surveys in the Grand Strand Call Area (GSCA; counts include part of WW)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Shark	**—**	**—**	**1**	**3**	**—**	**1**	**22**	**84**	**2**	**15**	**10**	**46**	**—**	**—**	**1**	**2**	**151**
White Shark	—	—	1	3	—	—	—	—	—	—	—	1	—	—	—	1	5
Carcharhinidae (unid.)	—	—	—	—	—	—	6	25	—	12	2	7	—	—	—	—	44
Dusky Shark	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Great Hammerhead	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Smooth Hammerhead	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Scalloped Hammerhead*	—	—	—	—	—	—	—	2	—	—	—	1	—	—	—	—	3
Hammerhead (unid.)*	—	—	—	—	—	—	4	8	—	—	2	4	—	—	—	—	12
Spurdog	—	—	—	—	—	—	5	40	—	—	3	30	—	—	—	—	70
species unknown	—	—	—	—	—	—	7	7	2	3	3	3	—	—	1	1	14
Ray	**—**	**—**	**—**	**—**	**2**	**4**	**3**	**3**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**7**
Giant Manta Ray*	—	—	—	—	2	2	—	—	—	—	—	—	—	—	—	—	2
Giant Devil Ray	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Chilean Devil Ray	—	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	2
Cownose Ray	—	—	—	—	—	1	1	1	—	—	—	—	—	—	—	—	2
Totals	**—**	**—**	**1**	**3**	**2**	**5**	**25**	**87**	**2**	**15**	**10**	**46**	**—**	**—**	**1**	**2**	**158**

*Listed under the Endangered Species Act

**Significantly submerged

F.2 Species Composition and Density (per km^2) by Survey Area for Each Survey

Table F–9. Density (per km^2) of rays for each area during the February 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Giant Manta Ray*	0.0005				0.0005						0.0004
Giant Devil Ray	0.0005				0.0005						0.0004
Cownose/Bullnose Ray	0.0005				0.0005						0.0004
Totals	**0.0016**	**—**	**—**	**—**	**0.0015**	**—**	**—**	**—**	**—**	**—**	**0.0013**

*Listed under the Endangered Species Act

Table F–10. Density (per km^2) of rays for each area during the February 2020 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Giant Devil Ray	0.0005				0.0005						0.0004
Cownose/Bullnose Ray	0.0005				0.0005						0.0004
Cownose Ray								0.0256		0.0052	0.0009
species unknown	0.0010				0.0010			0.0256		0.0052	0.0017
Total	**0.0021**	**—**	**—**	**—**	**0.0021**	**—**	**—**	**0.0512**	**0.0000**	**0.0104**	**0.0034**

Table F–11. Density (per km^2) of rays for each area during the May/June 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Giant Manta Ray*	0.0017				0.0017				0.0099	0.0051	0.0023
Giant Devil Ray	0.0029				0.0028				0.0049	0.0026	0.0028
Chilean Devil Ray	0.0023				0.0023	0.0272				0.0051	0.0028
Bullnose Ray	0.0046				0.0045						0.0037
Cownose/Bullnose Ray	0.0554				0.0543	5.8016				1.0963	0.2423
Cownose Ray	0.2163				0.2119	38.8995			0.0049	7.3530	1.5003
species unknown	0.0046				0.0045						0.0037
Totals	**0.2878**	**—**	**—**	**—**	**0.2820**	**44.7283**	**—**	**—**	**0.0198**	**8.4621**	**1.7579**

*Listed under the Endangered Species Act

Table F–12. Density (per km^2) of rays for each area during the May 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Giant Manta Ray*	0.0031				0.0031						0.0026
Giant Devil Ray	0.0010			0.0330	0.0010						0.0009
Chilean Devil Ray	0.0016				0.0015				0.0091	0.0049	0.0021
Atlantic Devil Ray						0.0136				0.0025	0.0004
Spotted Eagle Ray	0.0042				0.0041		0.0284			0.0025	0.0038
Cownose/Bullnose Ray	0.0031				0.0031		0.0284			0.0025	0.0030
Cownose Ray	7.5710				7.4336				0.0045		6.1441
species unknown	0.0121				0.0118					0.0025	0.0098
Total	**7.5962**	**—**	**—**	**0.0330**	**7.4583**	**0.0136**	**0.0568**	**0.0000**	**0.0136**	**0.0147**	**6.1666**

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Table F–13. Density (per km^2) of rays for each area during the October 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Giant Manta Ray*	0.0011				0.0011						0.0009
Giant Devil Ray	0.0022				0.0022						0.0018
Chilean Devil Ray	0.0006				0.0005						0.0004
Spotted Eagle Ray	0.0011				0.0011						0.0009
Cownose/Bullnose Ray	0.0664				0.0651						0.0531
Cownose Ray	0.3728				0.3657						0.2980
species unknown	0.0050				0.0049						0.0040
Totals	**0.4491**	**—**	**—**	**—**	**0.4405**	**—**	**—**	**—**	**—**	**—**	**0.3590**

*Listed under the Endangered Species Act

Table F–14. Density (per km^2) of rays for each area during the September 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Atlantic Stingray	0.0005				0.0005						0.0004
Giant Manta Ray*	0.0052				0.0051						0.0043
Giant Devil Ray	0.0026				0.0026						0.0021
Chilean Devil Ray	0.0005				0.0005						0.0004
Spotted Eagle Ray	0.0016				0.0015		0.0284			0.0026	0.0017
Cownose/Bullnose Ray	0.3151				0.3094						0.2585
Cownose Ray	1.4582				1.4319	0.0136				0.0026	1.1966
species unknown	0.0563				0.0553	0.0136		0.0256		0.0078	0.0475
Total	**1.8401**	**—**	**—**	**—**	**1.8069**	**0.0272**	**0.0284**	**0.0256**	**—**	**0.0130**	**1.5115**

*Listed under the Endangered Species Act

Table F–15. Density (per km^2) of rays for each area during the December 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Cownose/Bullnose Ray	0.0005				0.0005						0.0004
Cownose Ray	0.3096				0.3040						0.2526
species unknown	0.0047				0.0046						0.0038
Totals	**0.3149**	**—**	**—**	**—**	**0.3091**	**—**	**—**	**—**	**—**	**—**	**0.2568**

Table F–16. Density (per km^2) of rays for each area during the December 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Spotted Eagle Ray	0.0010				0.0010						0.0009
Cownose/Bullnose Ray	0.0707				0.0695						0.0610
species unknown	0.0021				0.0021						0.0018
Total	**0.0739**	**—**	**—**	**—**	**0.0726**	**—**	**—**	**—**	**—**	**—**	**0.0637**

Table F–17. Density (per km^2) of sharks for each area during the February 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Basking Shark	0.0130				0.0128						0.0107
White Shark	0.0042				0.0041						0.0034
Carcharhinidae (unid.)	0.0021				0.0020						0.0017
Silky Shark	0.0005				0.0005						0.0004
Tiger Shark	0.0005				0.0005						0.0004
Smooth Hammerhead	0.0037				0.0036						0.0030
Scalloped Hammerhead*	0.0031				0.0031						0.0026
Hammerhead (unid.)*	0.0945				0.0928						0.0774
species unknown	0.0235				0.0231						0.0193
Totals	**0.1451**	**—**	**—**	**—**	**0.1425**	**—**	**—**	**—**	**—**	**—**	**0.1189**

*Listed under the Endangered Species Act

Table F–18. Density (per km^2) of sharks for each area during the February 2020 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
White Shark	0.0031				0.0031			0.0128	0.0151	0.0104	0.0043
Carcharhinidae (unid.)	0.0073		0.3846		0.0077			0.2048		0.0415	0.0133
Tiger Shark	0.0005				0.0005						0.0004
Great Hammerhead	0.0005				0.0005						0.0004
Hammerhead (unid.)*	0.0010				0.0010			0.0128		0.0026	0.0013
Spurdog						0.4360				0.0831	0.0138
species unknown	0.0063				0.0062			0.1408		0.0286	0.0099
Total	**0.0189**	**—**	**0.3846**	**—**	**0.0191**	**0.4360**	**—**	**0.3711**	**0.0151**	**0.1661**	**0.0434**

*Listed under the Endangered Species Act

Table F–19. Density (per km^2) of sharks for each area during the May/June 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Thresher Shark	0.0012				0.0011						0.0009
White Shark	0.0058				0.0057						0.0046
Carcharhinidae (unid.)	0.0519				0.0509	0.0136		0.0128		0.0051	0.0426
Smooth Hammerhead	0.0035				0.0034				0.0049	0.0026	0.0032
Scalloped Hammerhead*	0.0029				0.0028			0.0128		0.0026	0.0028
Hammerhead (unid.)*	0.0219			0.0330	0.0215			0.0893		0.0180	0.0208
Spurdog	0.2053			0.0661	0.2012						0.1649
species unknown	0.0513				0.0503			0.0128		0.0026	0.0417
Totals	**0.3437**	**—**	**—**	**0.0991**	**0.3368**	**0.0136**	**—**	**0.1276**	**0.0049**	**0.0308**	**0.2816**

*Listed under the Endangered Species Act

Table F–20. Density (per km^2) of sharks for each area during the May 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale Shark*	0.0005				0.0005						0.0004
White Shark	0.0042				0.0041						0.0034
Blacktip Shark	0.0939				0.0922						0.0762
Blue Shark	0.0016				0.0015	0.0136				0.0025	0.0017
Carcharhinidae (unid.)	0.1558	0.4237			0.1530	0.0136	0.3122	0.0256	0.1132	0.0859	0.1413
Dusky Shark									0.0045	0.0025	0.0004
Tiger Shark	0.0005				0.0005						0.0004
Great Hammerhead	0.0031				0.0031				0.0045	0.0025	0.0030
Smooth Hammerhead	0.0037	0.4237		0.0661	0.0036						0.0030
Scalloped Hammerhead*	0.0163				0.0170			0.0128	0.0091	0.0074	0.0153
Hammerhead (unid.)*	0.0525				0.0515	0.0409	0.0284	0.0768	0.0362	0.0442	0.0502
Spurdog	0.1249	0.4237			0.1226		0.1419	0.5631	0.1811	0.2110	0.1379
species unknown	0.0456			0.0330	0.0448		0.0284	0.0256	0.0317	0.0245	0.0413
Total	**0.5026**	**1.2712**	**—**	**0.0991**	**0.4945**	**0.0681**	**0.5109**	**0.7039**	**0.3803**	**0.3802**	**0.4746**

*Listed under the Endangered Species Act

Table F–21. Density (per km^2) of sharks for each area during the October 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
White Shark	0.0022				0.0022	0.0136				0.0024	0.0022
Carcharhinidae (unid.)	0.0896				0.0879	0.0408			0.0533	0.0358	0.0783
Smooth Hammerhead	0.0006				0.0005						0.0004
Scalloped Hammerhead*	0.0033				0.0033		0.0240			0.0024	0.0031
Hammerhead (unid.)*	0.0160				0.0157			0.0128		0.0024	0.0133
Spurdog	0.0033				0.0033						0.0027
species unknown	0.0216				0.0212			0.0128	0.0133	0.0096	0.0190
Totals	**0.1366**	**—**	**—**	**—**	**0.1340**	**0.0543**	**0.0240**	**0.0255**	**0.0666**	**0.0525**	**0.1189**

*Listed under the Endangered Species Act

Table F–22. Density (per km^2) of sharks for each area during the September 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale Shark*	0.0005				0.0005						0.0004
White Shark	0.0021				0.0020	0.0136		0.0128	0.0051	0.0078	0.0030
Carcharhinidae (unid.)	0.0110				0.0108	0.0817	0.0568	0.0640	0.0354	0.0520	0.0175
Tiger Shark	0.0016				0.0015						0.0013
Great Hammerhead	0.0010				0.0010						0.0009
Smooth Hammerhead	0.0005				0.0005		0.0284			0.0026	0.0009
Scalloped Hammerhead*	0.0010				0.0010				0.0051	0.0026	0.0013
Hammerhead (unid.)*	0.0073			0.0991	0.0087	0.0136	0.0284	0.0128	0.0202	0.0182	0.0103
Spurdog	0.0897		1.9231	0.0330	0.0912	0.0136		0.1281	0.1515	0.1144	0.0950
species unknown	0.0219				0.0215	0.0136	0.0852		0.0152	0.0104	0.0197
Total	**0.1367**	**—**	**1.9231**	**0.1321**	**0.1388**	**0.1362**	**1.9870**	**0.2177**	**0.2323**	**0.2079**	**0.1502**

*Listed under the Endangered Species Act

Table F–23. Density (per km^2) of sharks for each area during the December 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
White Shark	0.0026				0.0026						0.0021
Carcharhinidae (unid.)	0.0005				0.0005						0.0004
Smooth Hammerhead	0.0005				0.0005						0.0004
Scalloped Hammerhead*	0.0010				0.0010						0.0009
Hammerhead (unid.)*	0.0042		0.3831		0.0046						0.0038
Spurdog	0.0010				0.0010						0.0009
species unknown	0.0110				0.0108						0.0089
Totals	**0.0209**	**—**	**0.3831**	**—**	**0.0210**	**—**	**—**	**—**	**—**	**—**	**0.0175**

*Listed under the Endangered Species Act

Table F–24. Density (per km^2) of sharks for each area during the December 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
White Shark	0.0094				0.0093			0.0256	0.0096	0.0111	0.0095
Blacktip Shark	0.0047				0.0046						0.0041
Carcharhinidae (unid.)	0.0650	0.4237			0.0643						0.0564
Bonnethead Shark	0.0005				0.0005						0.0005
Great Hammerhead	0.0005				0.0005						0.0005
Scalloped Hammerhead*	0.0110				0.0108						0.0095
Hammerhead (unid.)*	0.0231				0.0226			0.0384		0.0111	0.0212
species unknown	0.0215				0.0211			0.0512	0.0096	0.0184	0.0208
Total	**0.1357**	**0.4237**	**—**	**—**	**0.1338**	**—**	**—**	**0.1152**	**0.0192**	**0.0406**	**0.1224**

*Listed under the Endangered Species Act

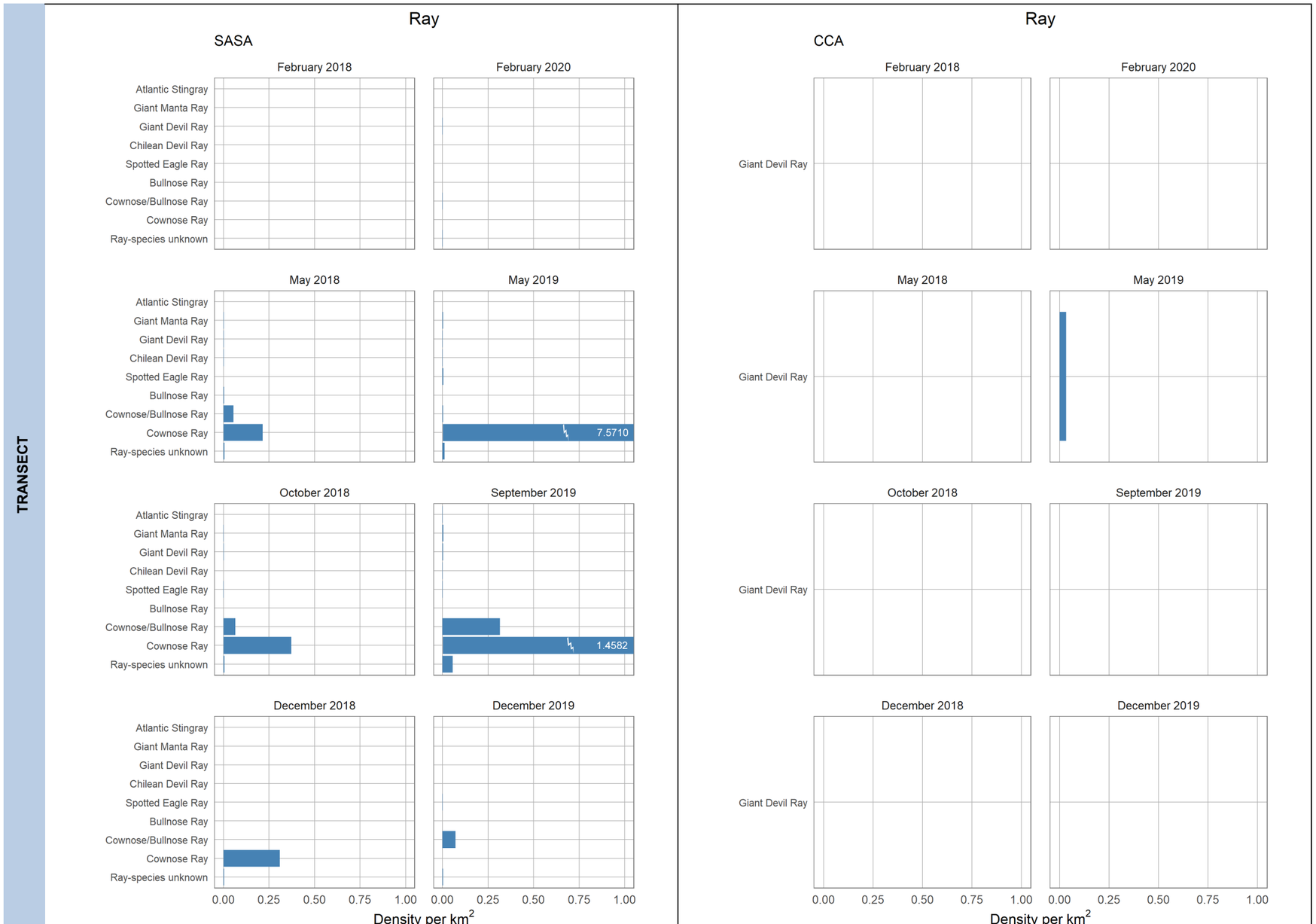


Figure F–1. Density (per km^2) of ray species encountered during the February 2018 through February 2020 surveys for each area by survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

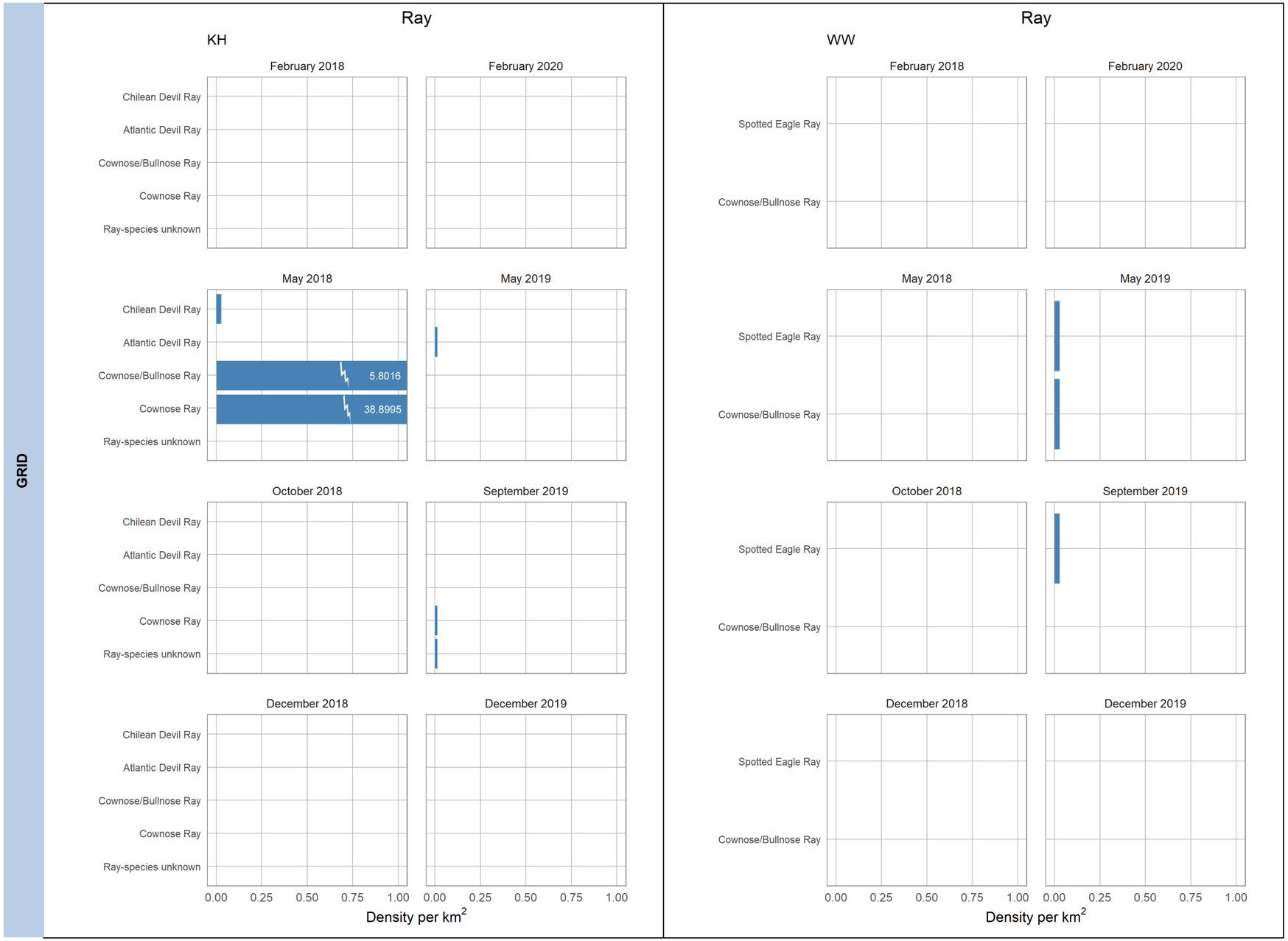


Figure F–1. (Continued)

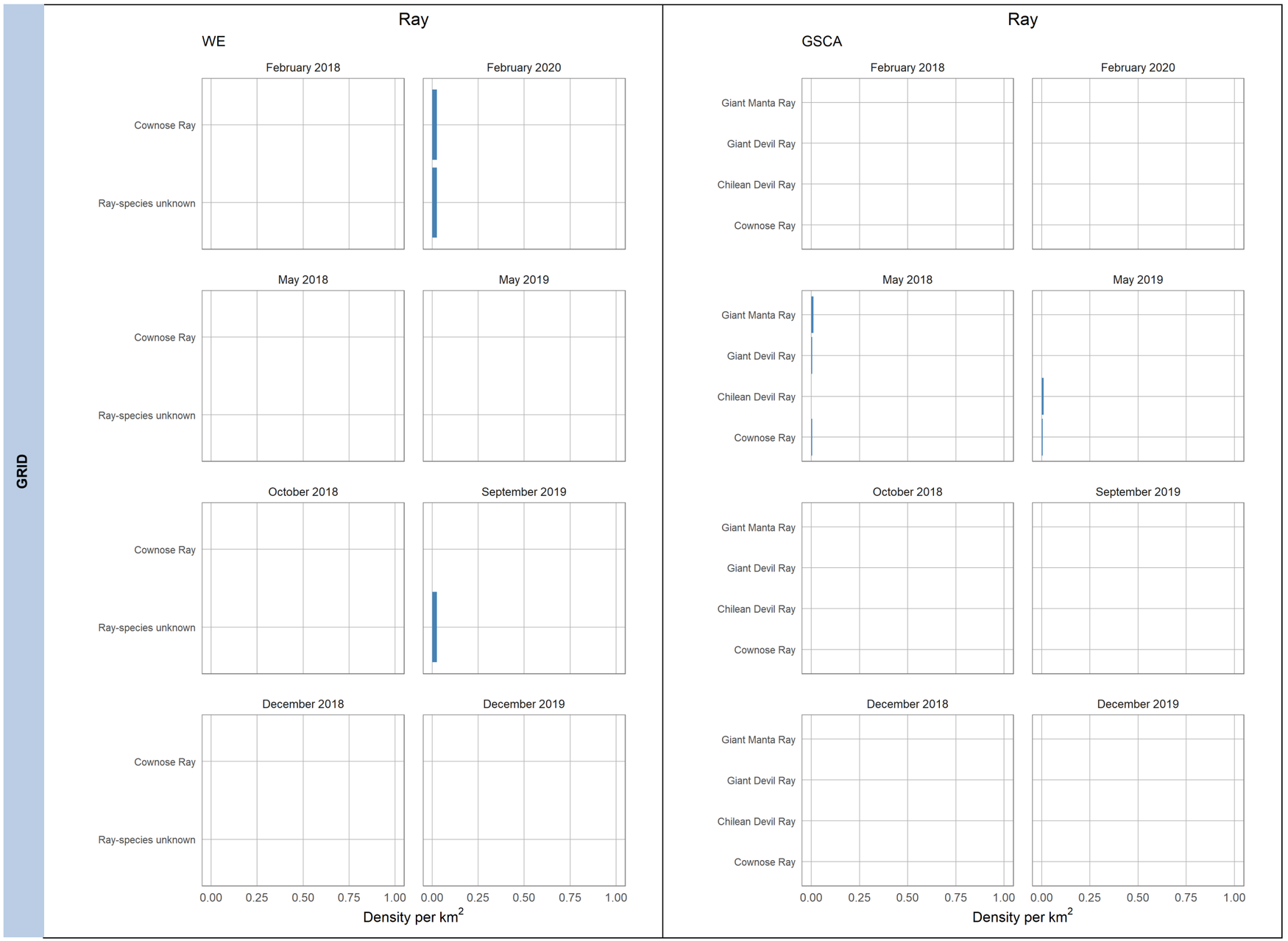


Figure F–1 (Continued)

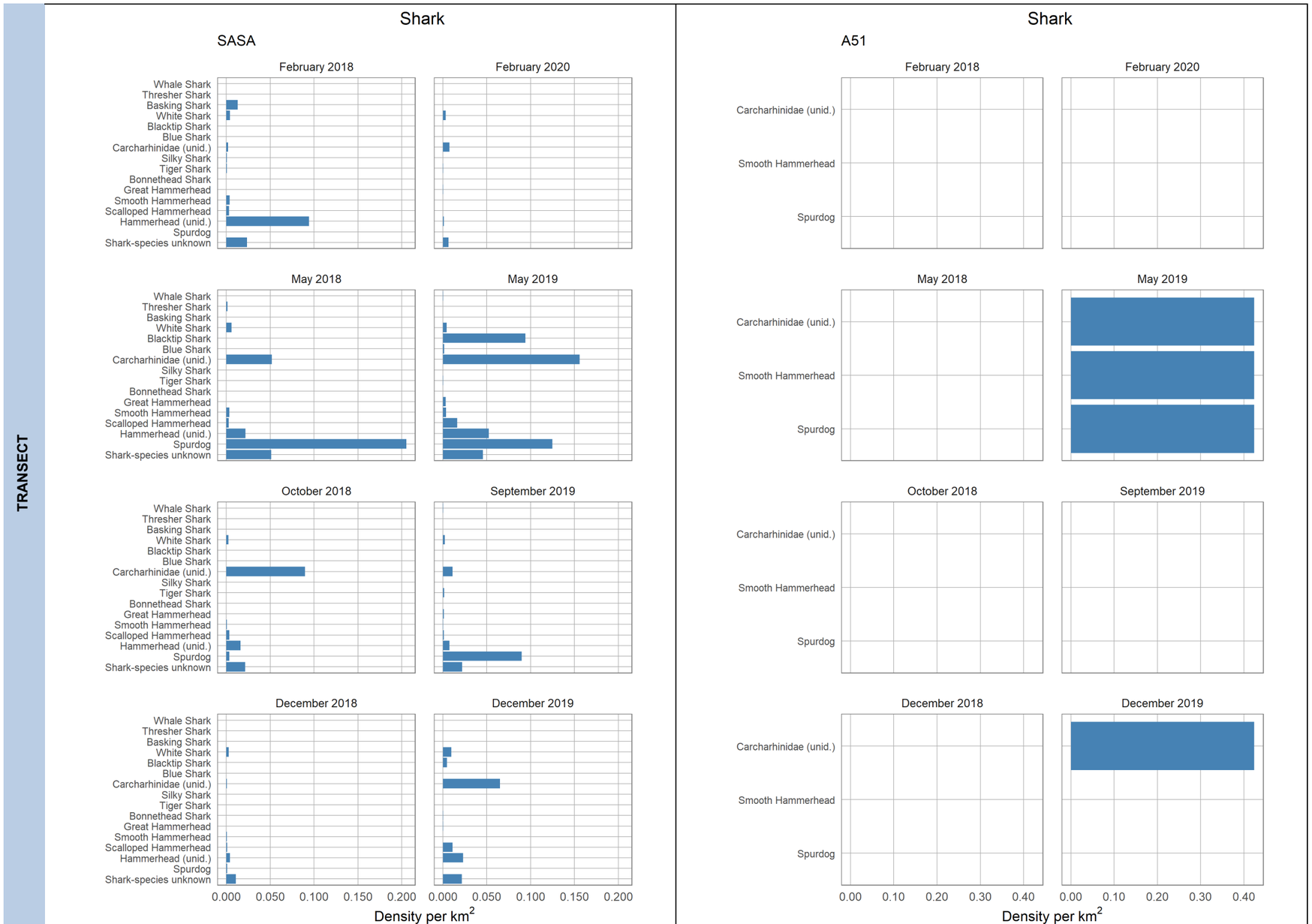


Figure F–2. **Density (per km^2) of shark species encountered during the February 2018 through February 2020 surveys for each area by survey (figure continued below)**
Note: X-axes are scaled according to the maximum density for each area.

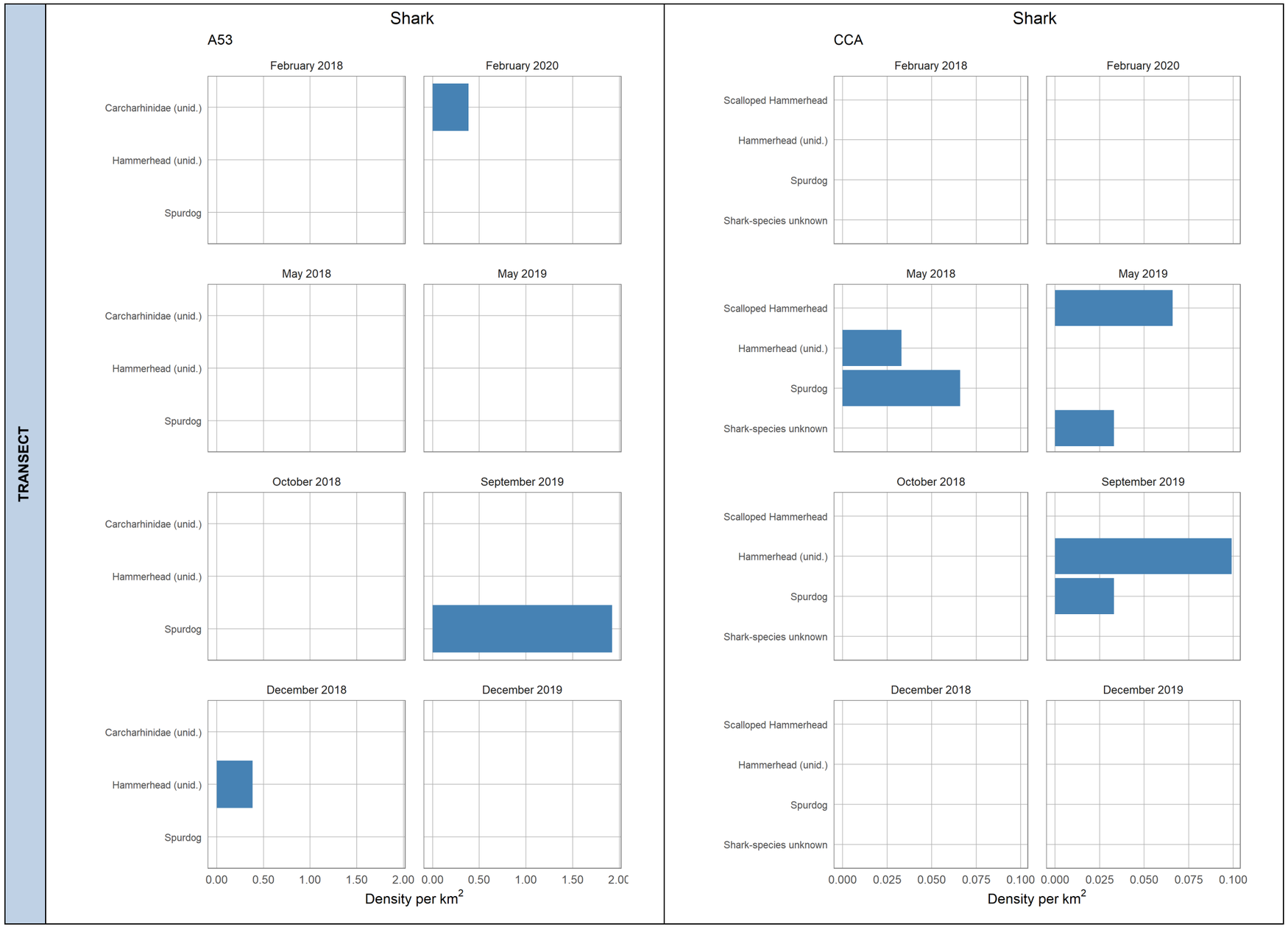


Figure F–2. (Continued)

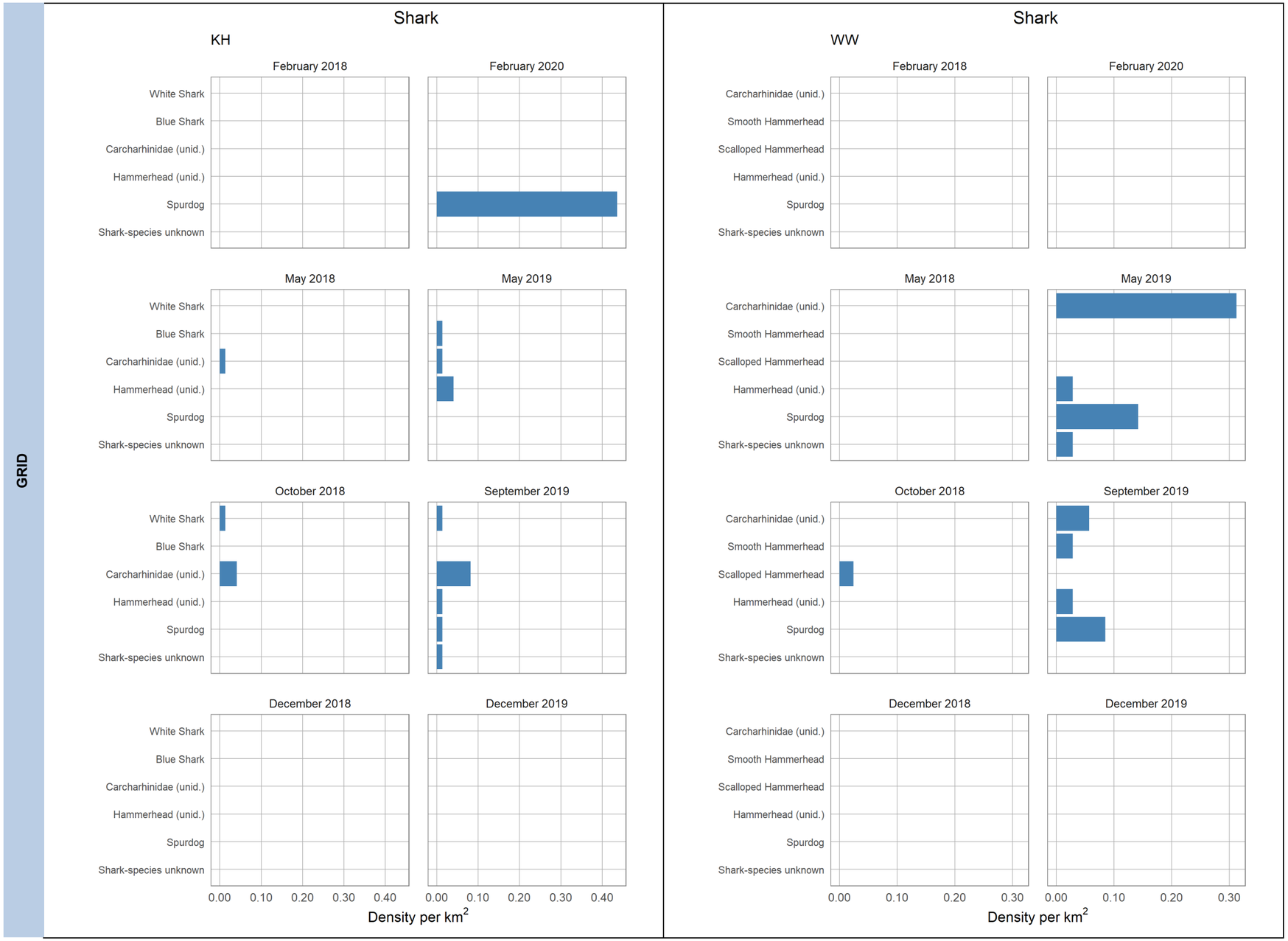


Figure F–2. (Continued)

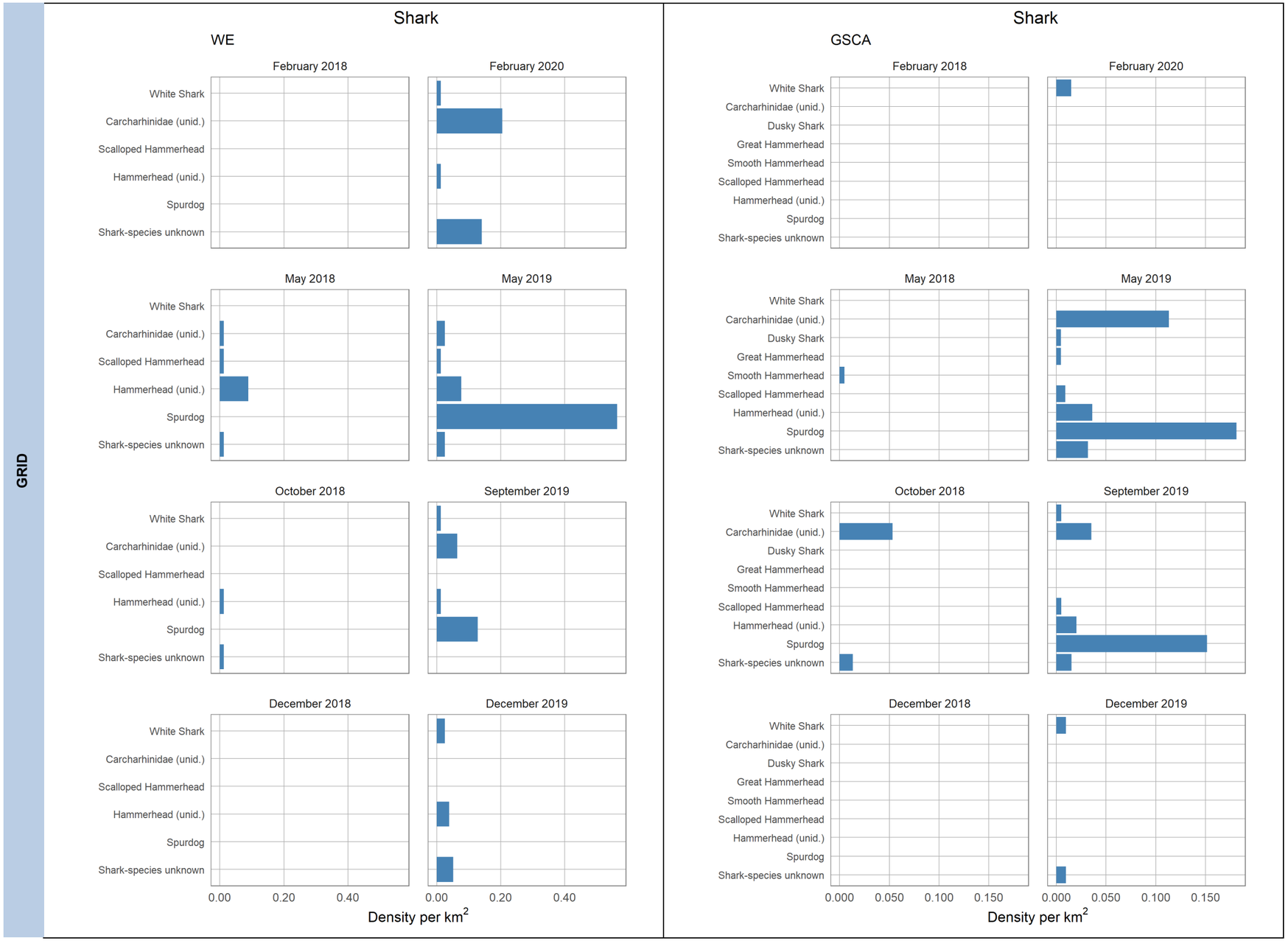


Figure F–2. (Continued)

F.3 Ray and Shark Species Spatial Distribution Maps

F.3.1 Ray

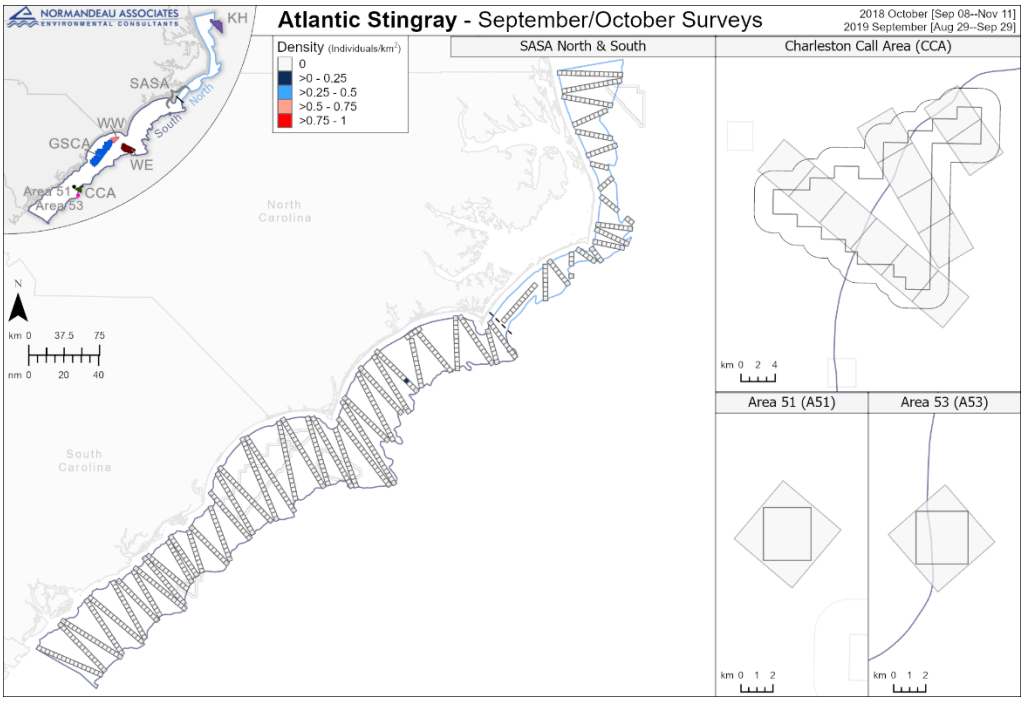


Figure F–3. Spatial distribution of Atlantic stingrays during the September/ October surveys for all areas

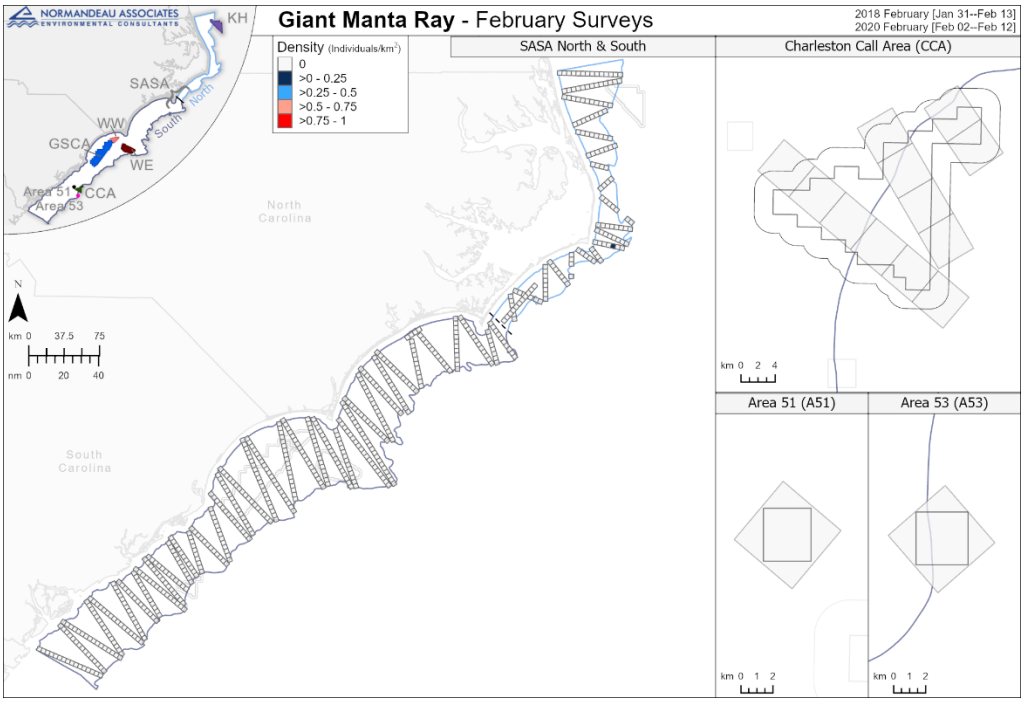


Figure F–4. Spatial distribution of giant manta rays during the February surveys for all areas

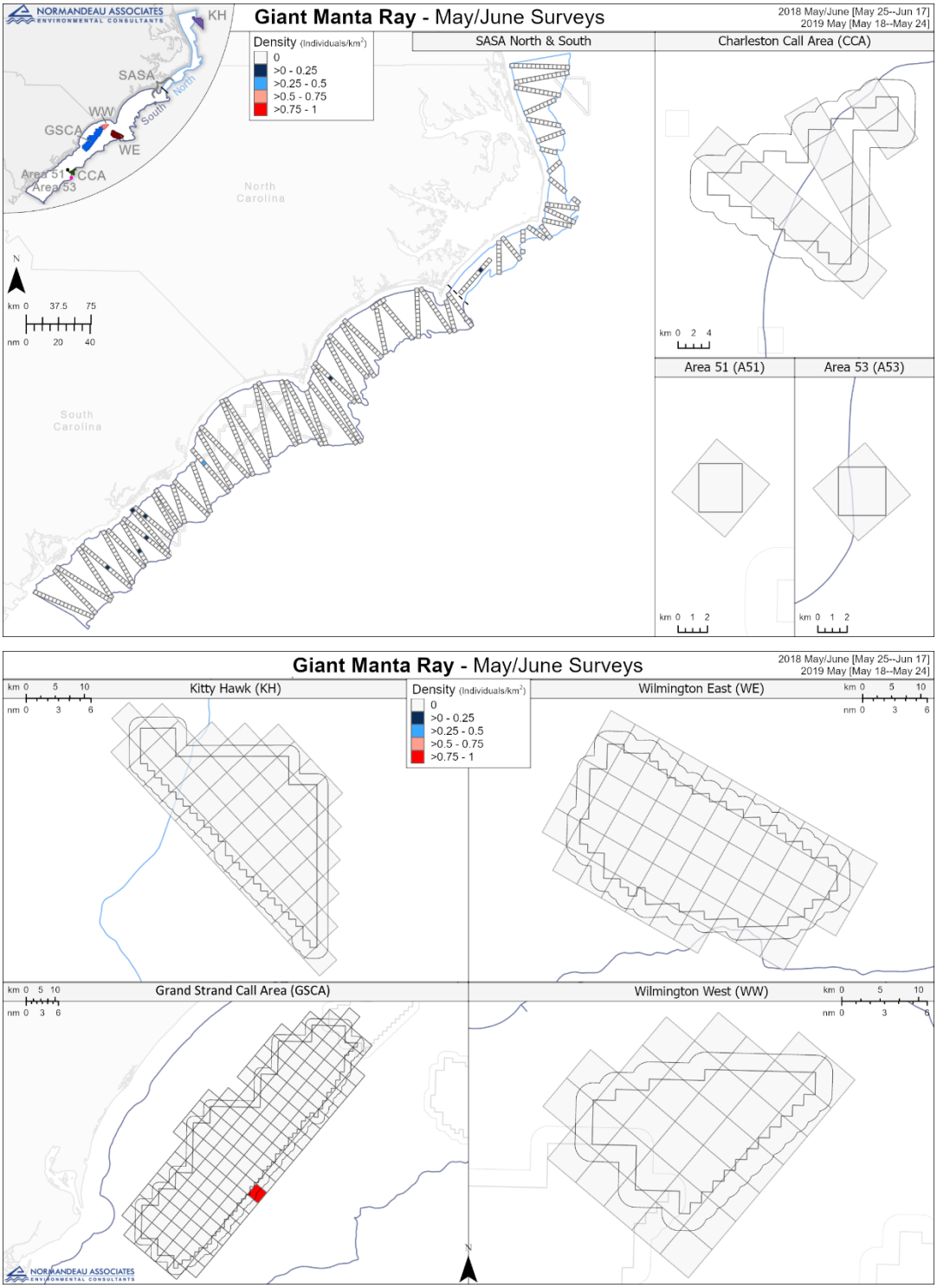


Figure F–5. Spatial distribution of giant manta rays during the May/June surveys for all areas

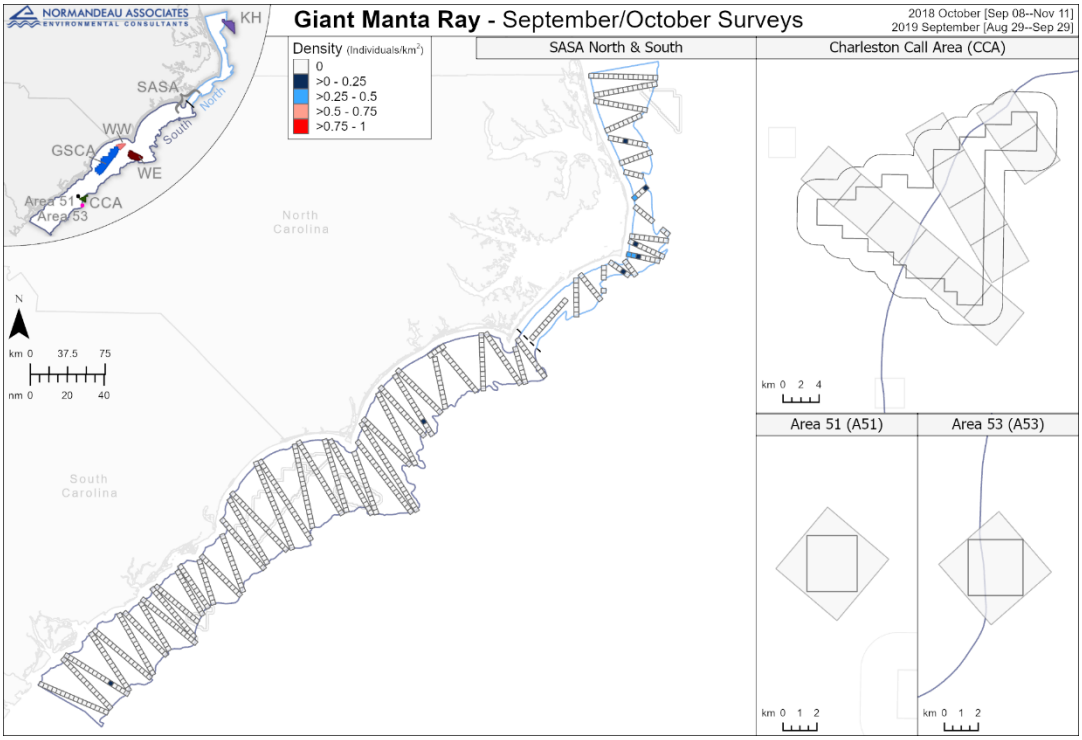


Figure F–6. Spatial distribution of giant manta rays during the September/October surveys for all areas

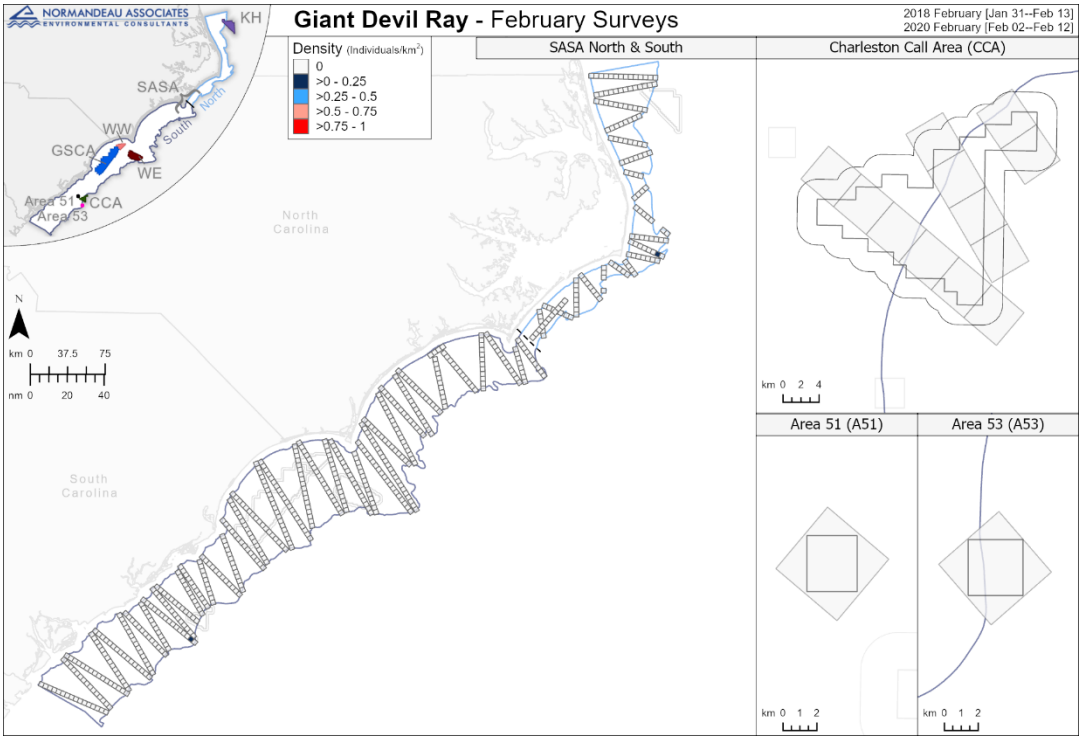


Figure F–7. Spatial distribution of giant devil rays during the February surveys for all areas

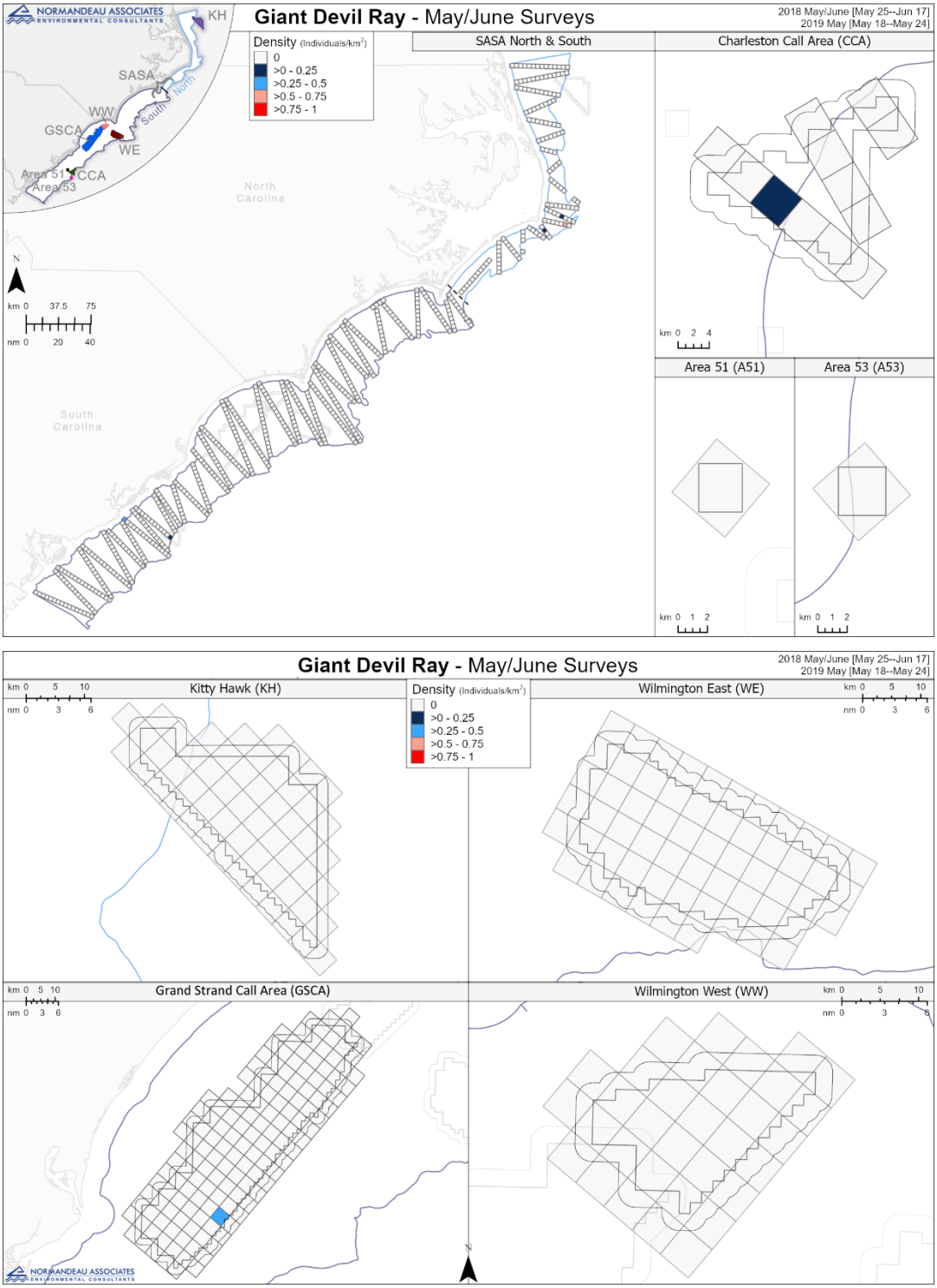


Figure F–8. Spatial distribution of giant devil rays during the May/June surveys for all areas

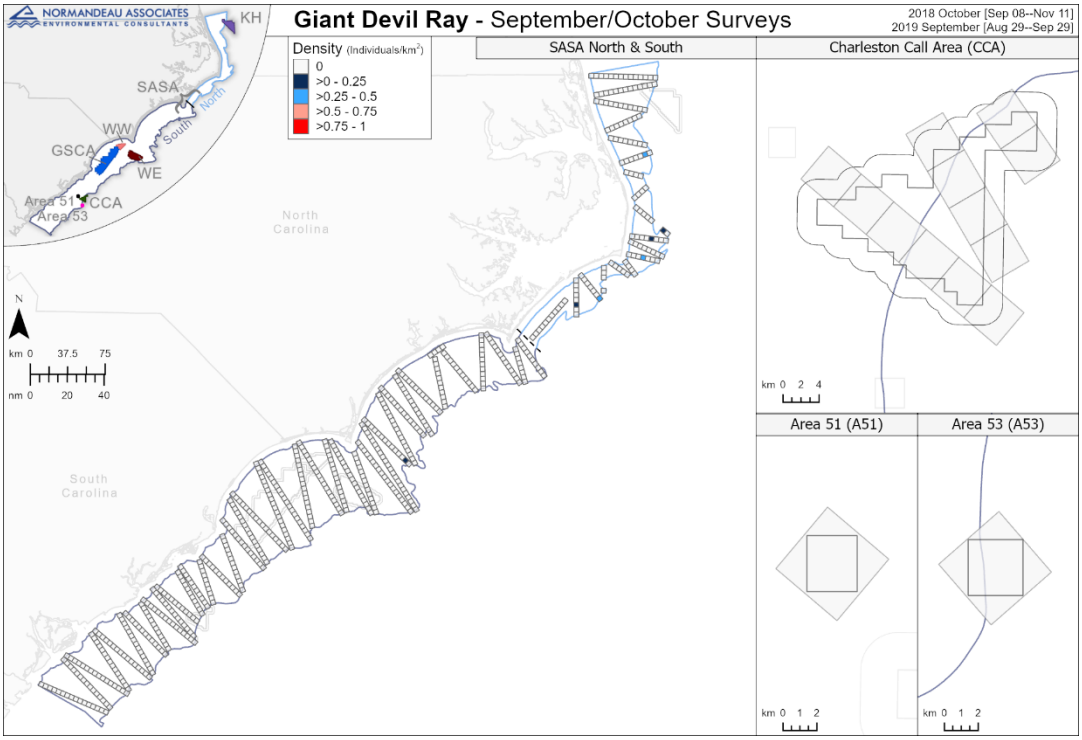


Figure F–9. Spatial distribution of giant devil rays during the September/October surveys for all areas

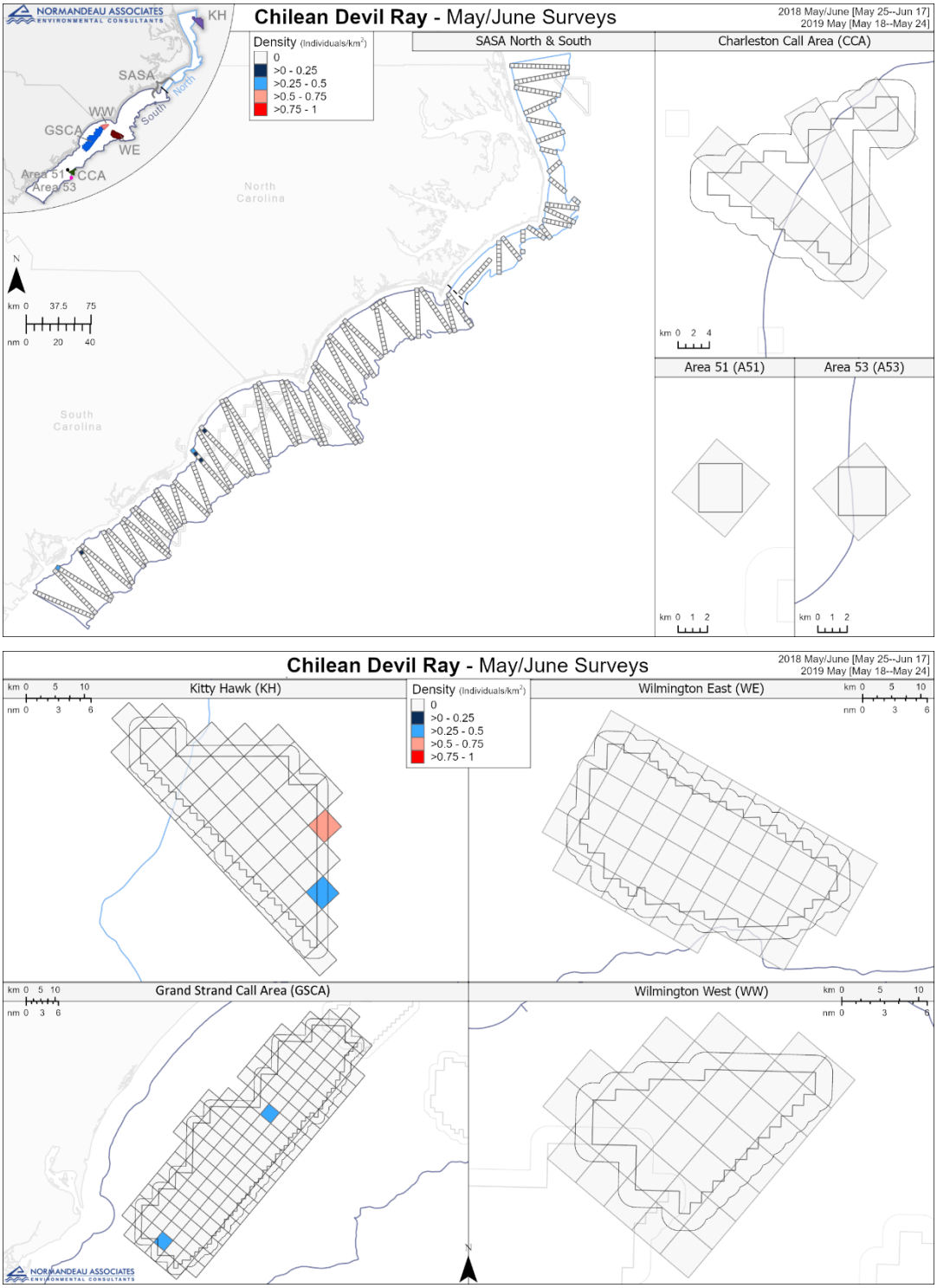


Figure F–10. Spatial distribution of Chilean devil rays during the May/June surveys for all areas

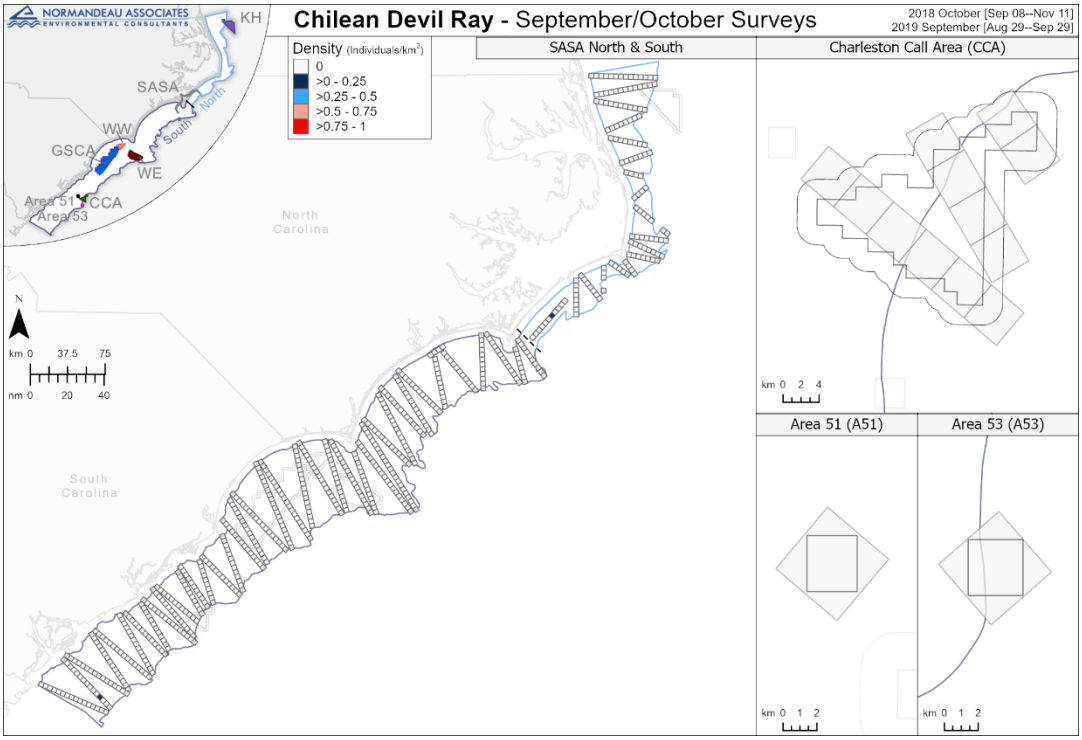


Figure F–11. Spatial distribution of Chilean devil rays during the September/ October surveys for all areas

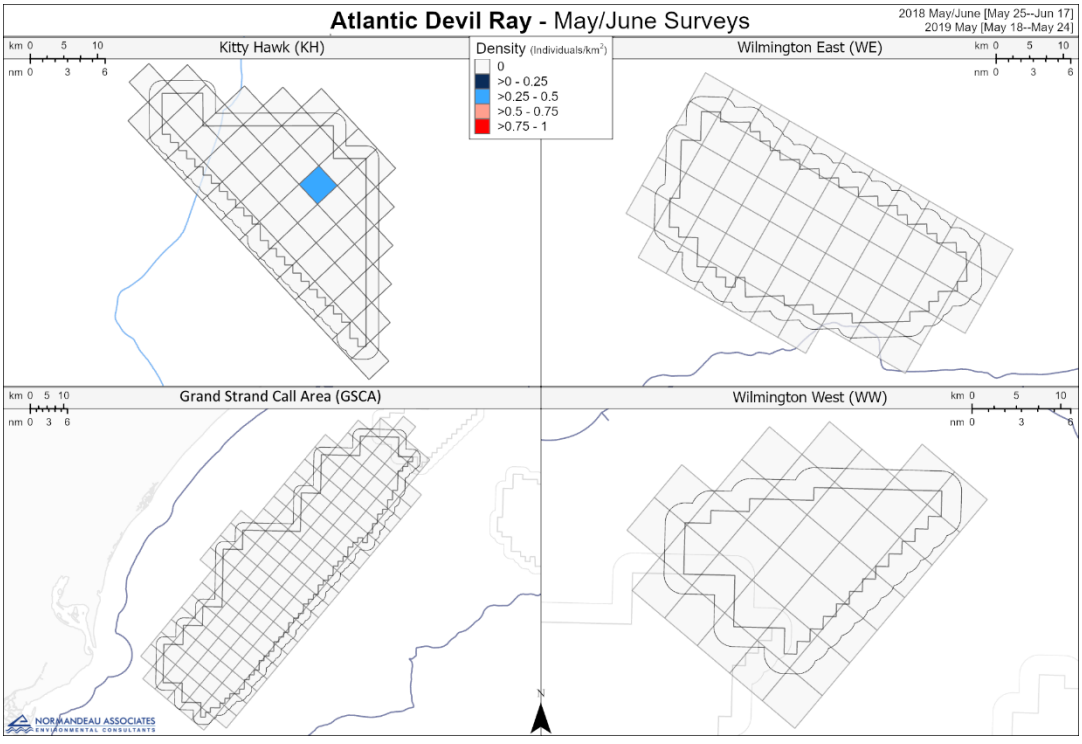


Figure F–12. Spatial distribution of Atlantic devil rays during the May/June surveys for all areas

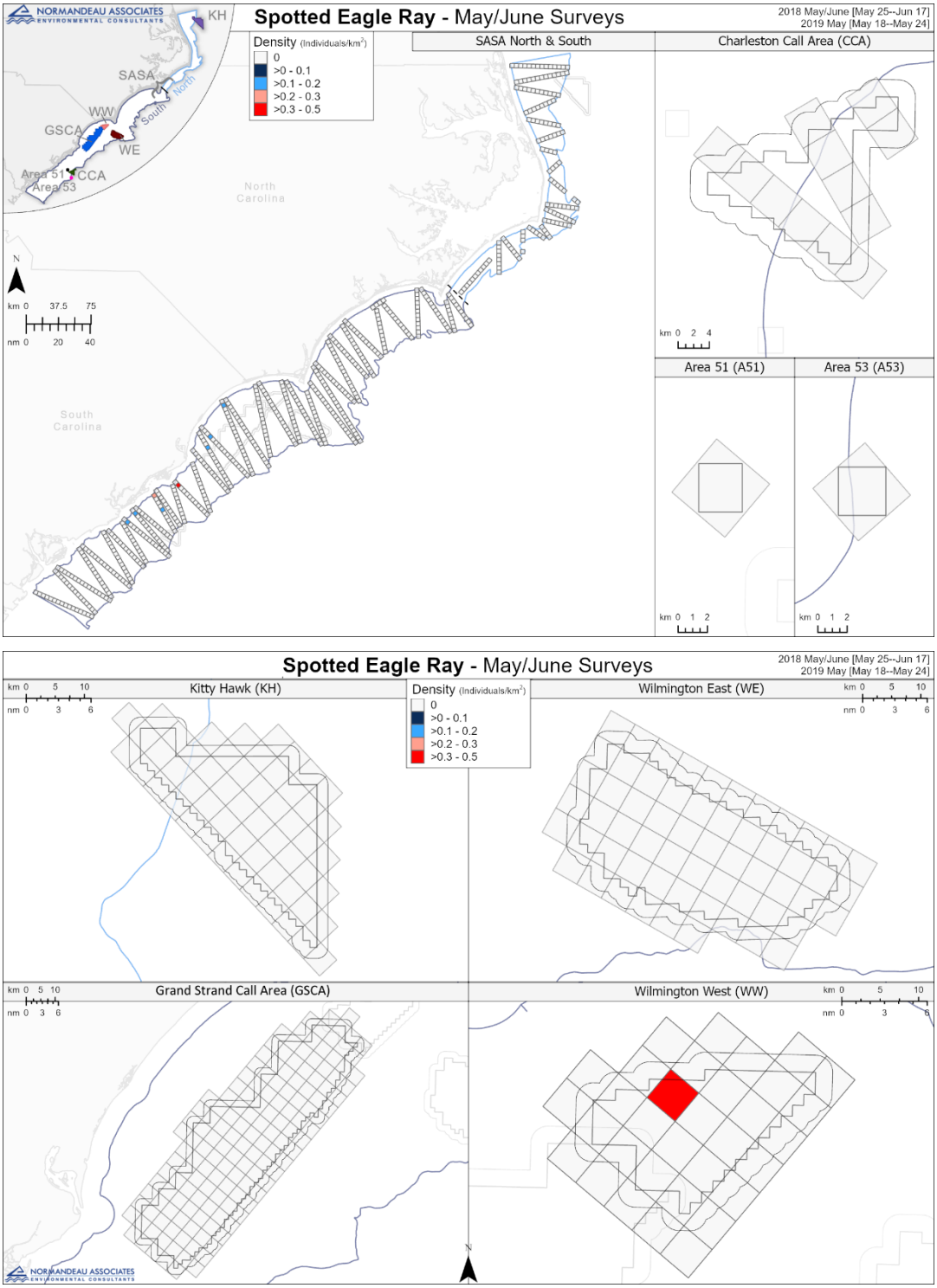


Figure F–13. Spatial distribution of spotted eagle rays during the May/June surveys for all areas

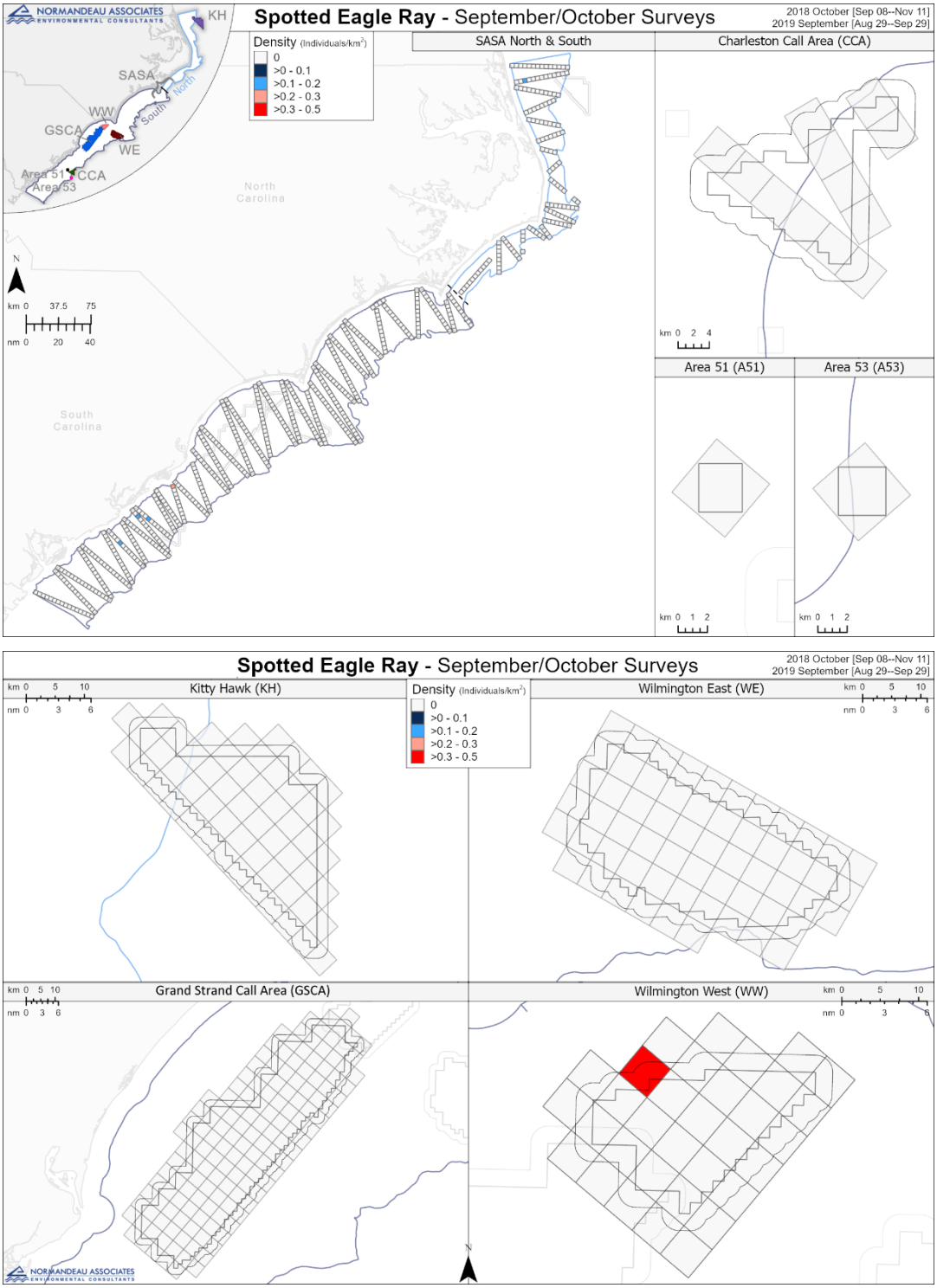


Figure F–14. Spatial distribution of spotted eagle rays during the September/ October surveys for all areas

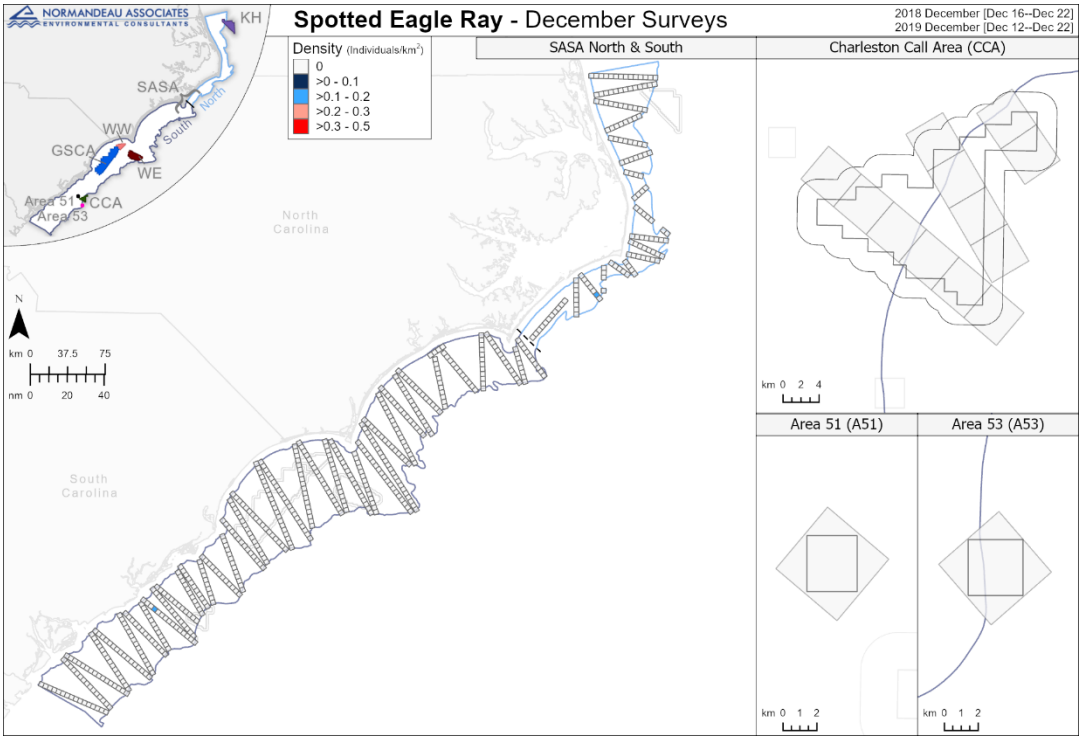


Figure F–15. Spatial distribution of spotted eagle rays during the December surveys for all areas

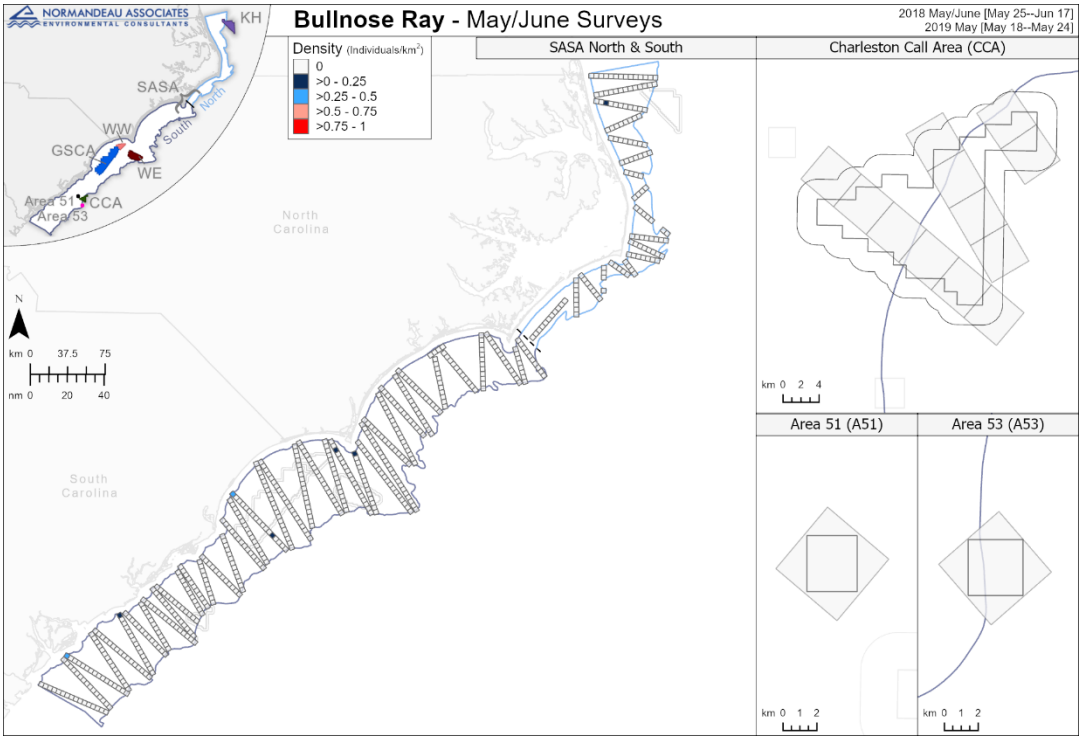


Figure F–16. Spatial distribution of bullnose rays during the May/June surveys for all areas

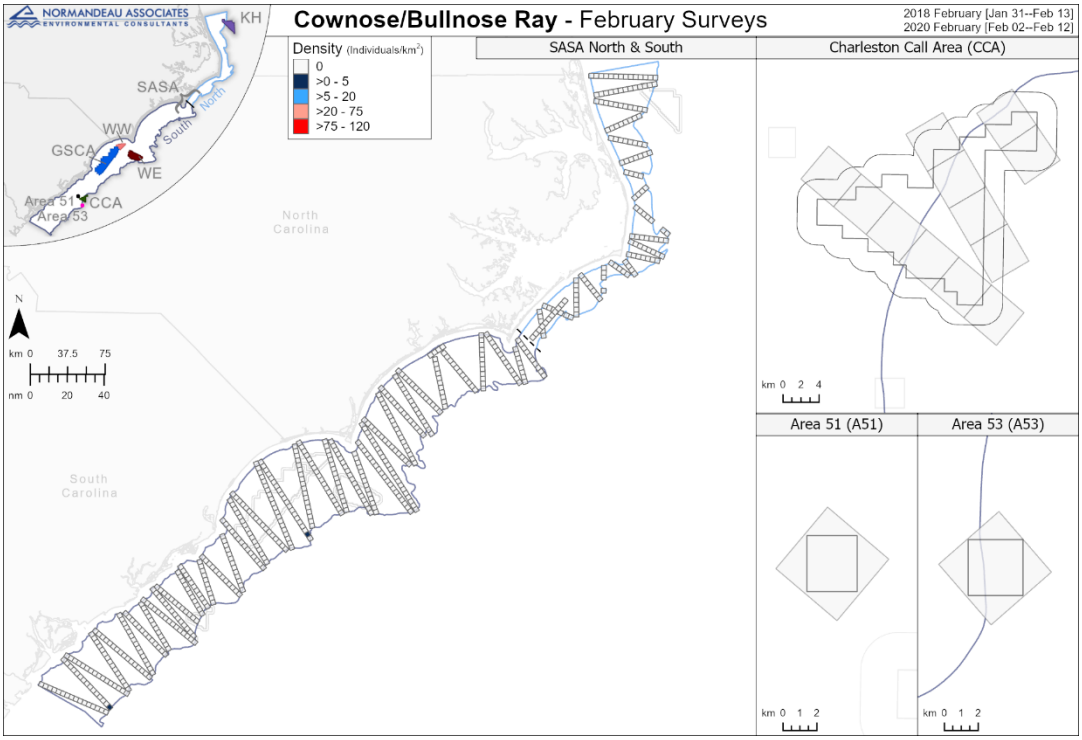


Figure F–17. Spatial distribution of cownose/bullnose rays during the February surveys for all areas

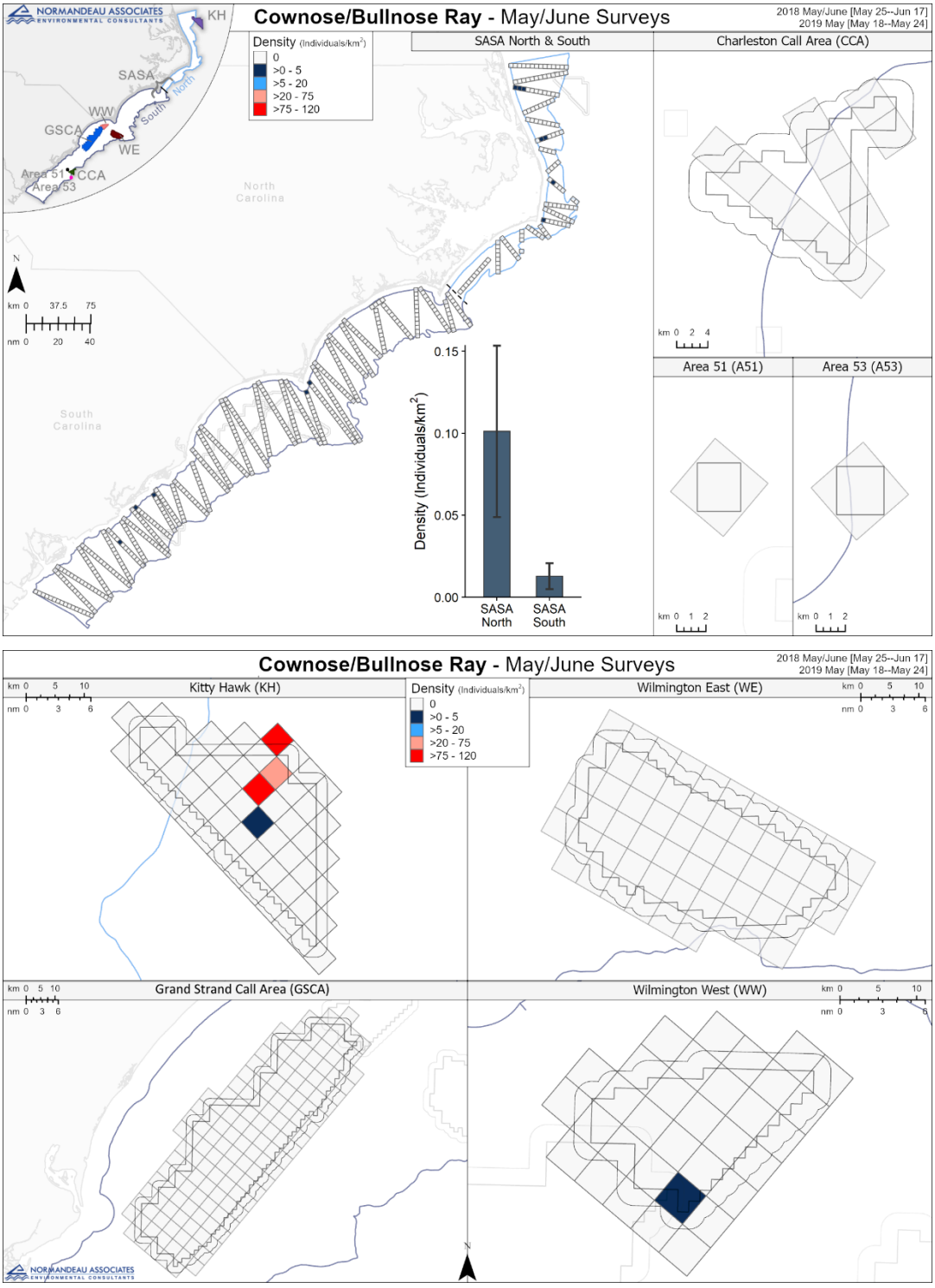


Figure F–18. Spatial distribution of cownose/bullnose rays during the May/June surveys for all areas

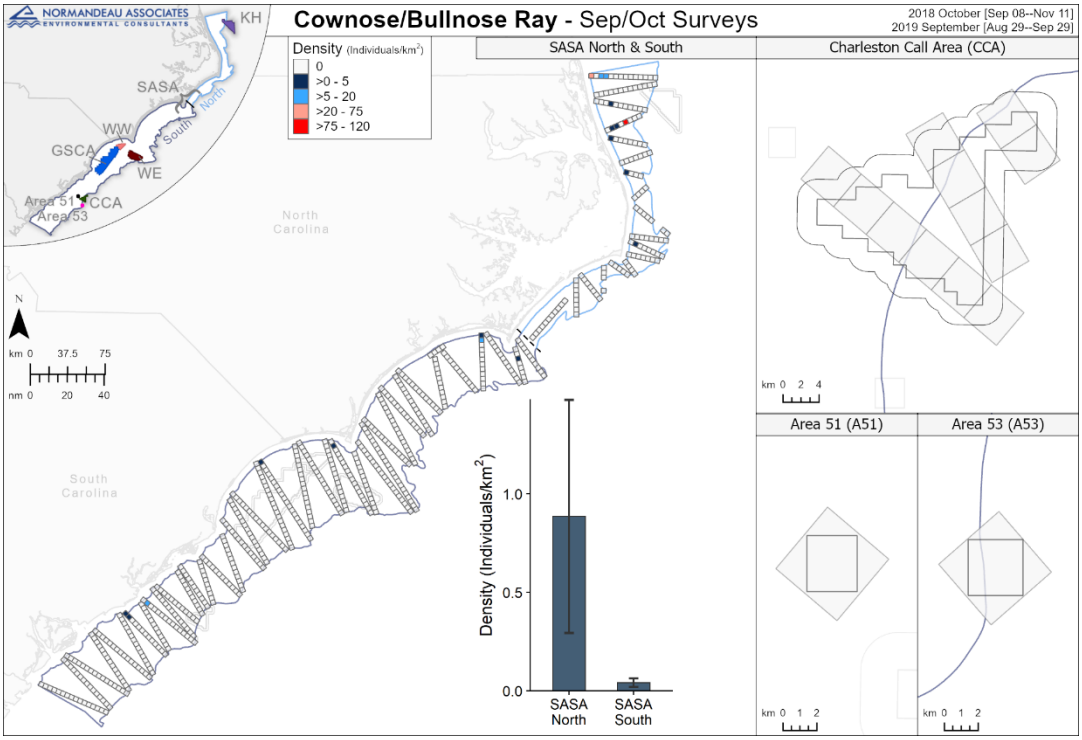


Figure F–19. Spatial distribution of cownose/bullnose rays during the September/ October surveys for all areas

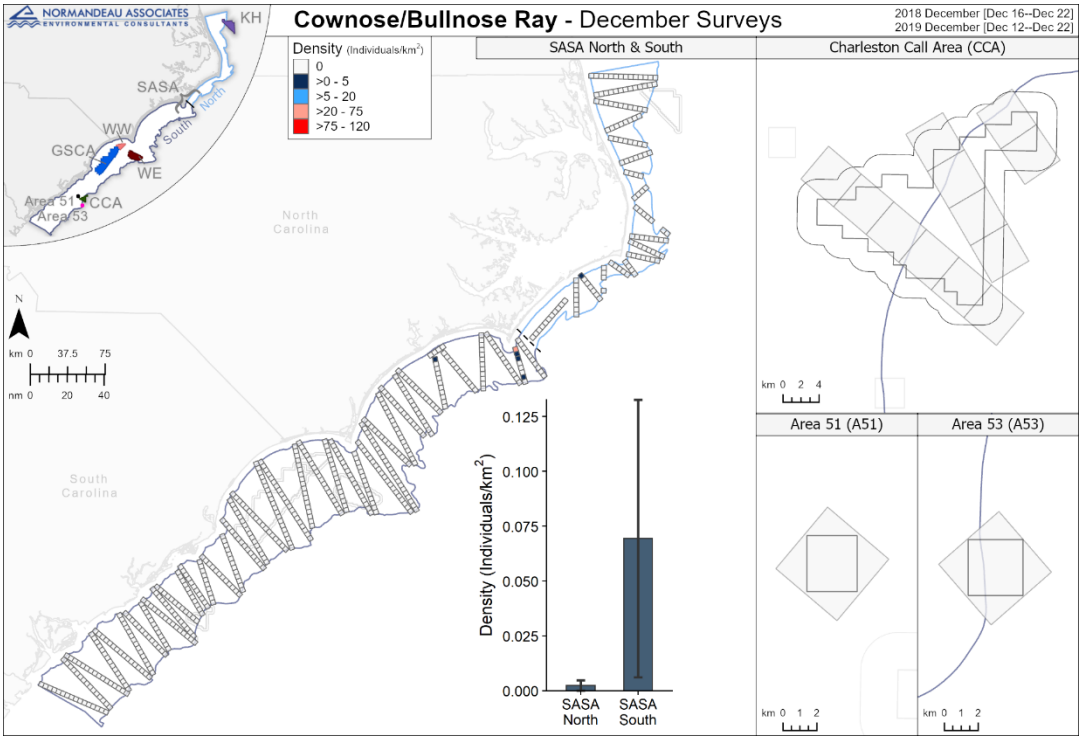


Figure F–20. Spatial distribution of cownose/bullnose rays during the December surveys for all areas

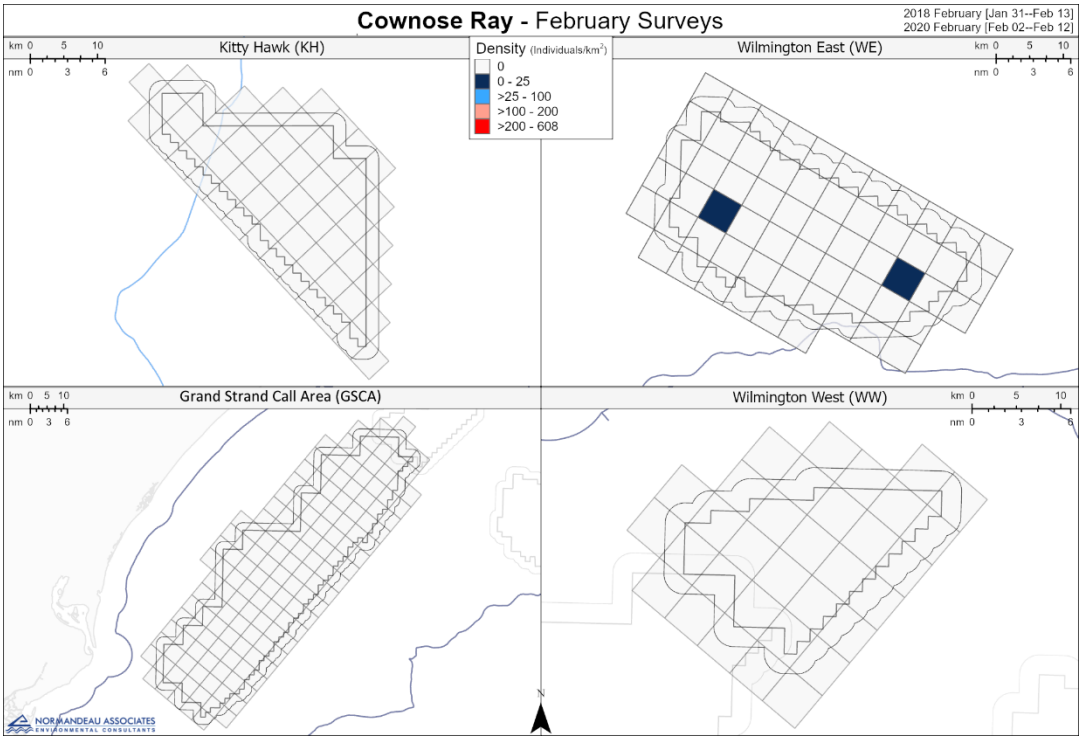


Figure F–21. Spatial distribution of cownose rays during the February surveys for all areas

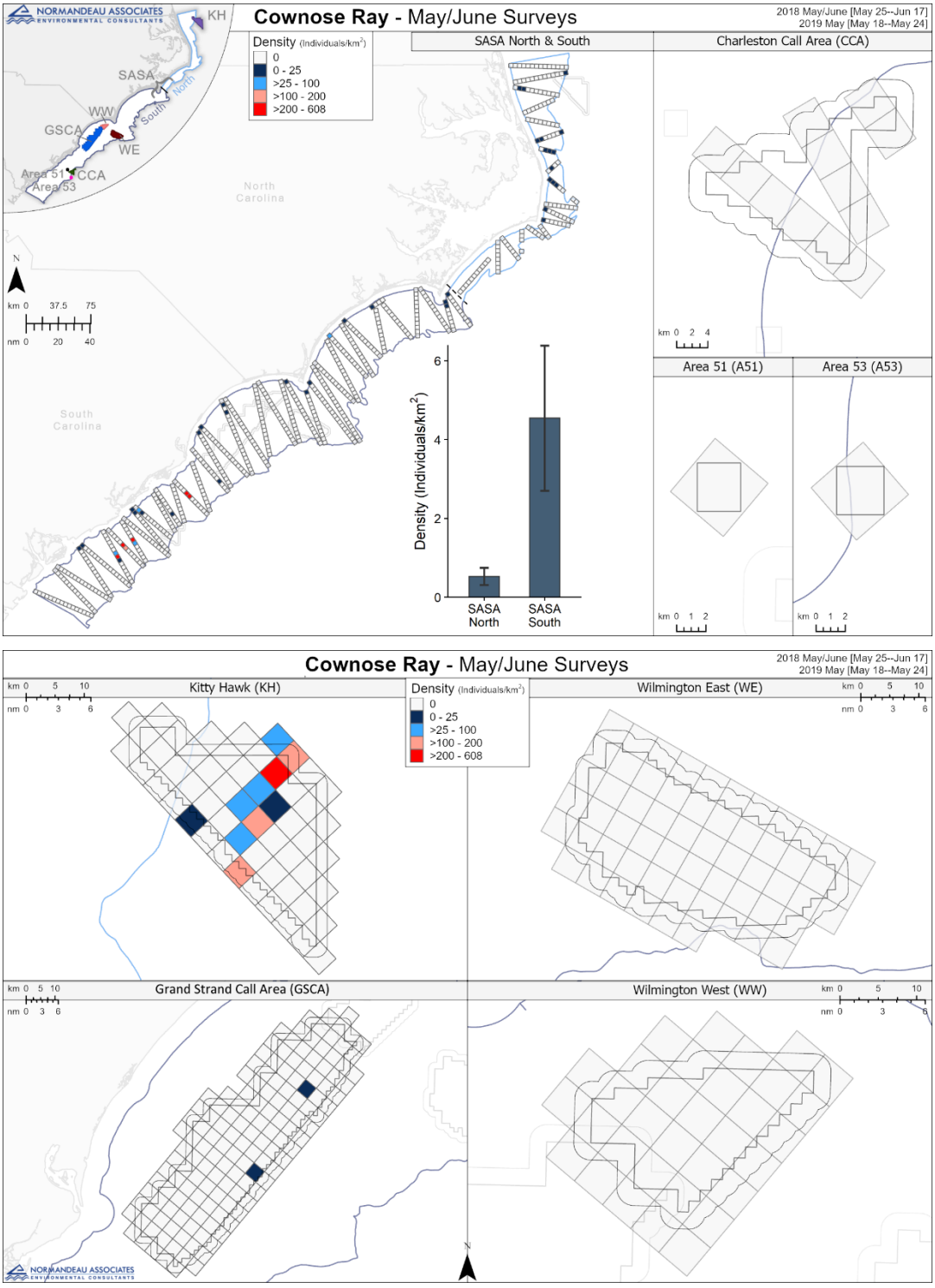


Figure F–22. Spatial distribution of cownose rays during the May/June surveys for all areas

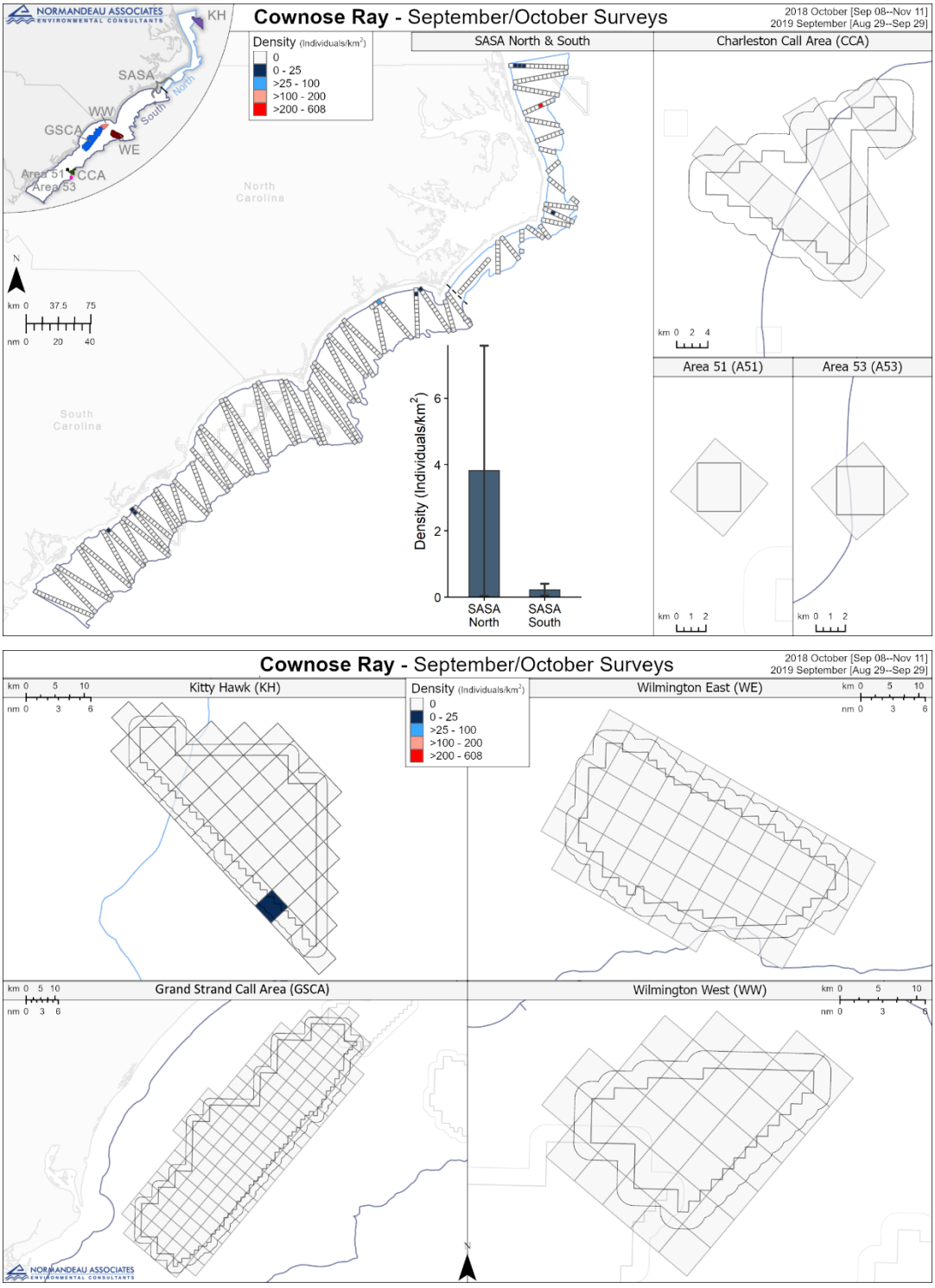


Figure F–23. Spatial distribution of cownose rays during the September/October surveys for all areas

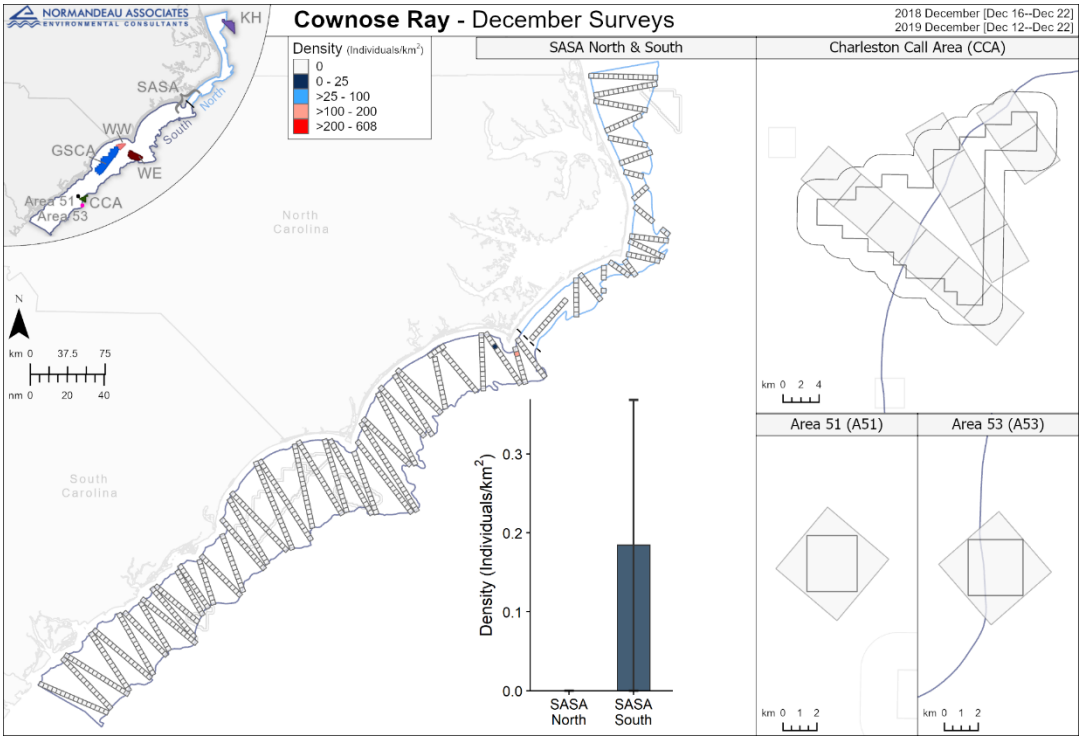


Figure F–24. Spatial distribution of cownose rays during the December surveys for all areas

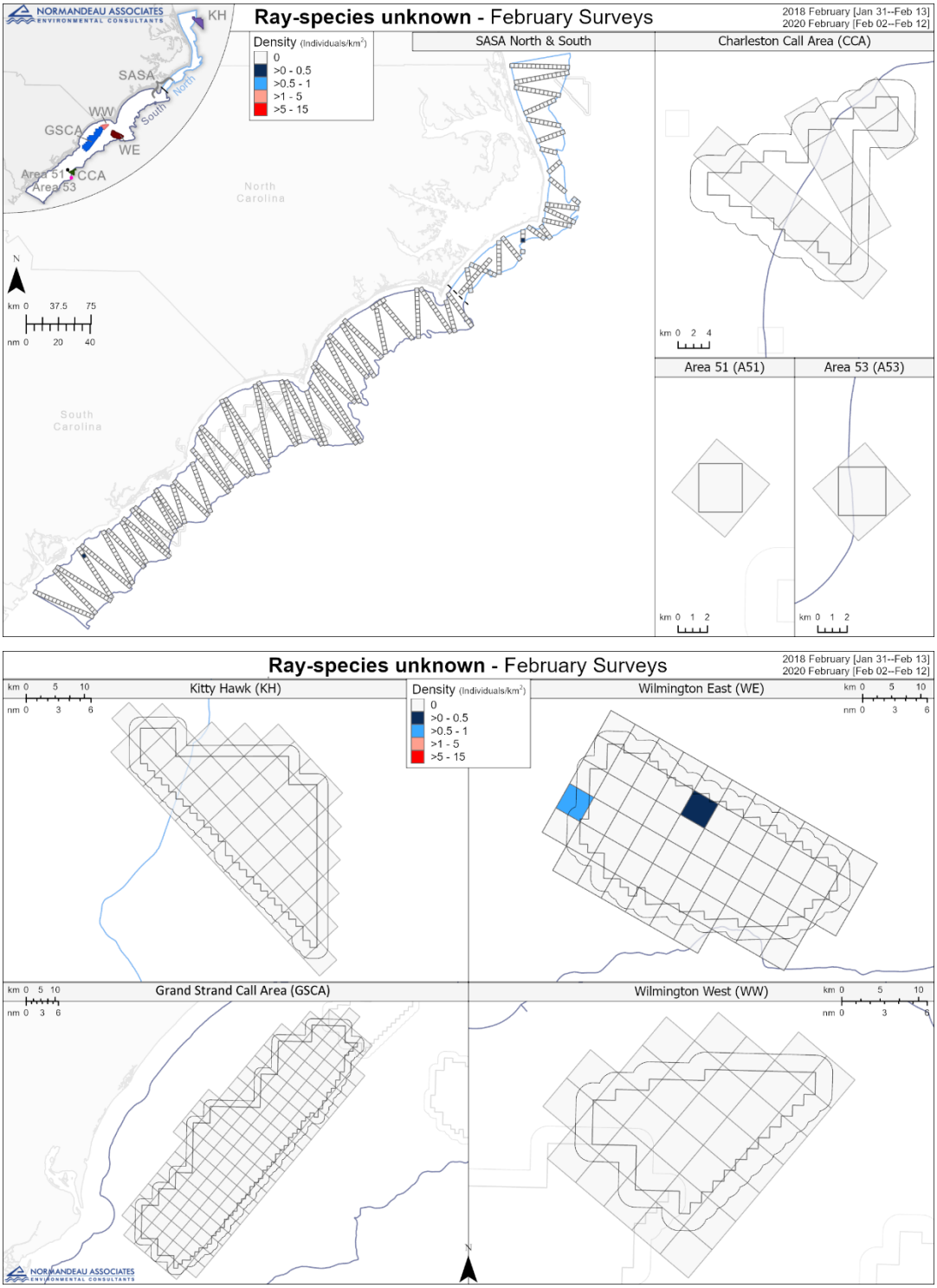


Figure F–25. Spatial distribution of ray-species unknown during the February surveys for all areas

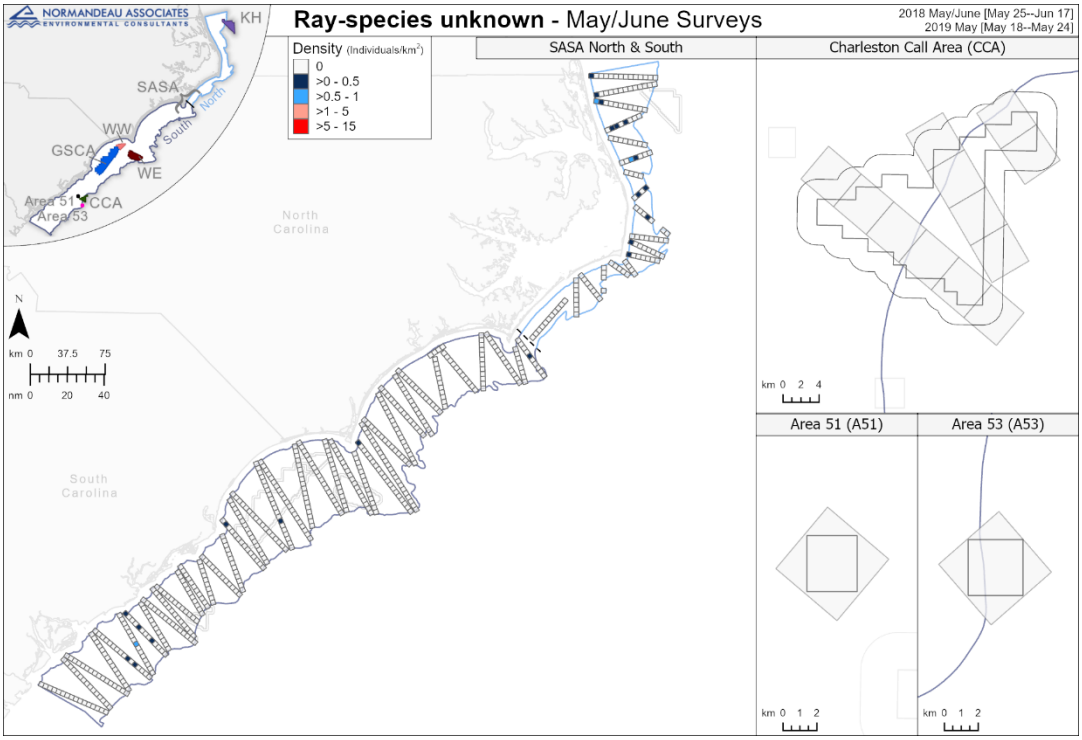


Figure F–26. Spatial distribution of ray-species unknown during the May/June surveys for all areas

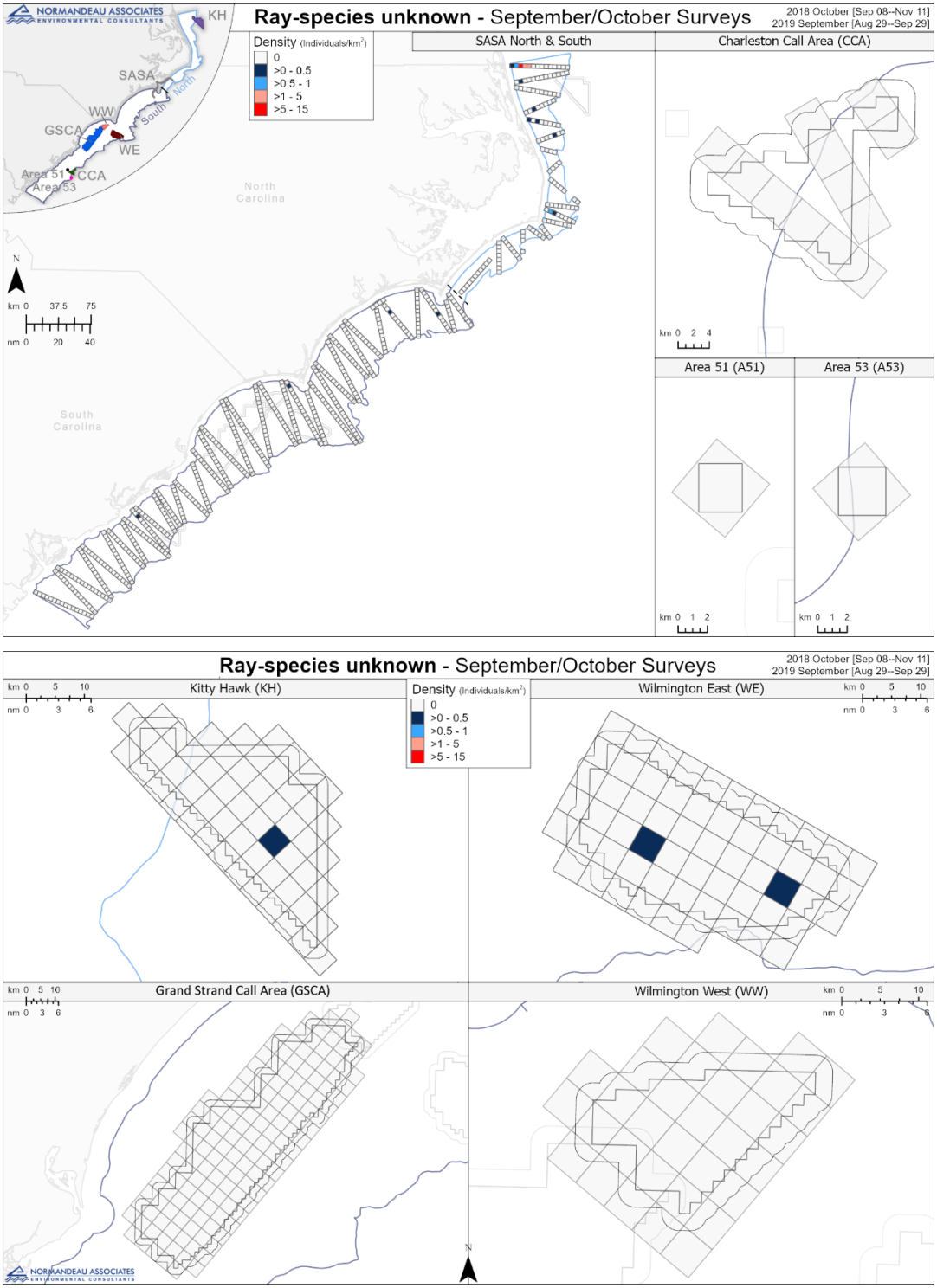


Figure F–27. Spatial distribution of ray-species unknown during the September/ October surveys for all areas

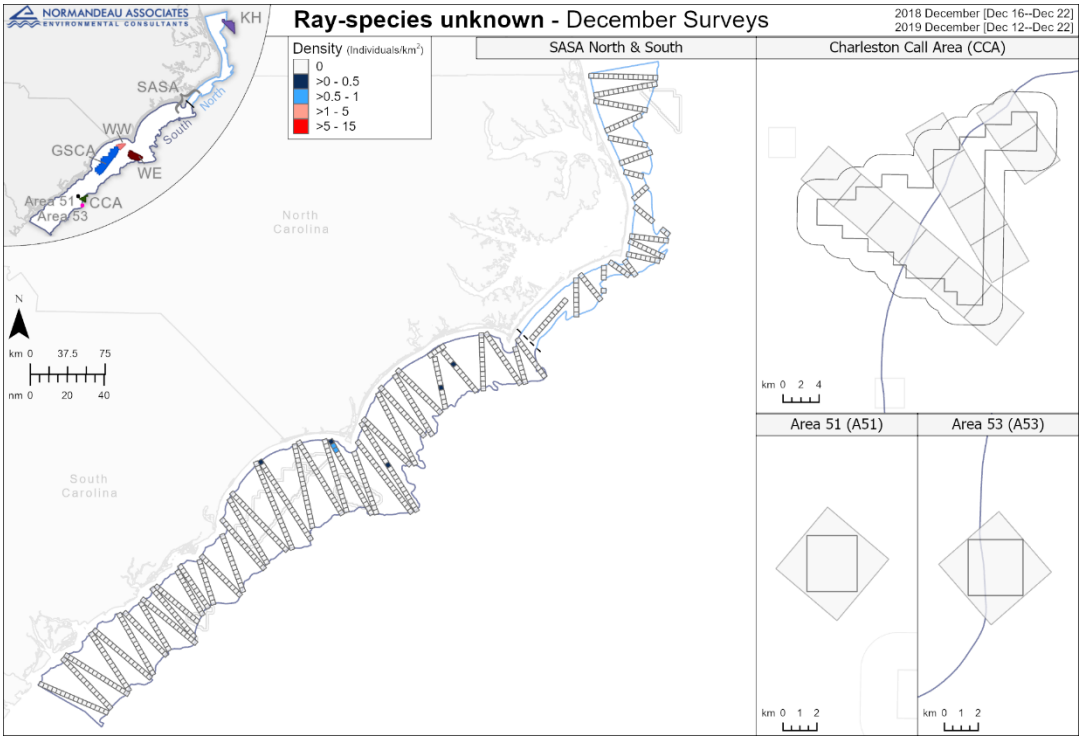


Figure F–28. Spatial distribution of ray-species unknown during the December surveys for all areas

F.3.2 Shark

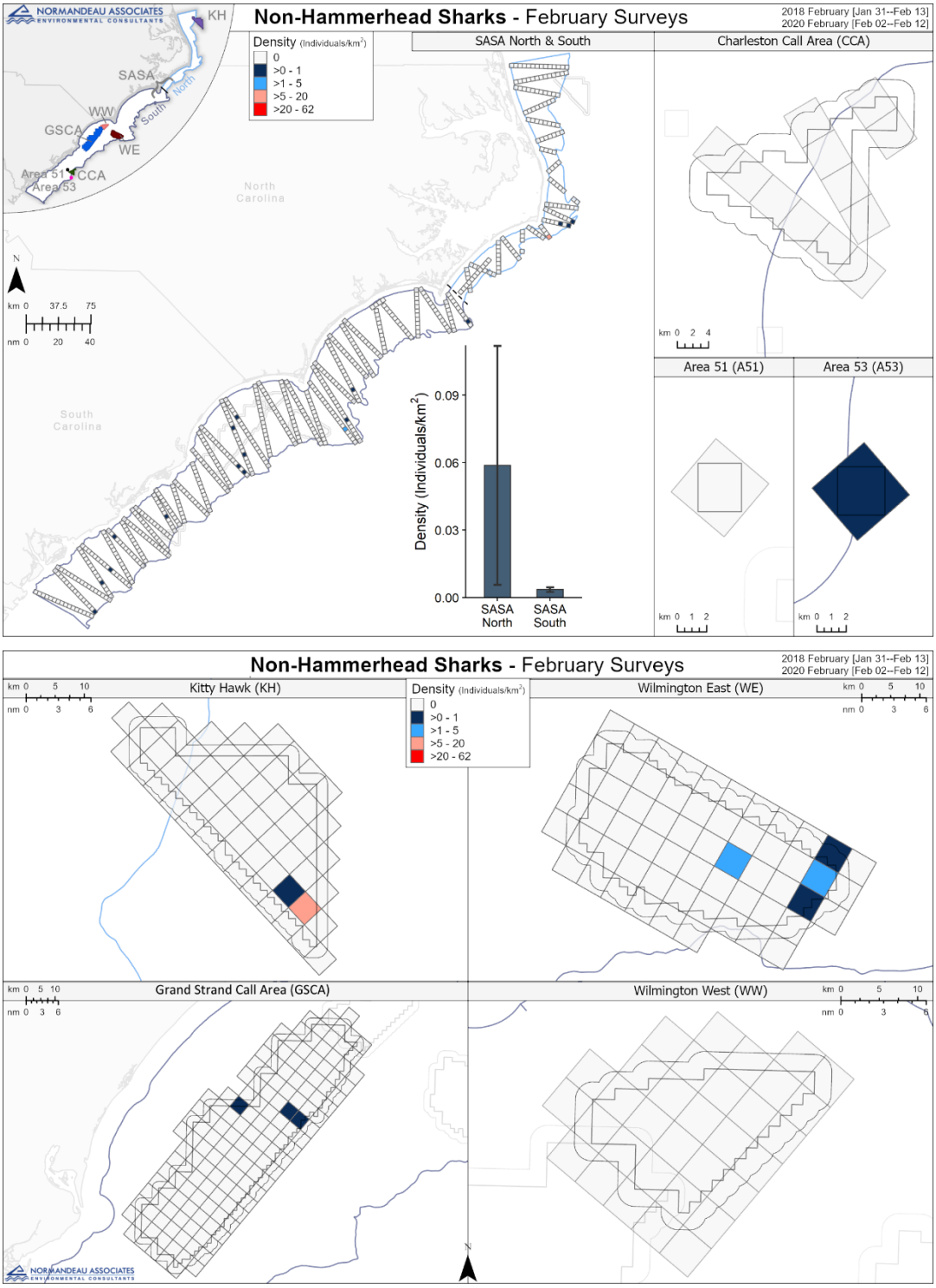


Figure F–29. Spatial distribution of non-hammerhead sharks during the February surveys for all areas

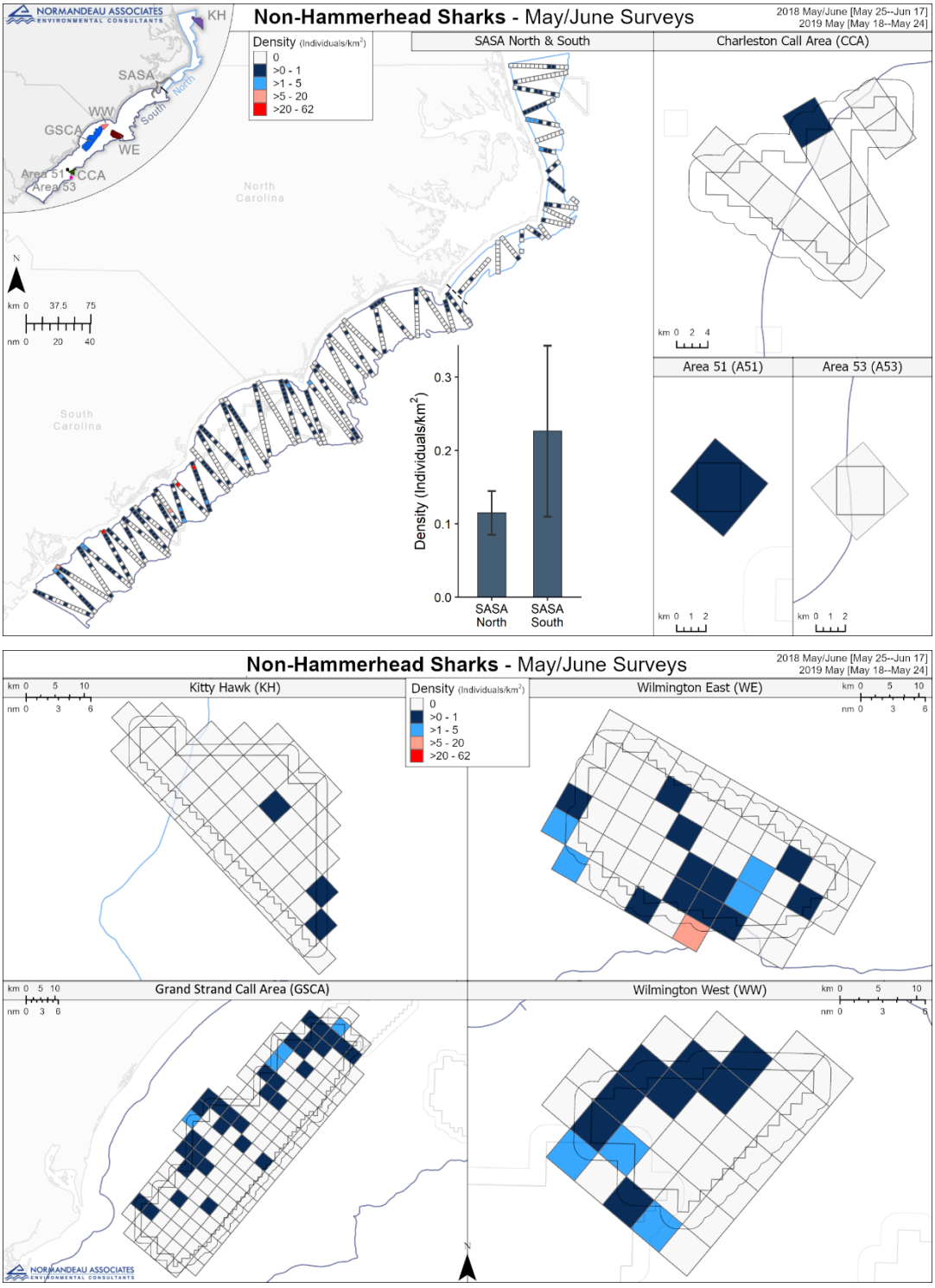


Figure F–30. Spatial distribution of non-hammerhead sharks during the May/June surveys for all areas

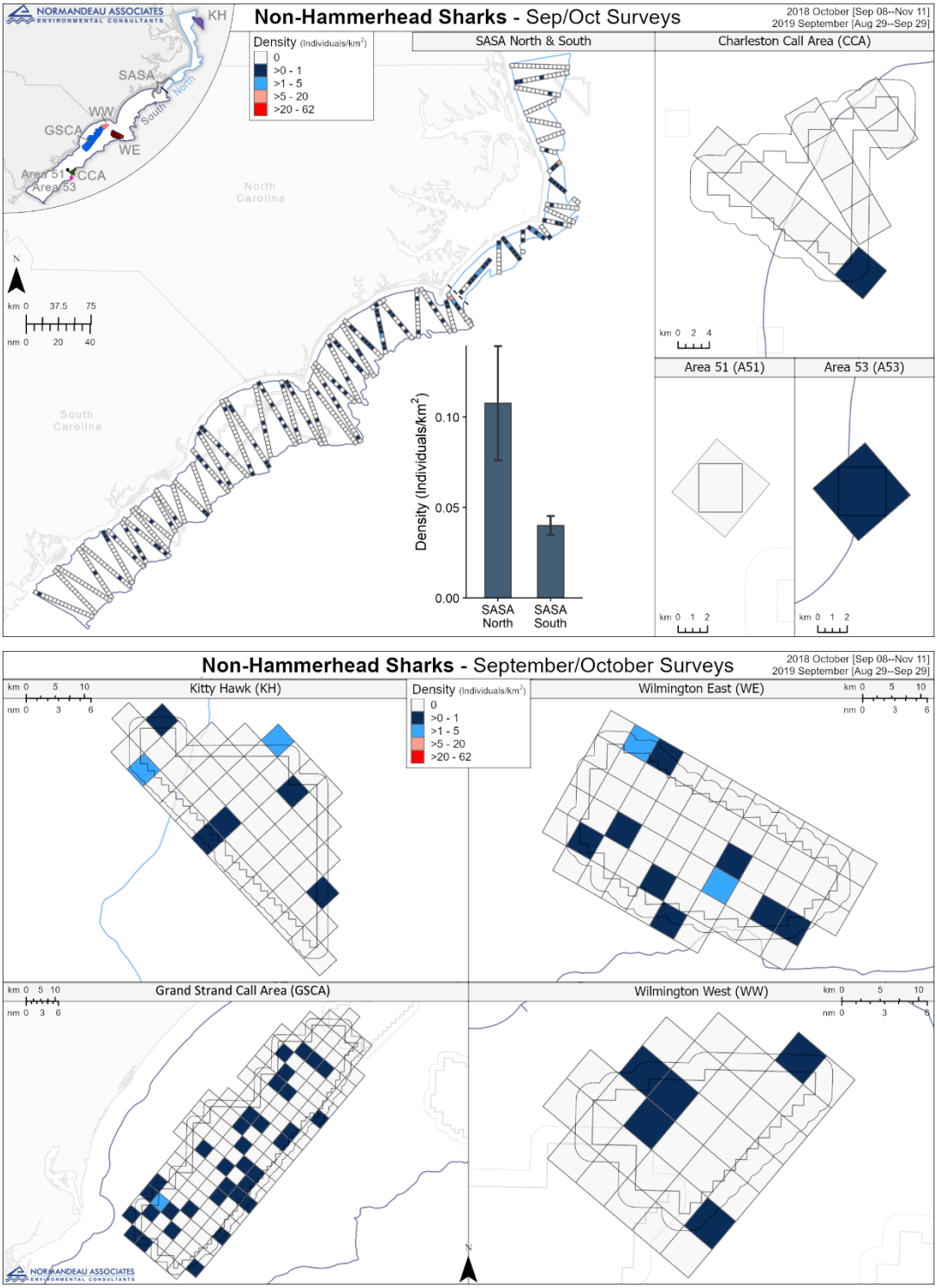


Figure F–31. Spatial distribution of non-hammerhead sharks during the September/October surveys for all areas

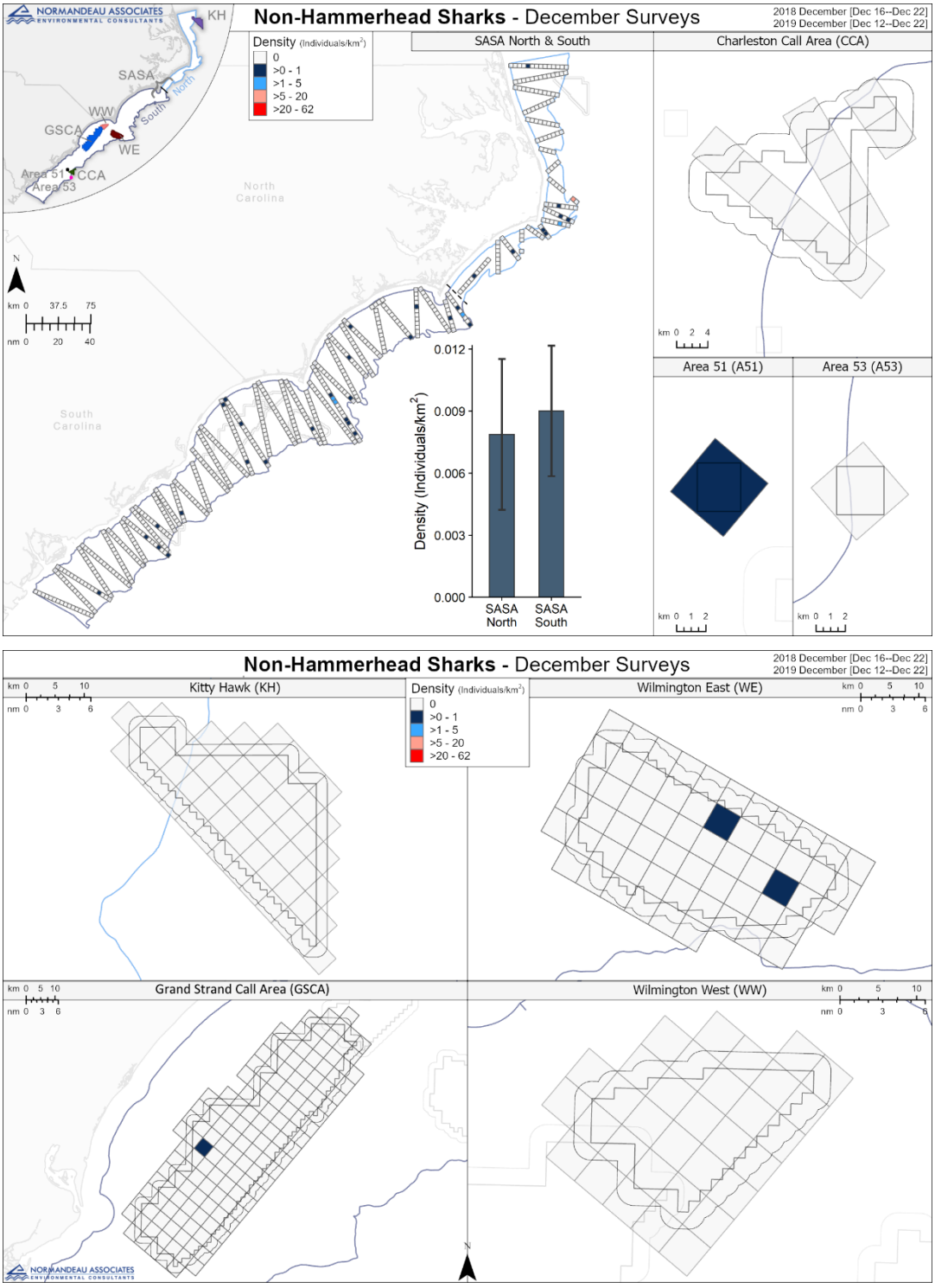


Figure F–32. Spatial distribution of non-hammerhead sharks during the December surveys for all areas

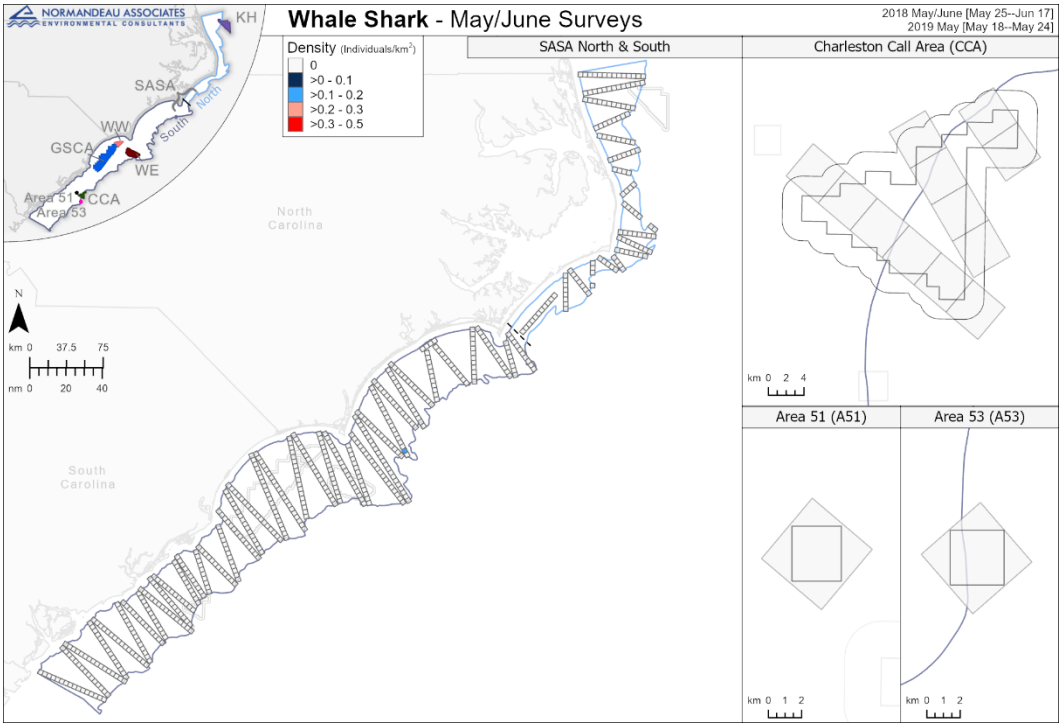


Figure F–33. Spatial distribution of whale sharks during the May/June surveys for all areas

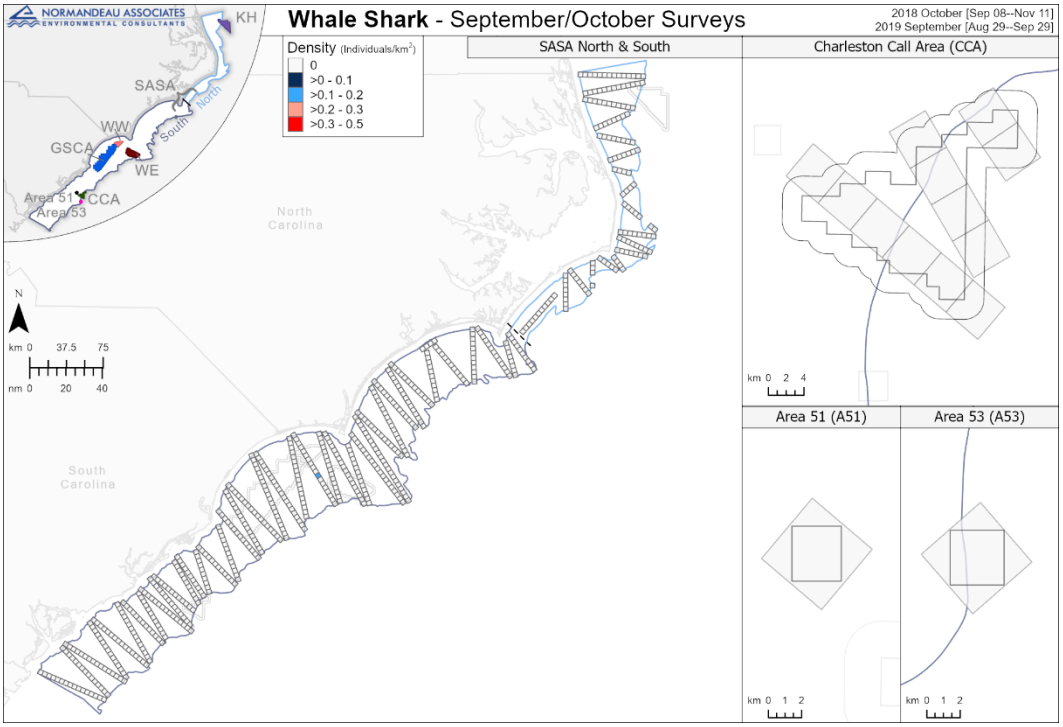


Figure F–34. Spatial distribution of whale sharks during the September/October surveys for all areas

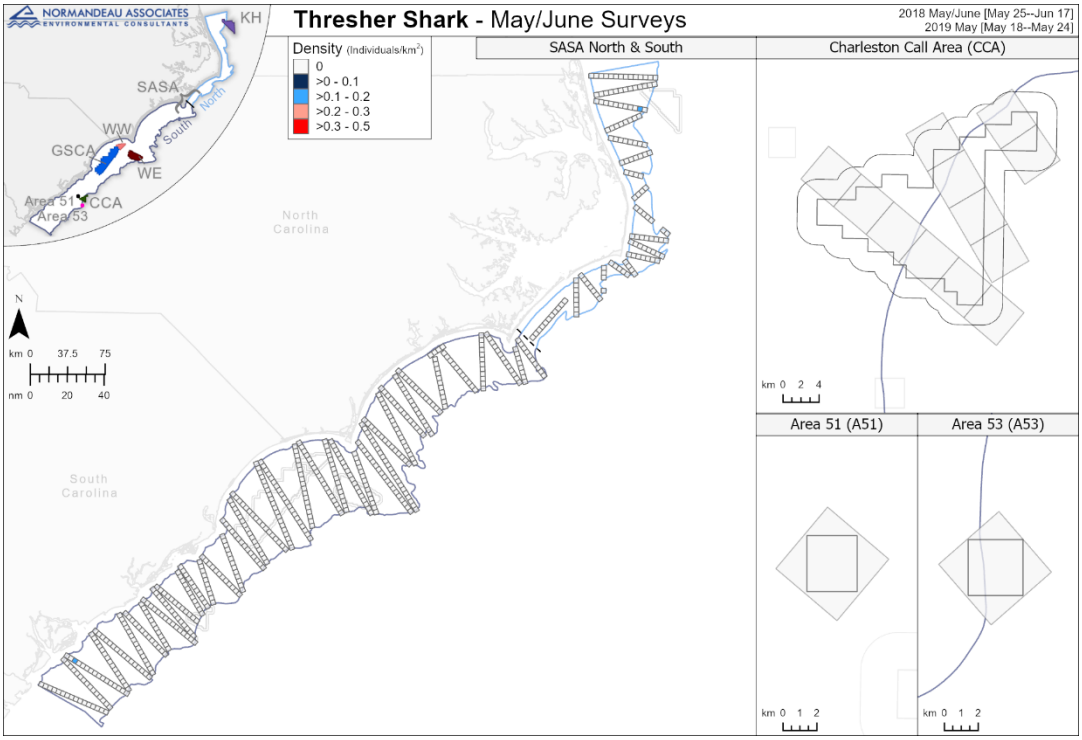


Figure F–35. Spatial distribution of thresher sharks during the May/June surveys for all areas

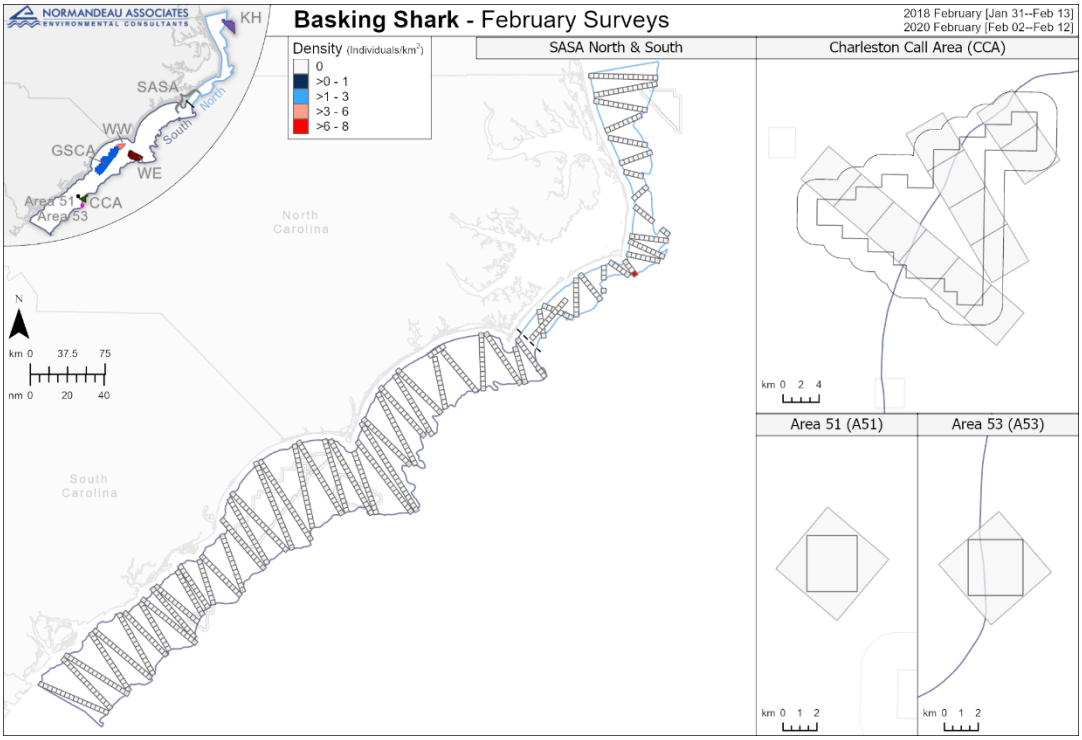


Figure F–36. Spatial distribution of basking sharks during the February surveys for all areas

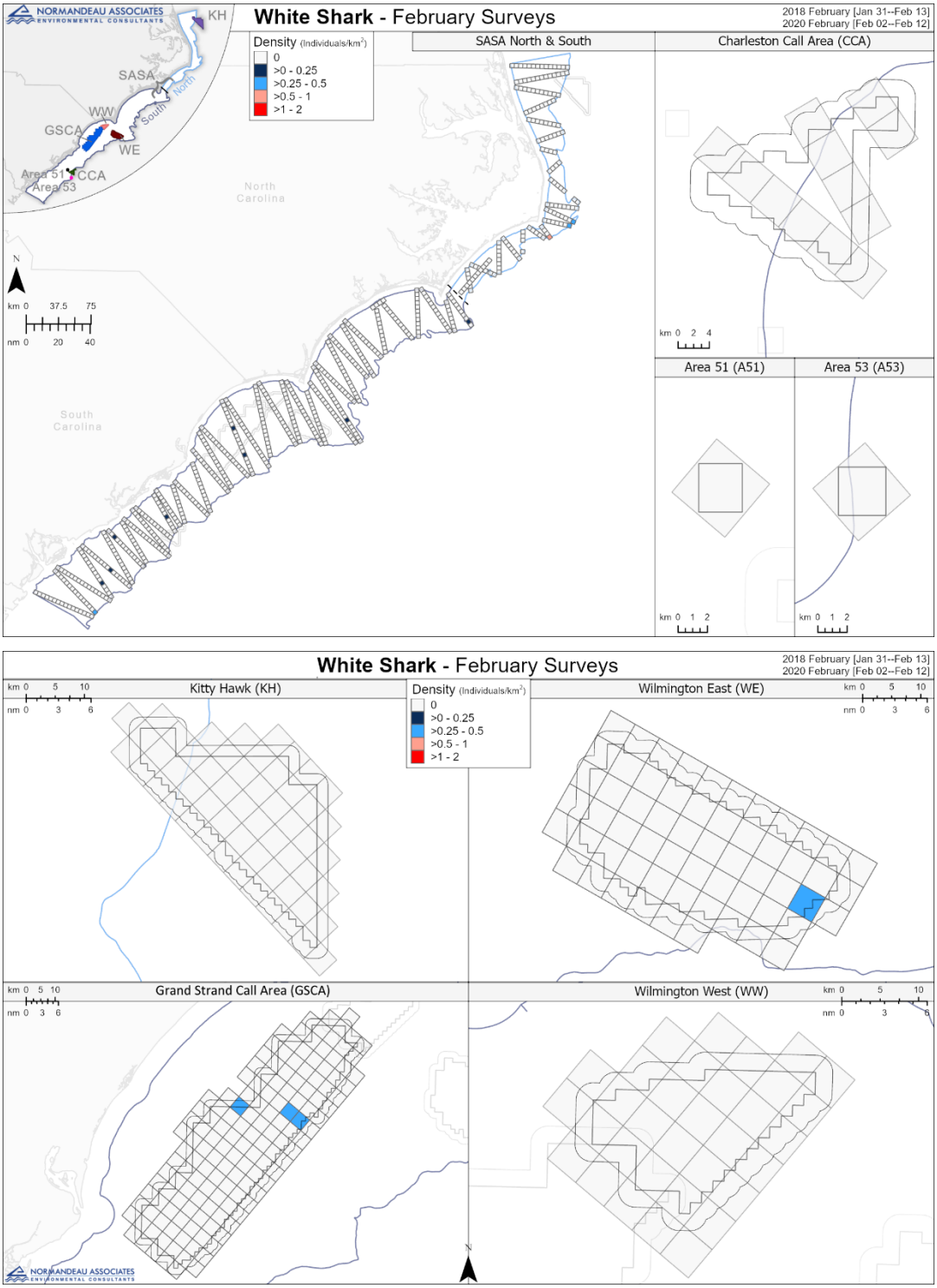


Figure F–37. Spatial distribution of white sharks during the February surveys for all areas

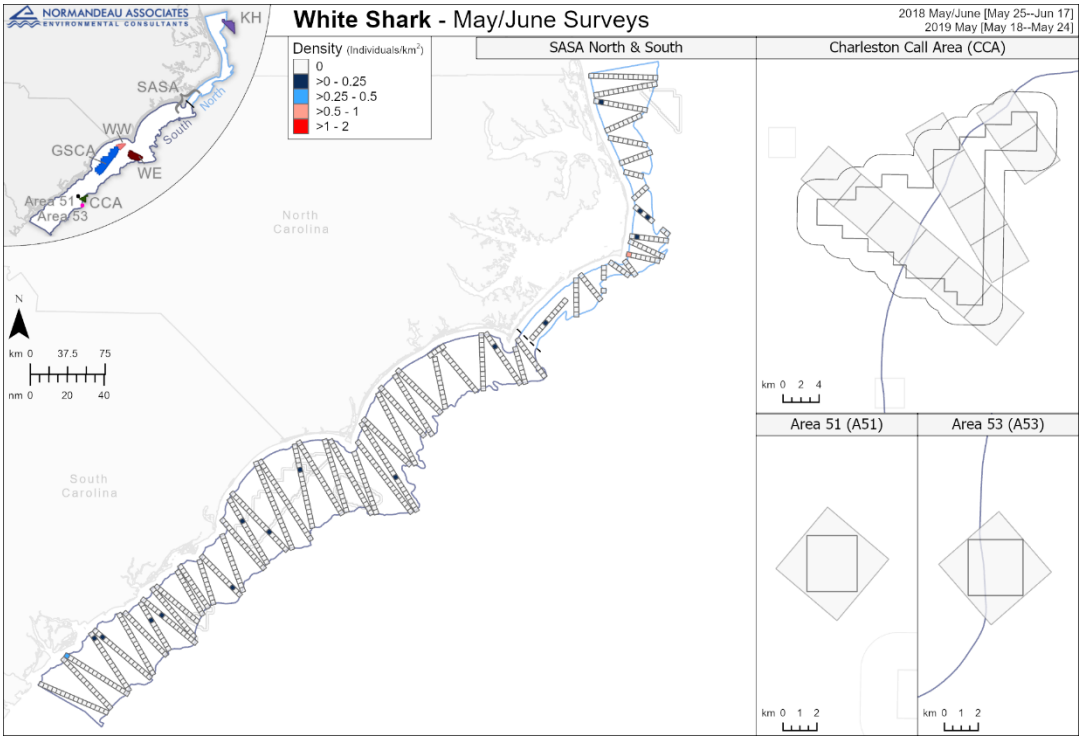


Figure F–38. Spatial distribution of white sharks during the May/June surveys for all areas

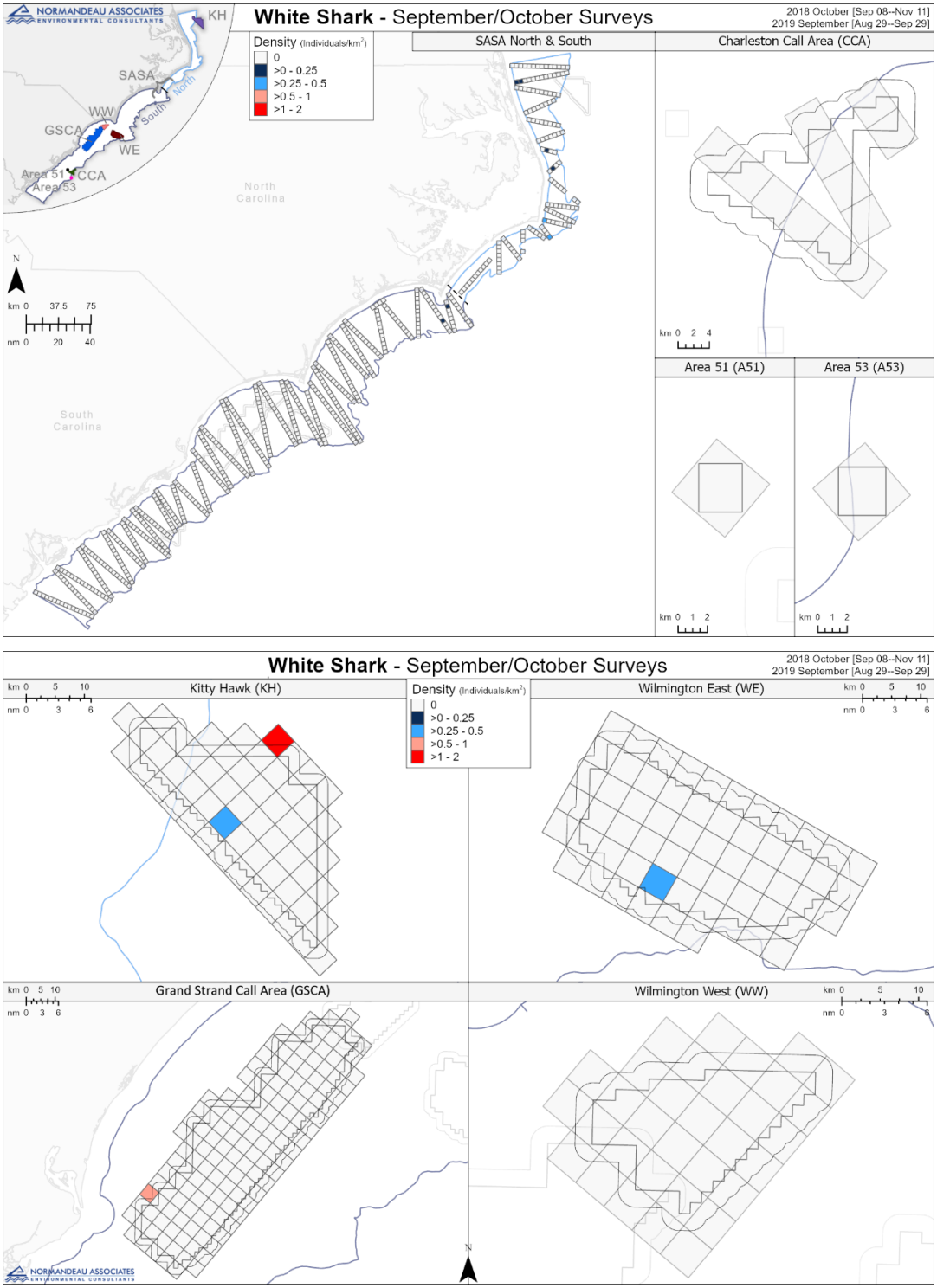


Figure F–39. Spatial distribution of white sharks during the September/October surveys for all areas

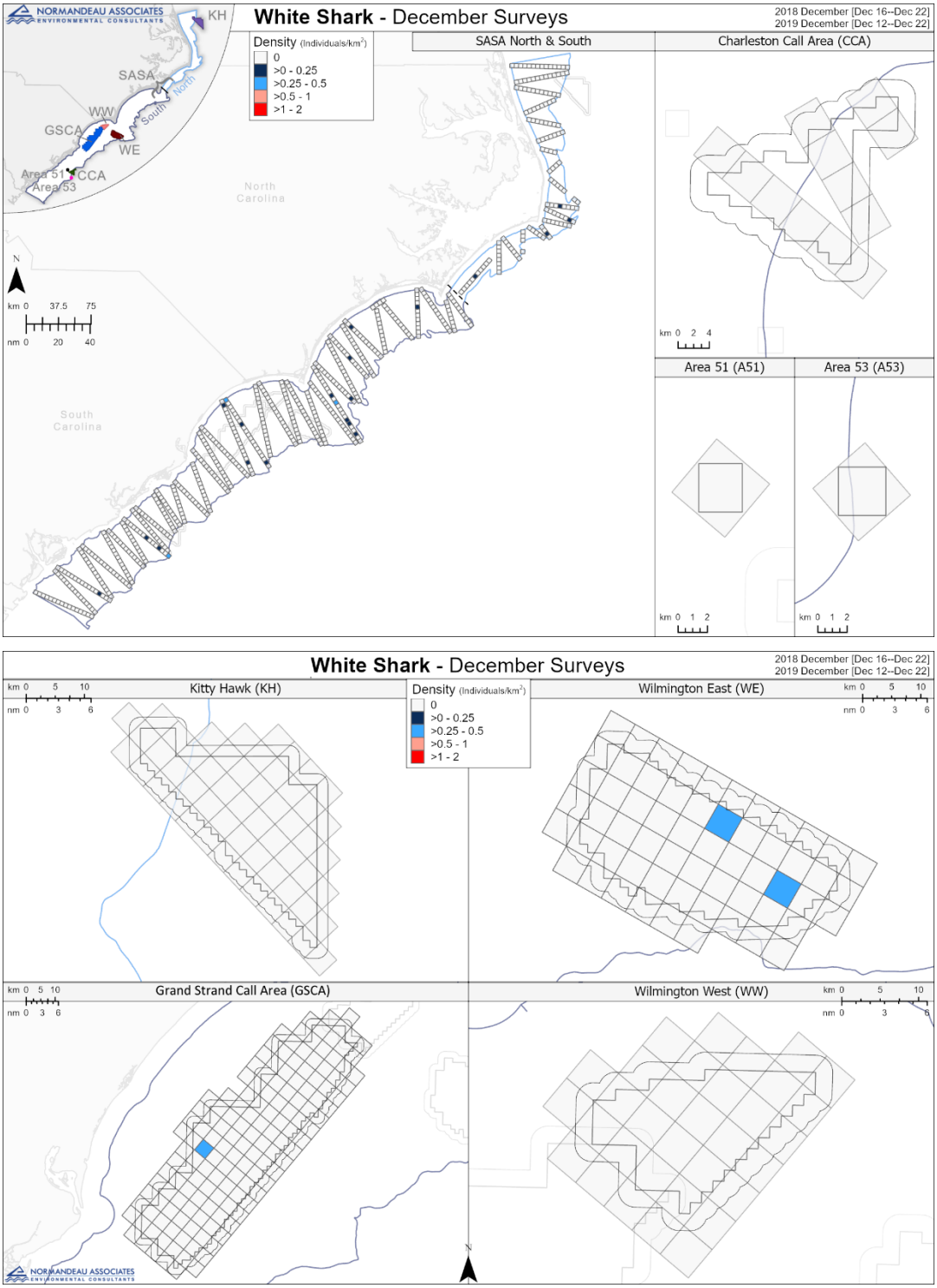


Figure F–40. Spatial distribution of white sharks during the December surveys for all areas

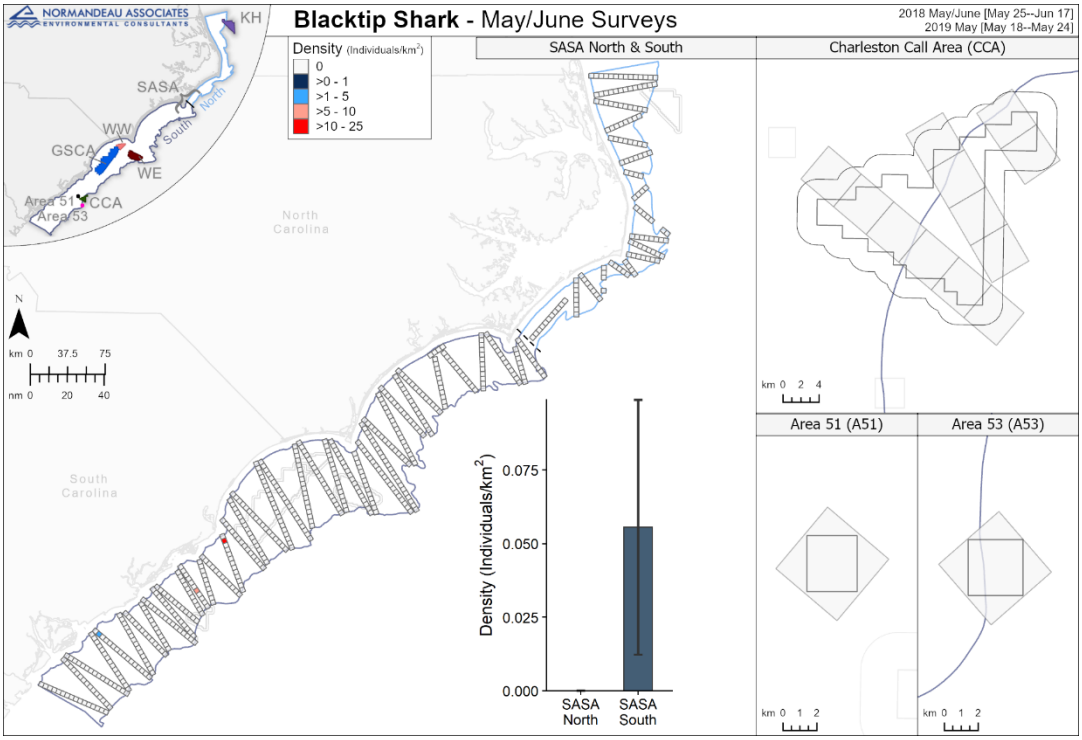


Figure F–41. Spatial distribution of blacktip sharks during the May/June surveys for all areas

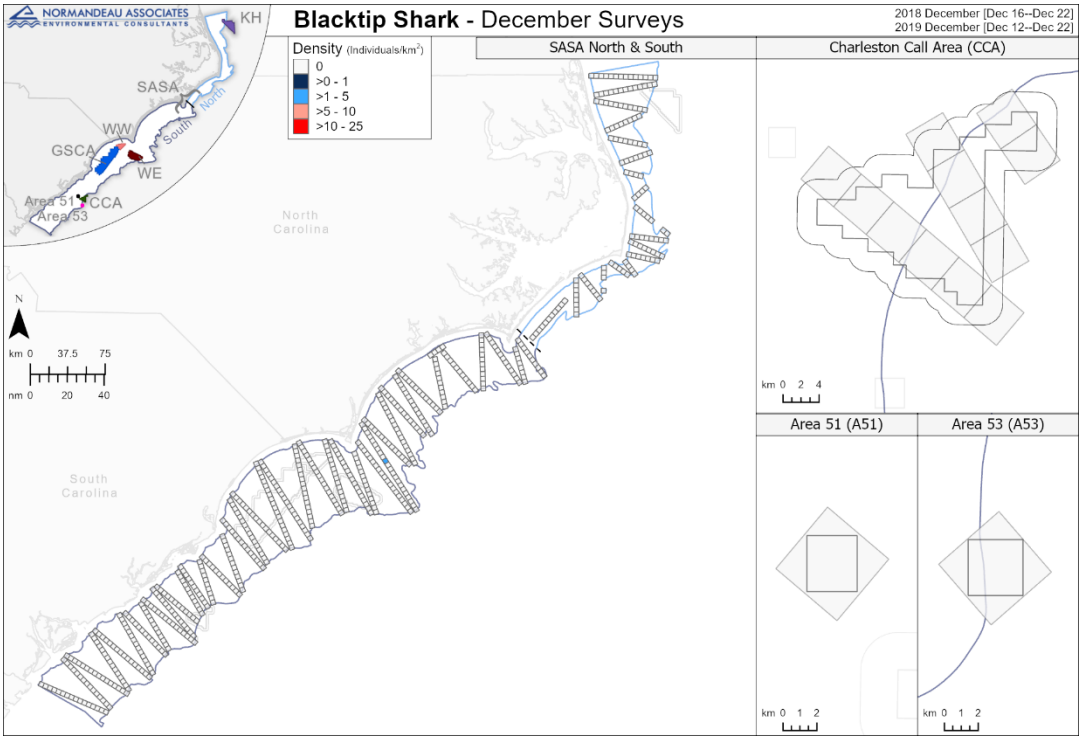


Figure F–42. Spatial distribution of blacktip sharks during the December surveys for all areas

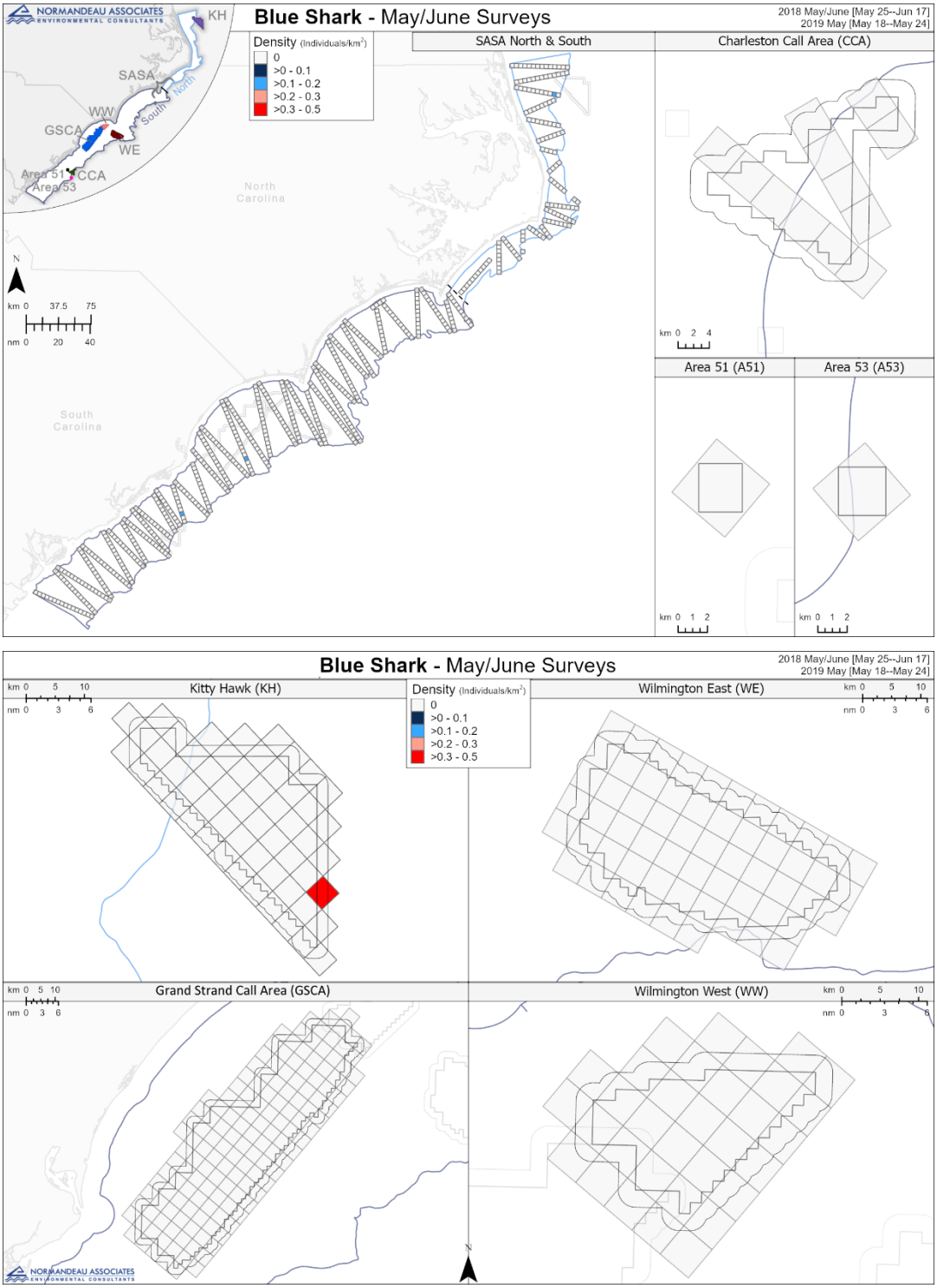


Figure F–43. Spatial distribution of blue sharks during the May/June surveys for all areas

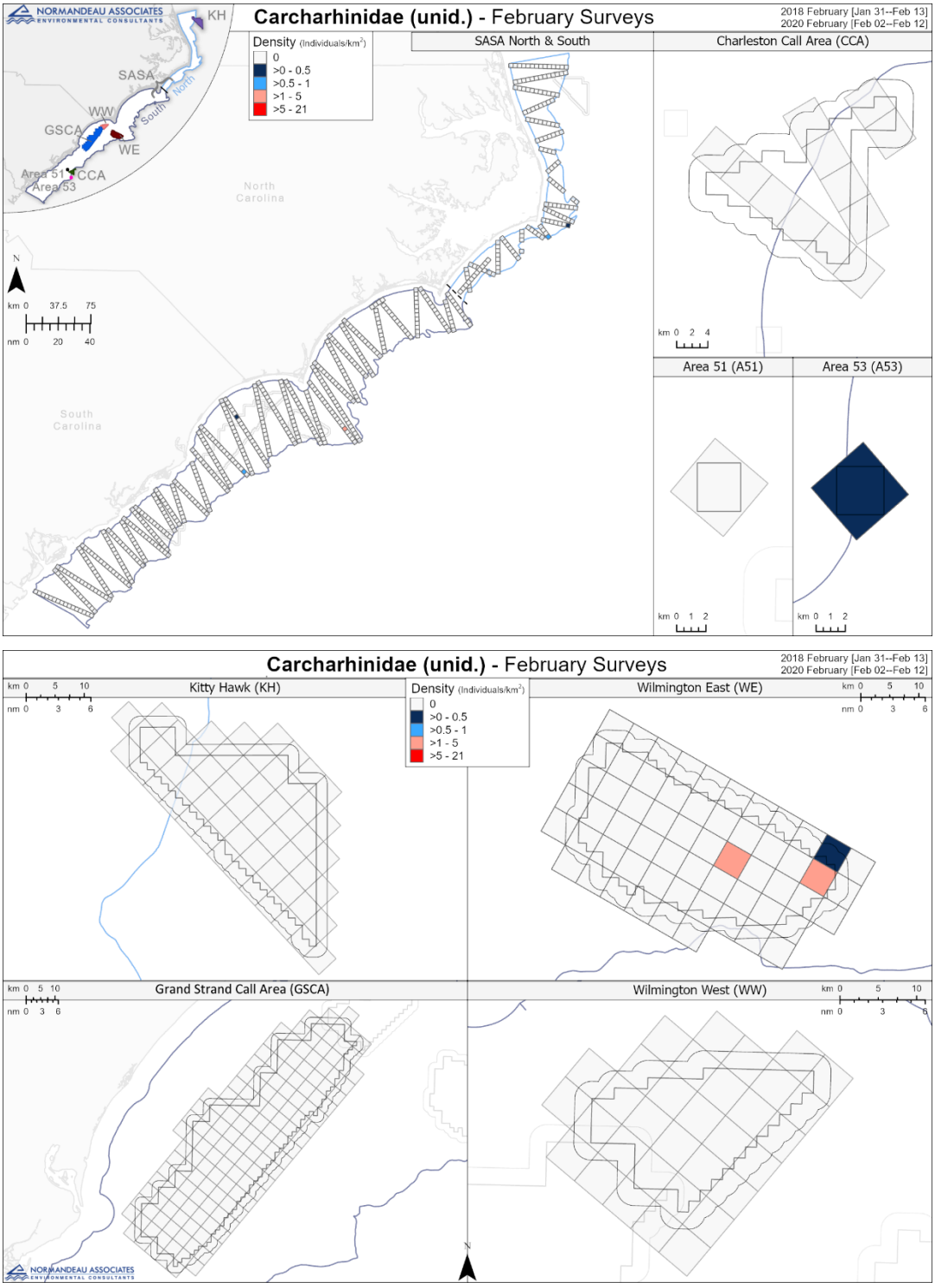
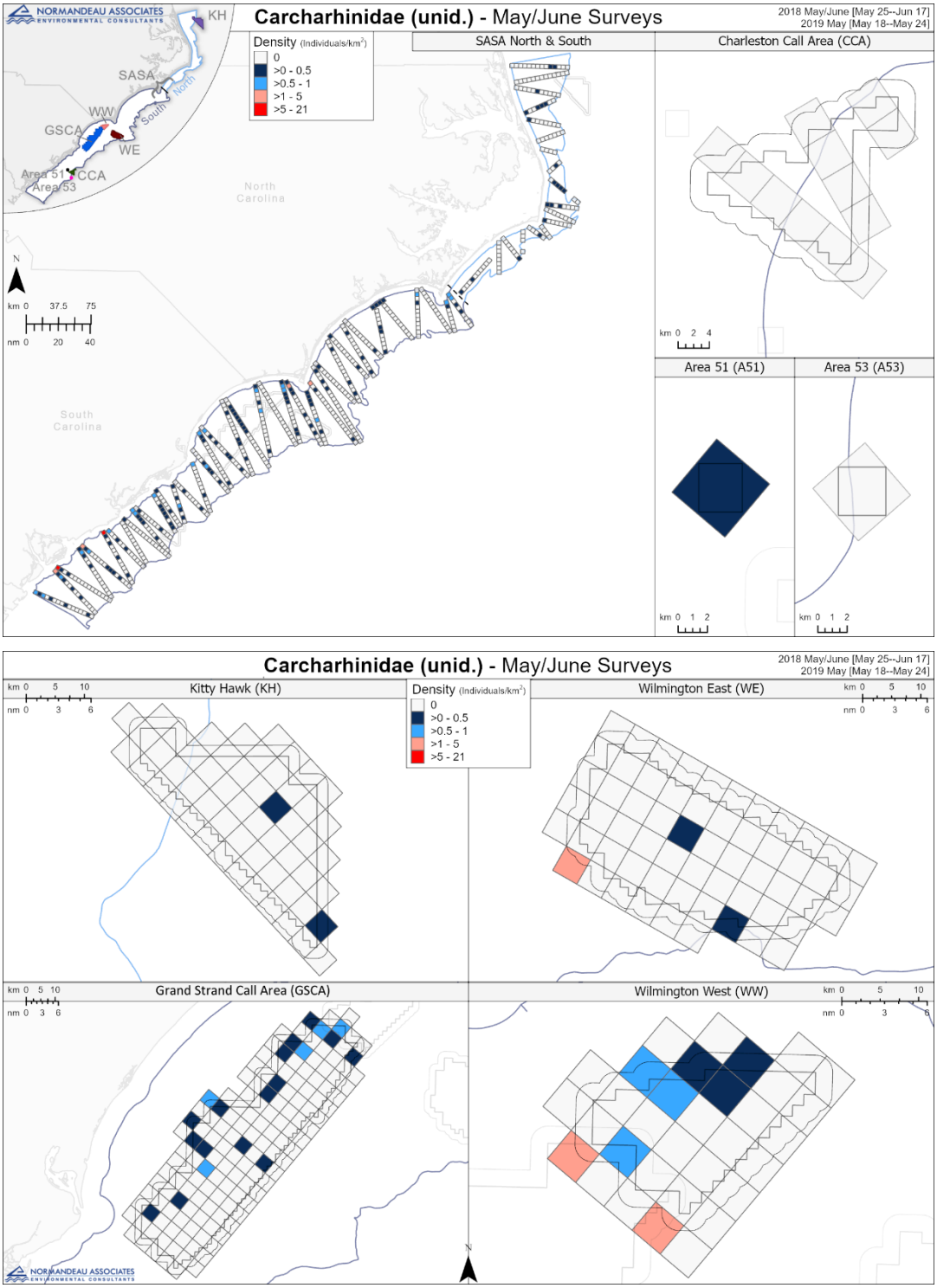


Figure F–44. Spatial distribution of Carcharhinidae (unid.) during the February surveys for all areas



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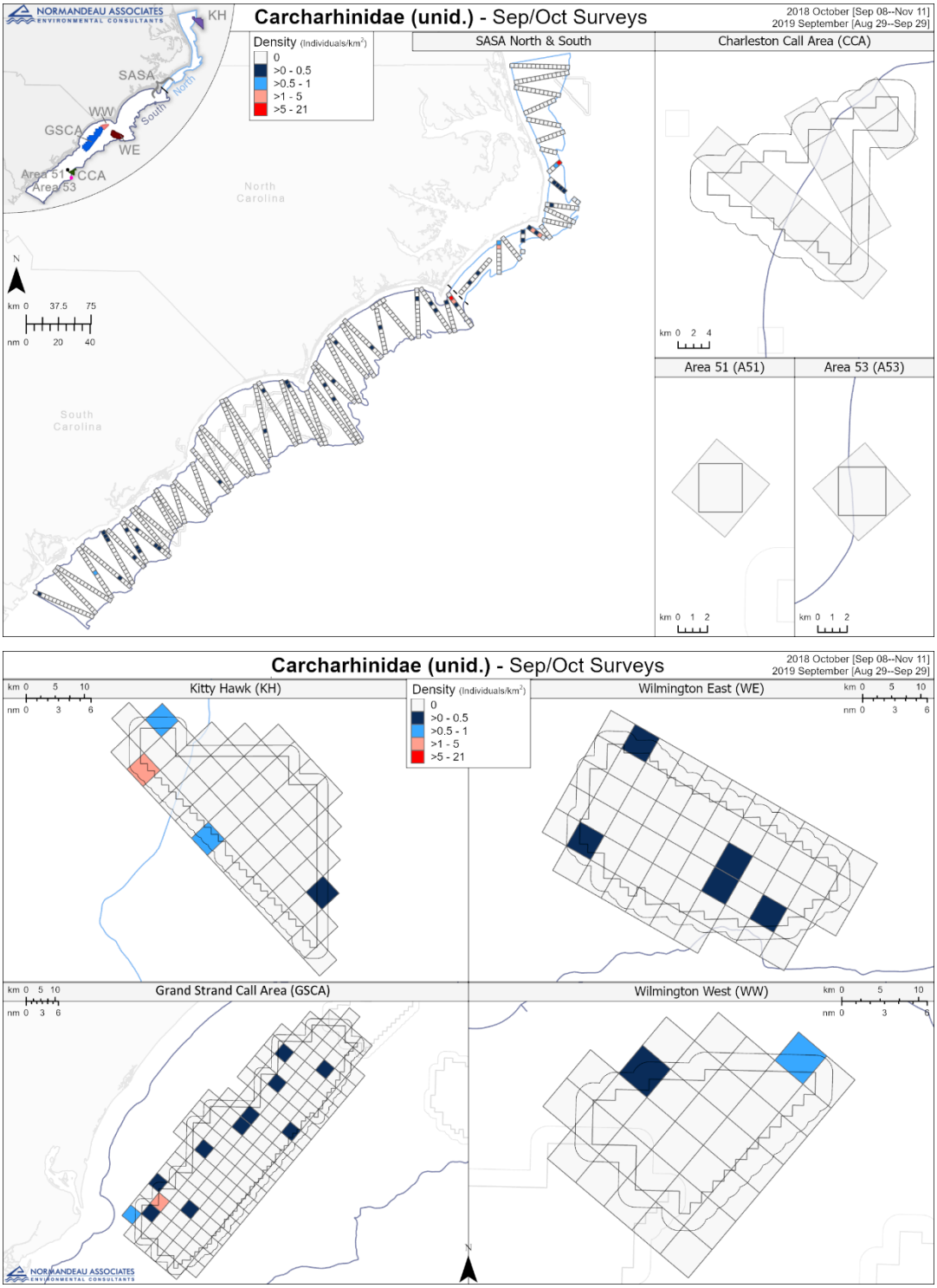

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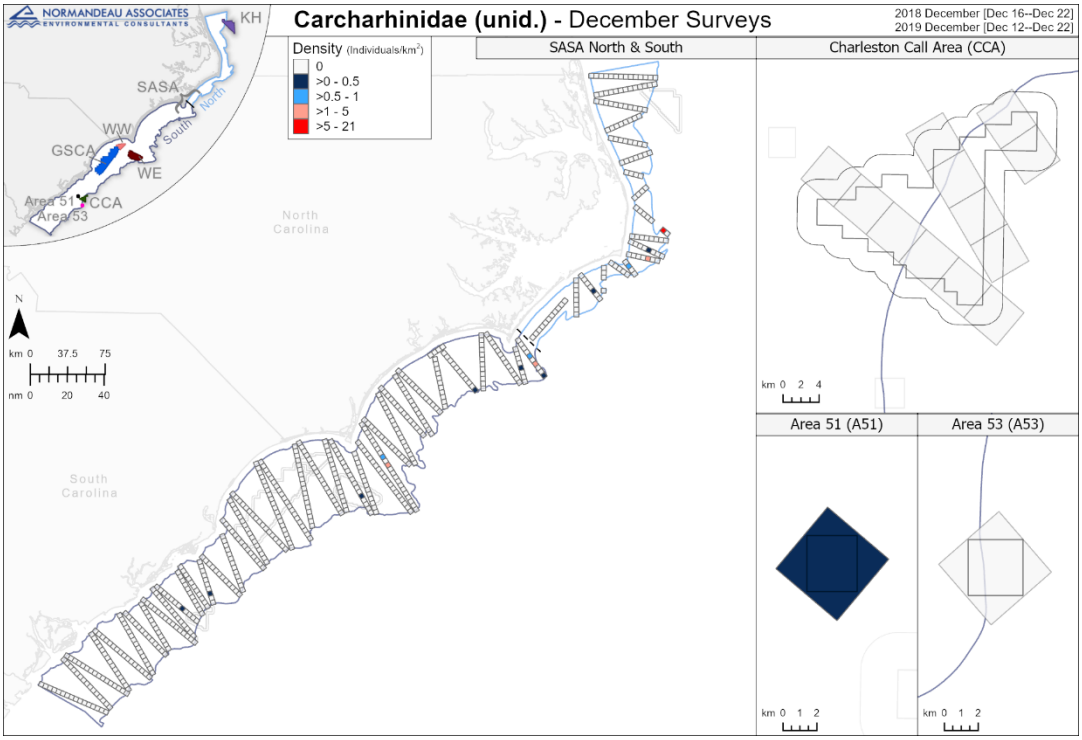

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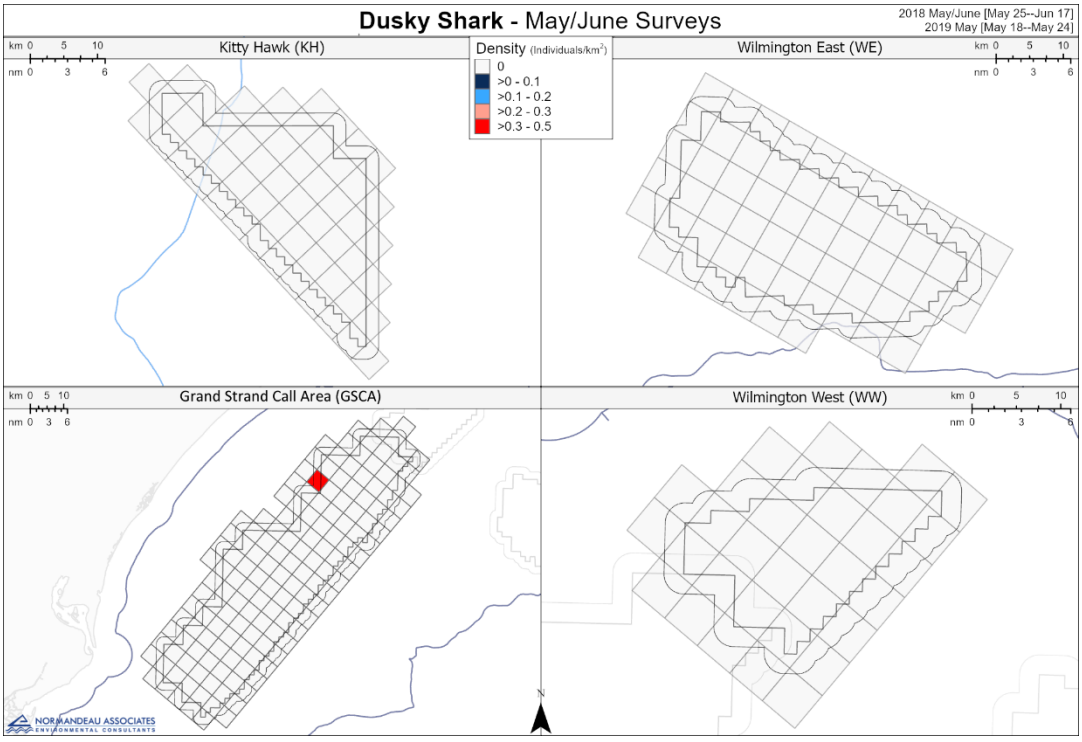
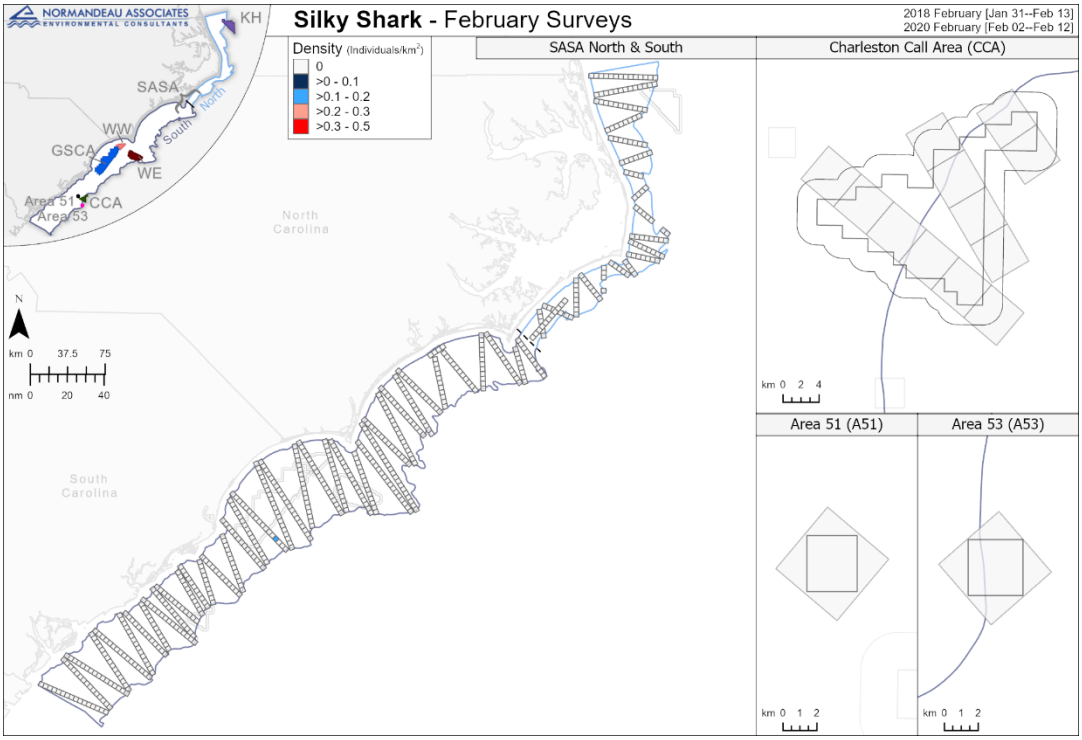


Figure F–48. Spatial distribution of dusky sharks during the May/June surveys for all areas



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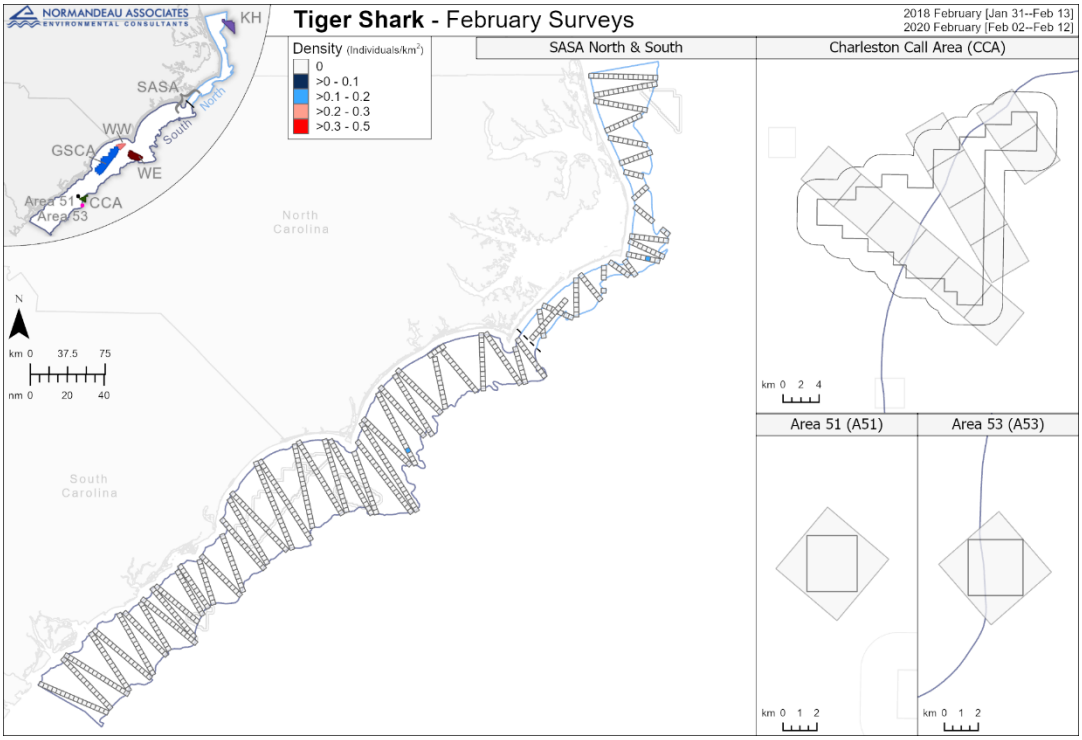

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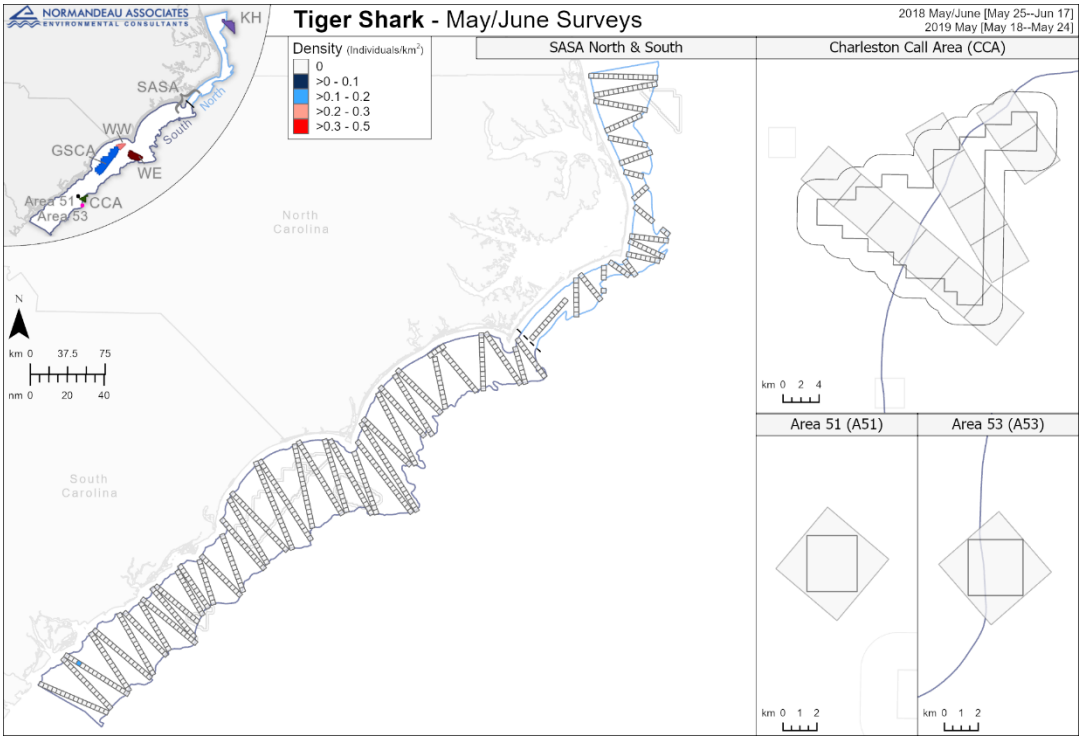

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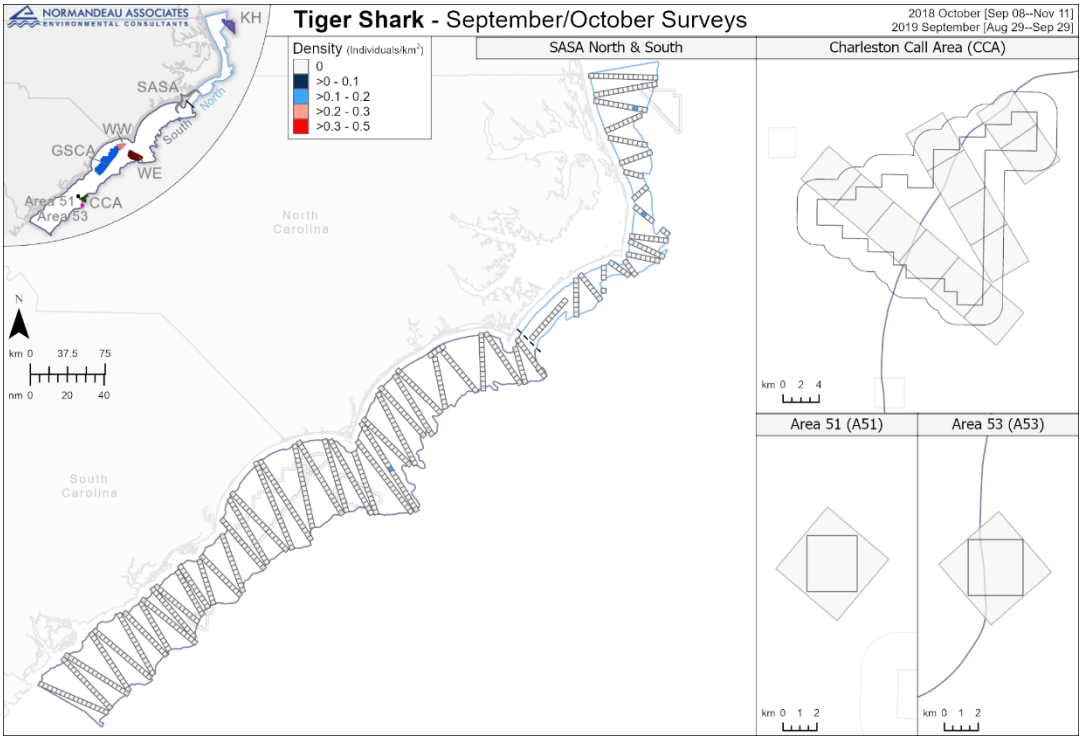

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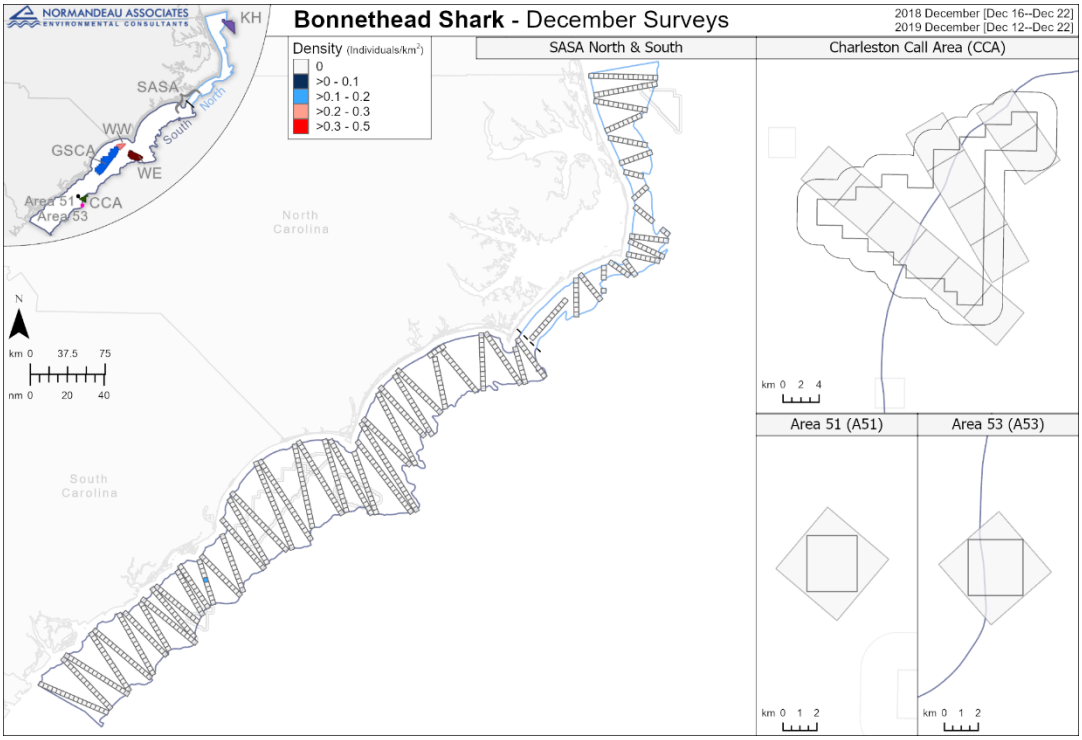

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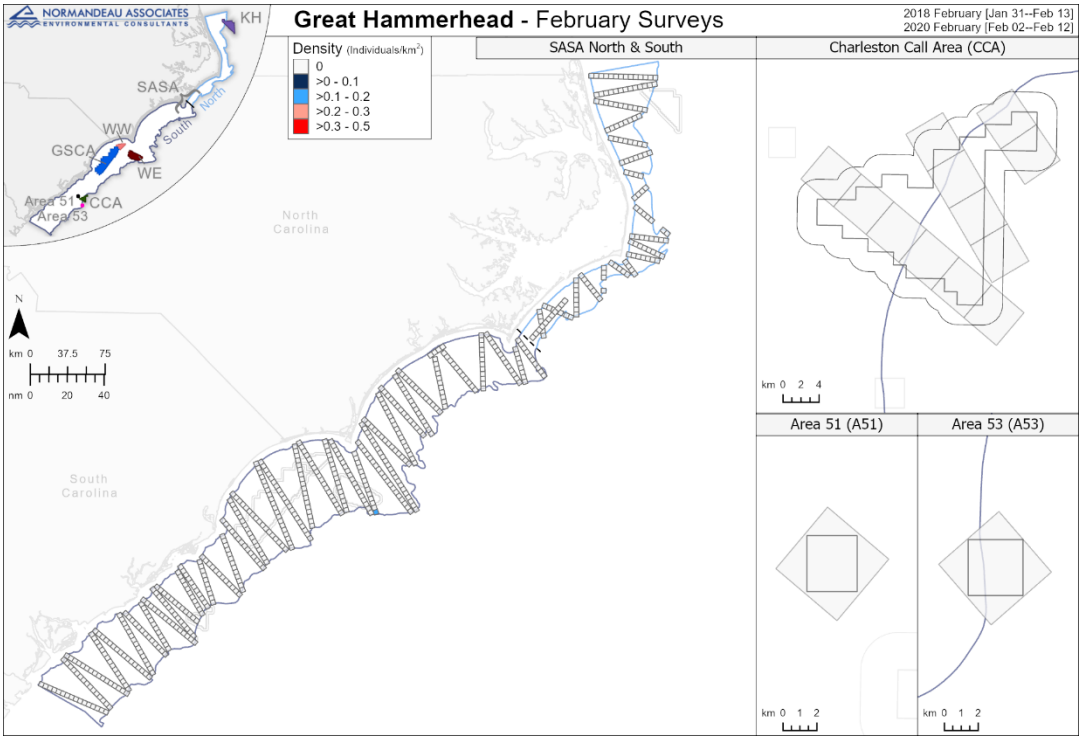

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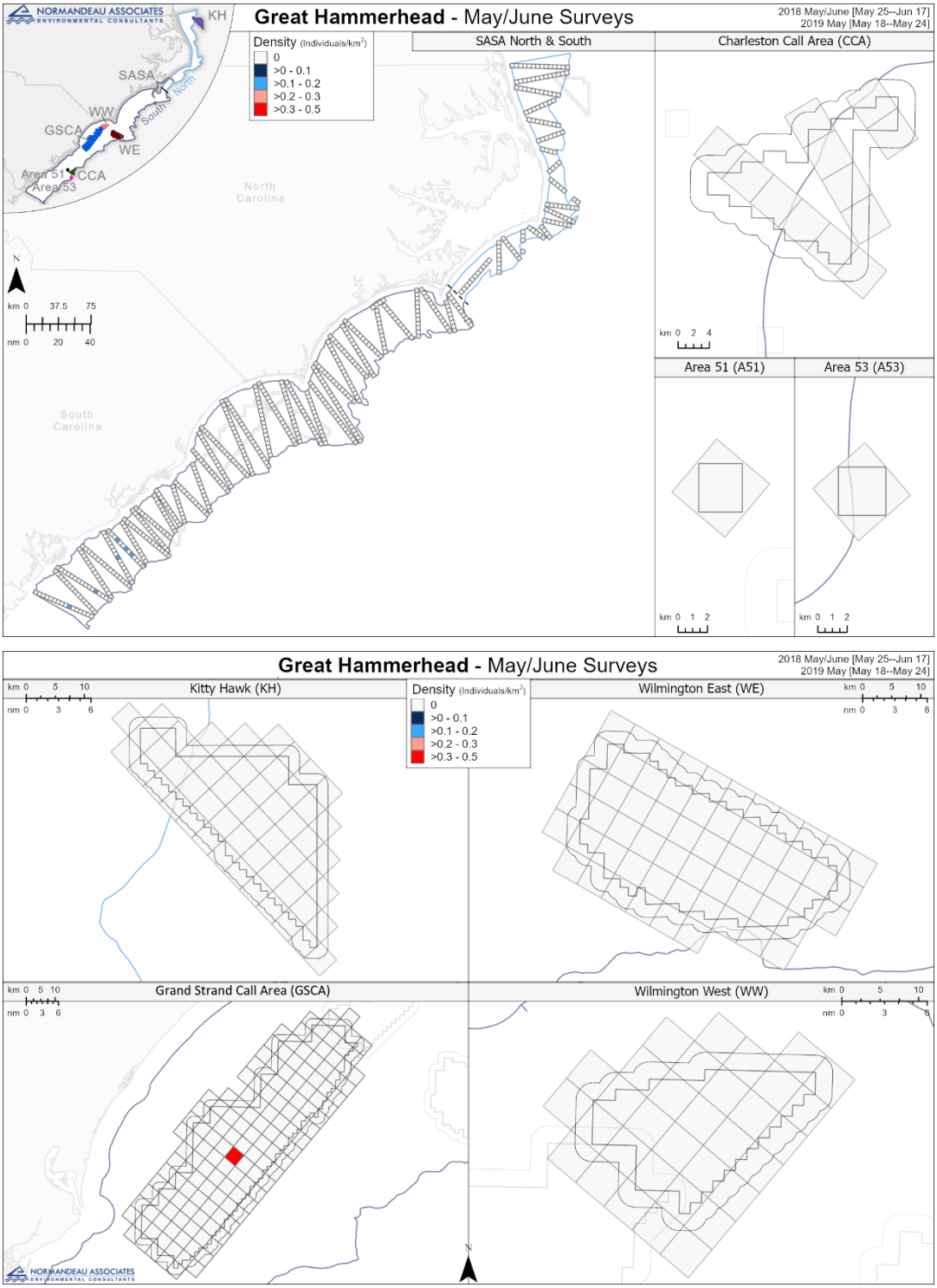

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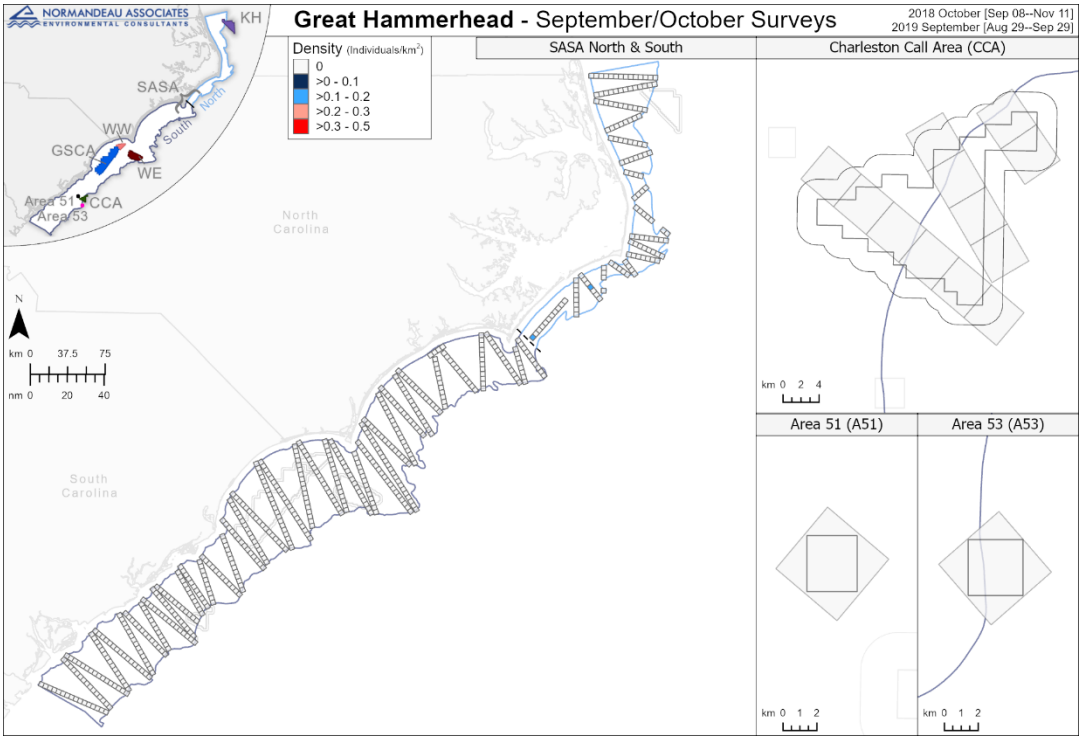

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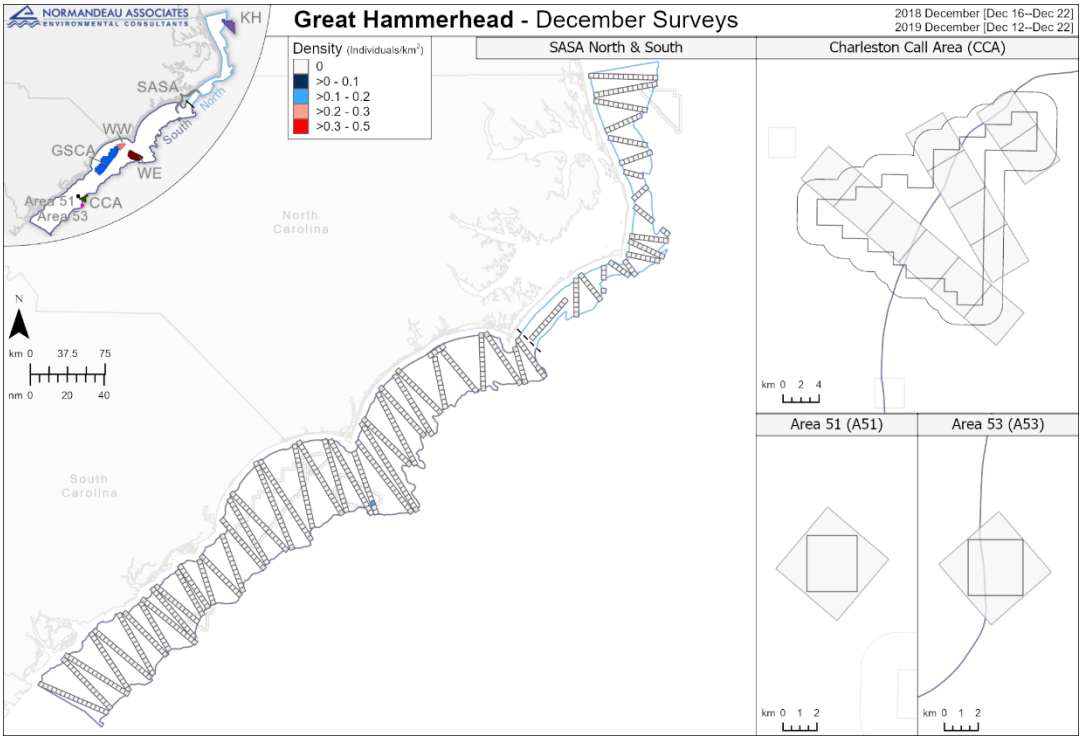

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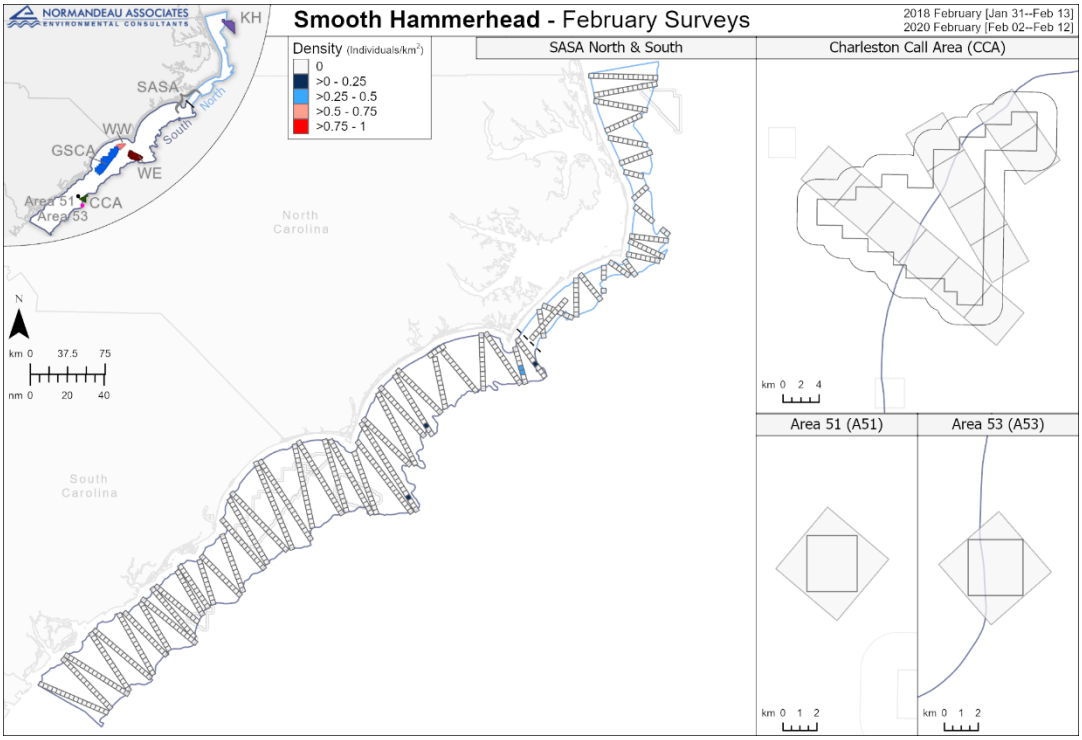

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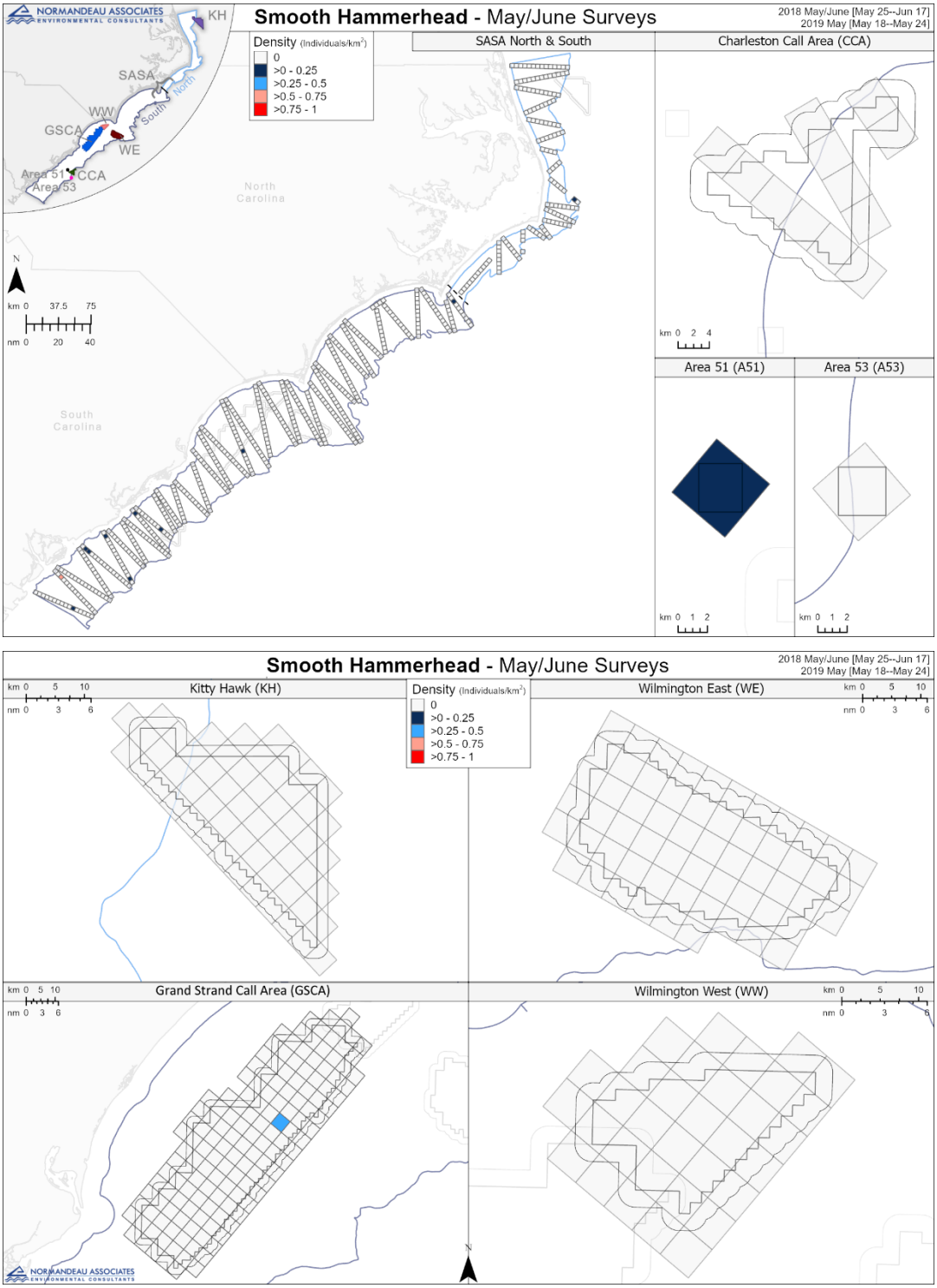

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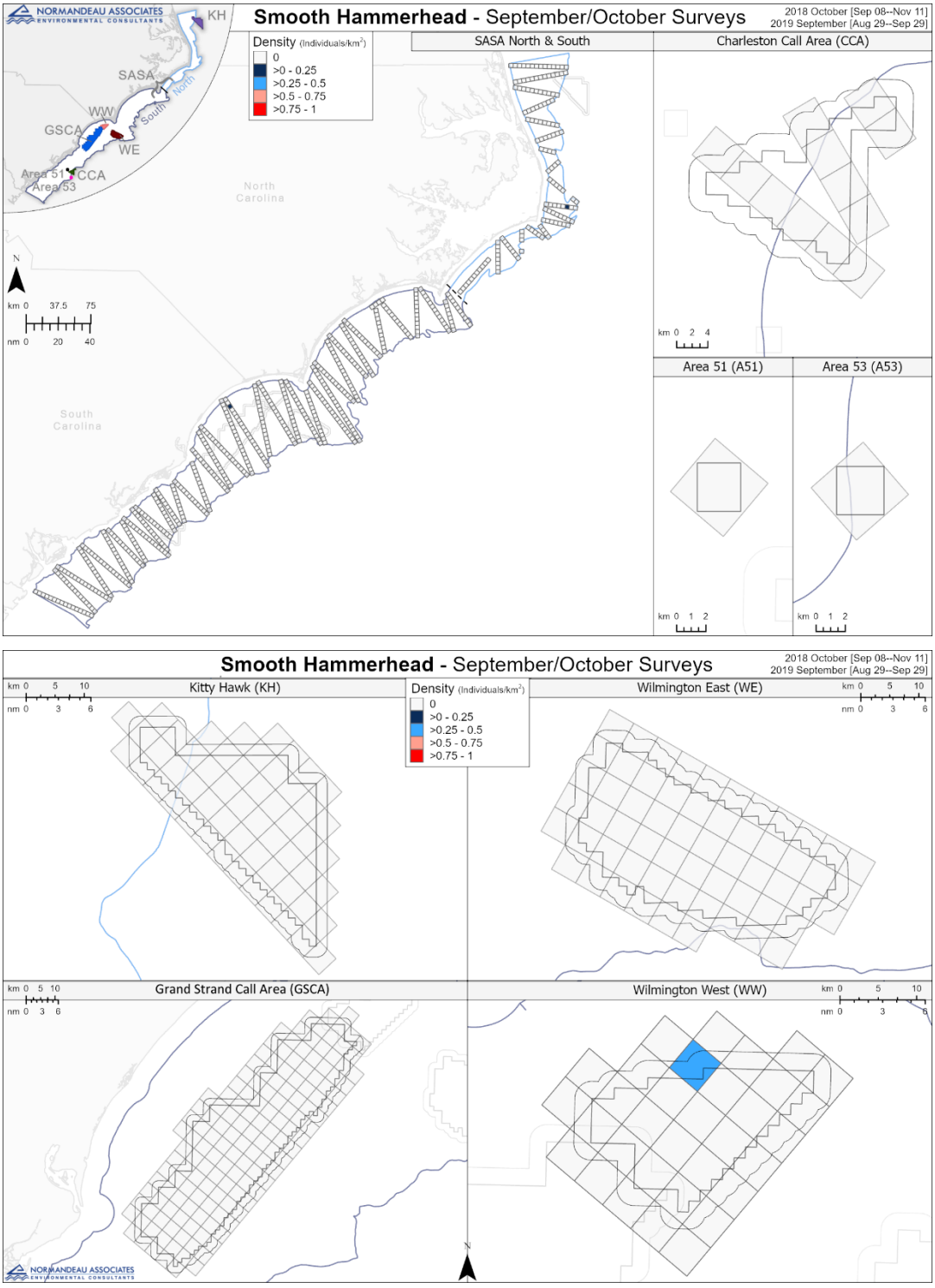

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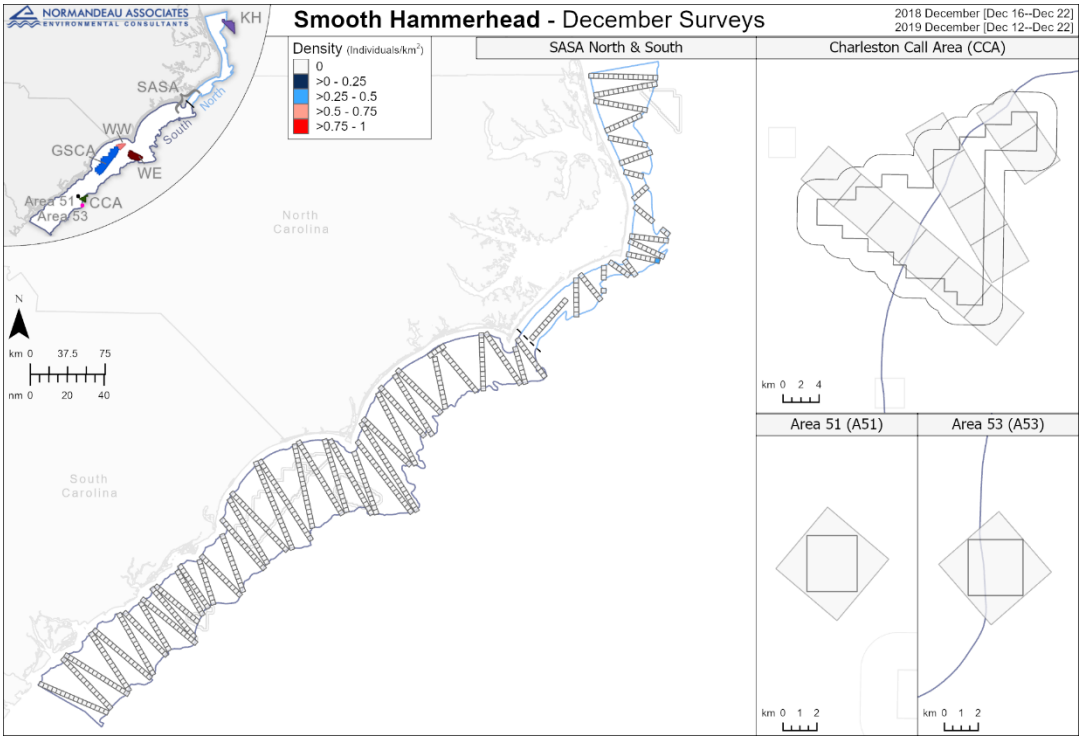

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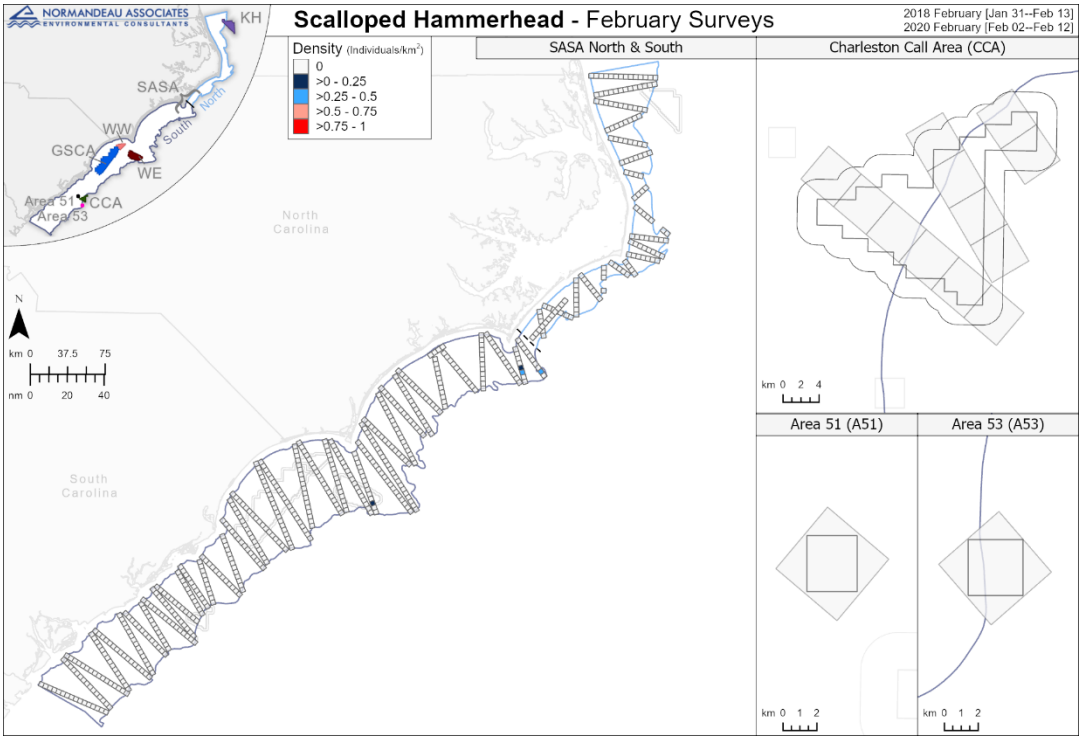

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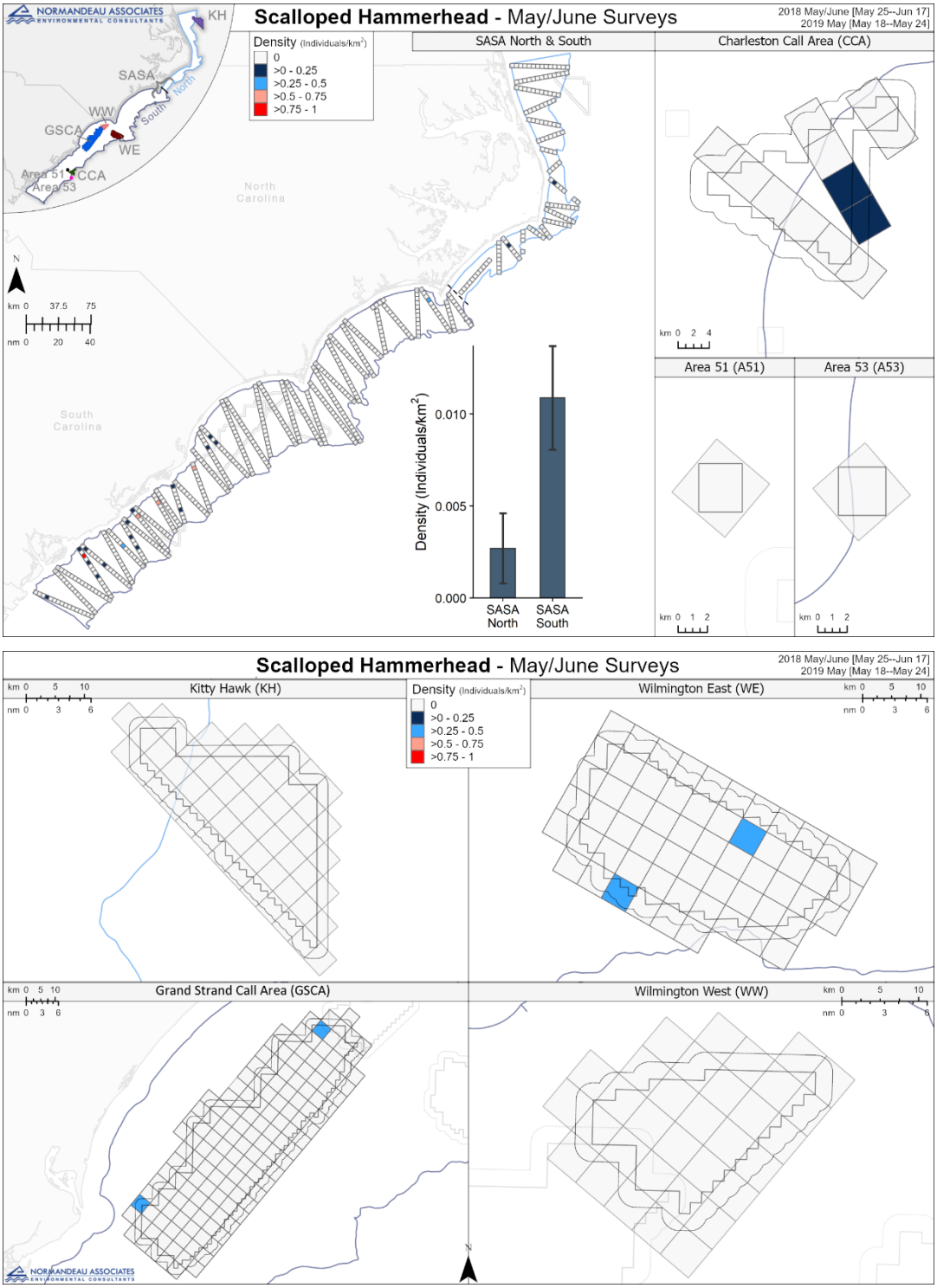

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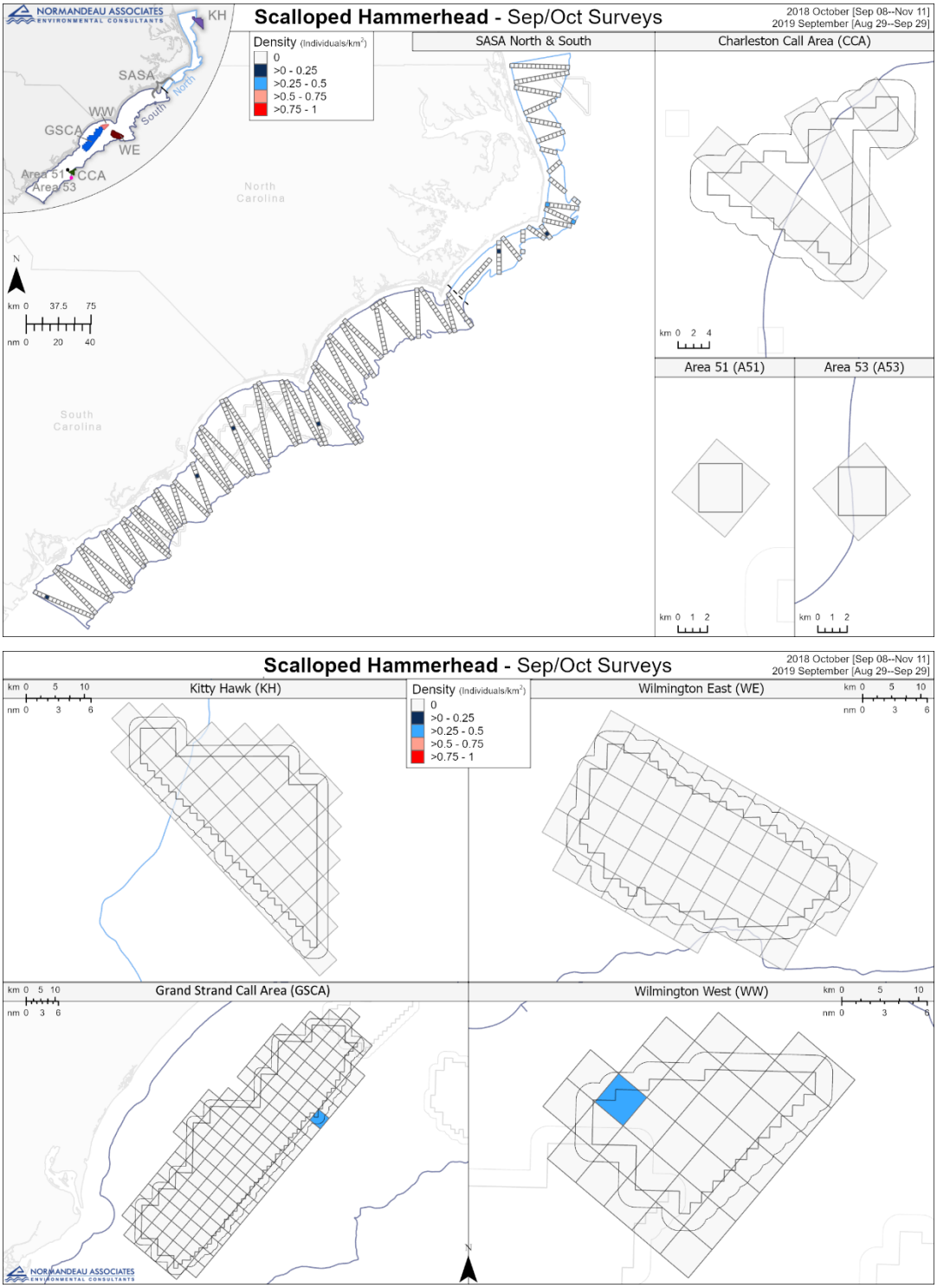

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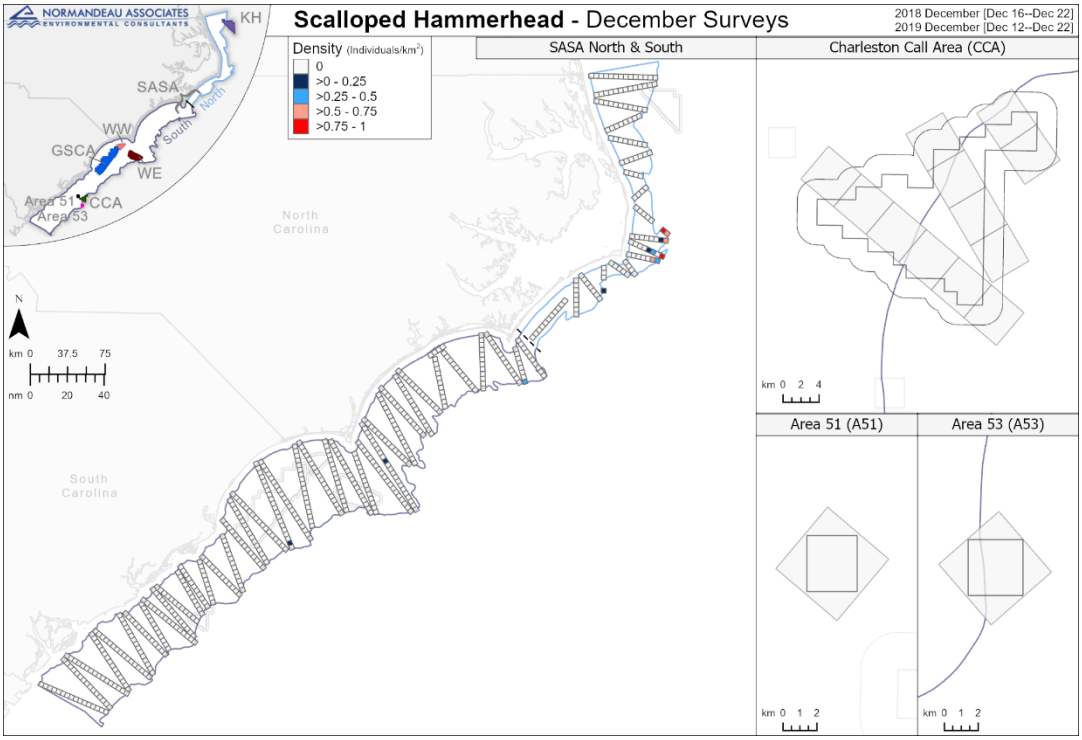

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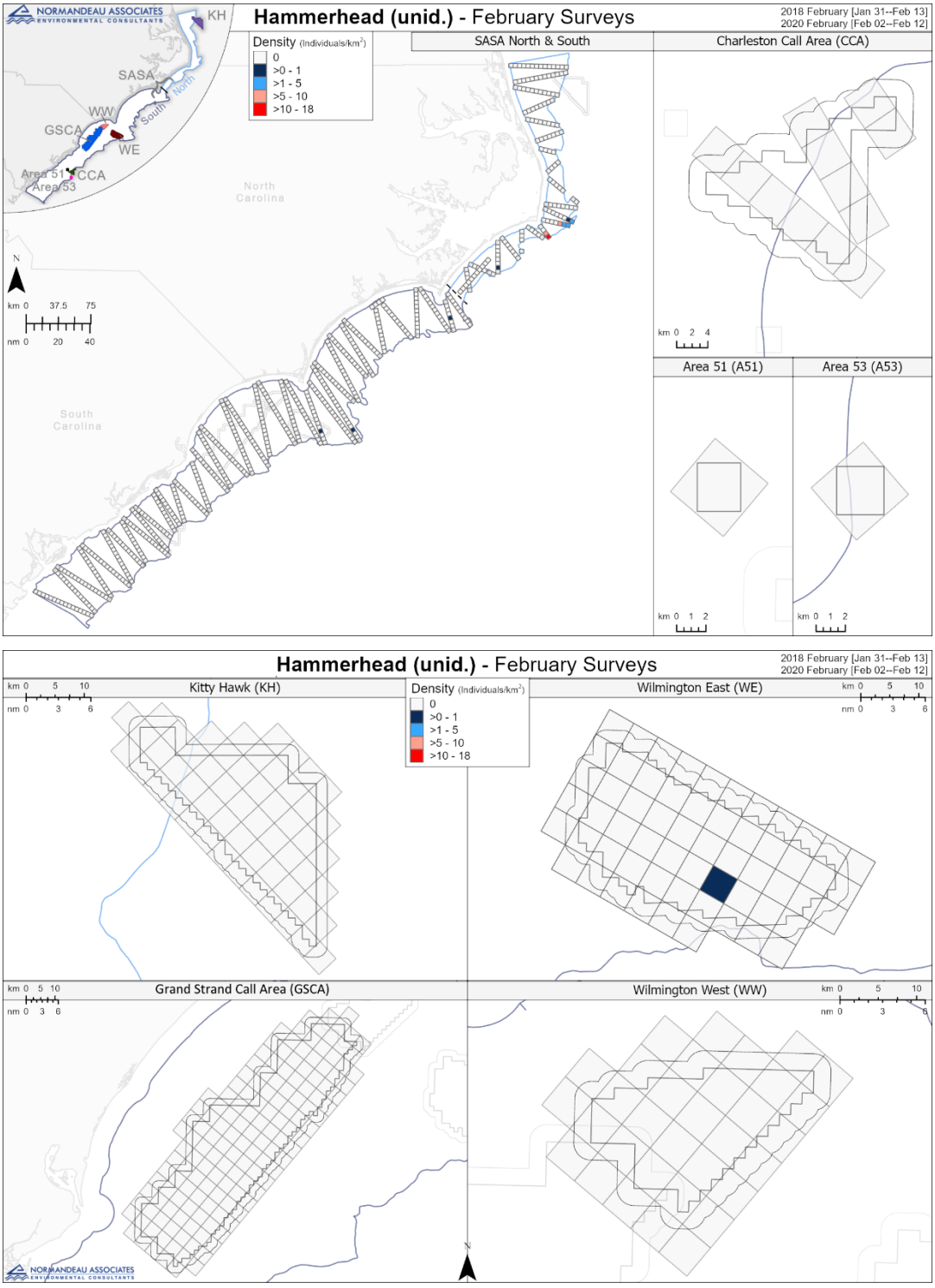

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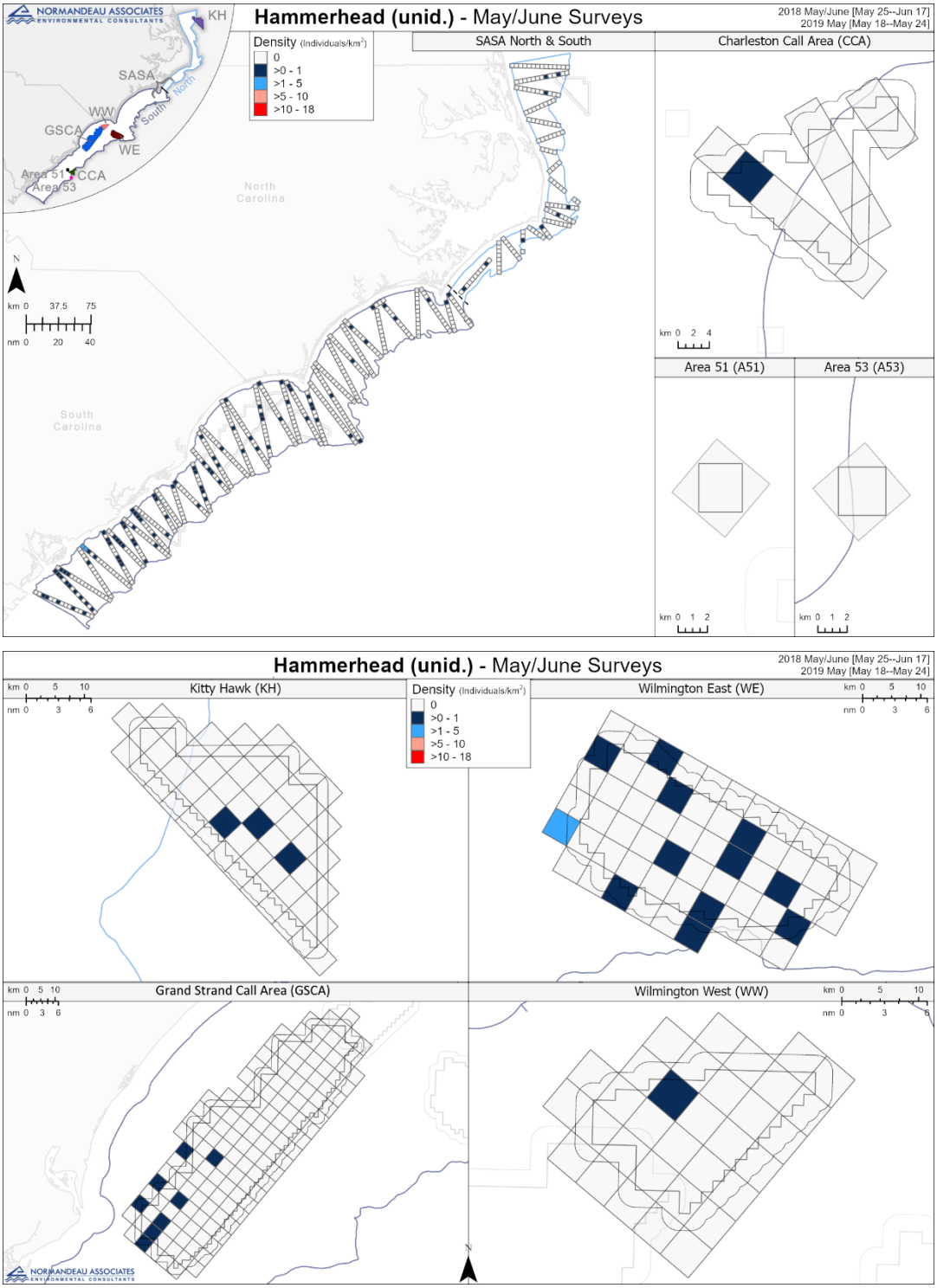

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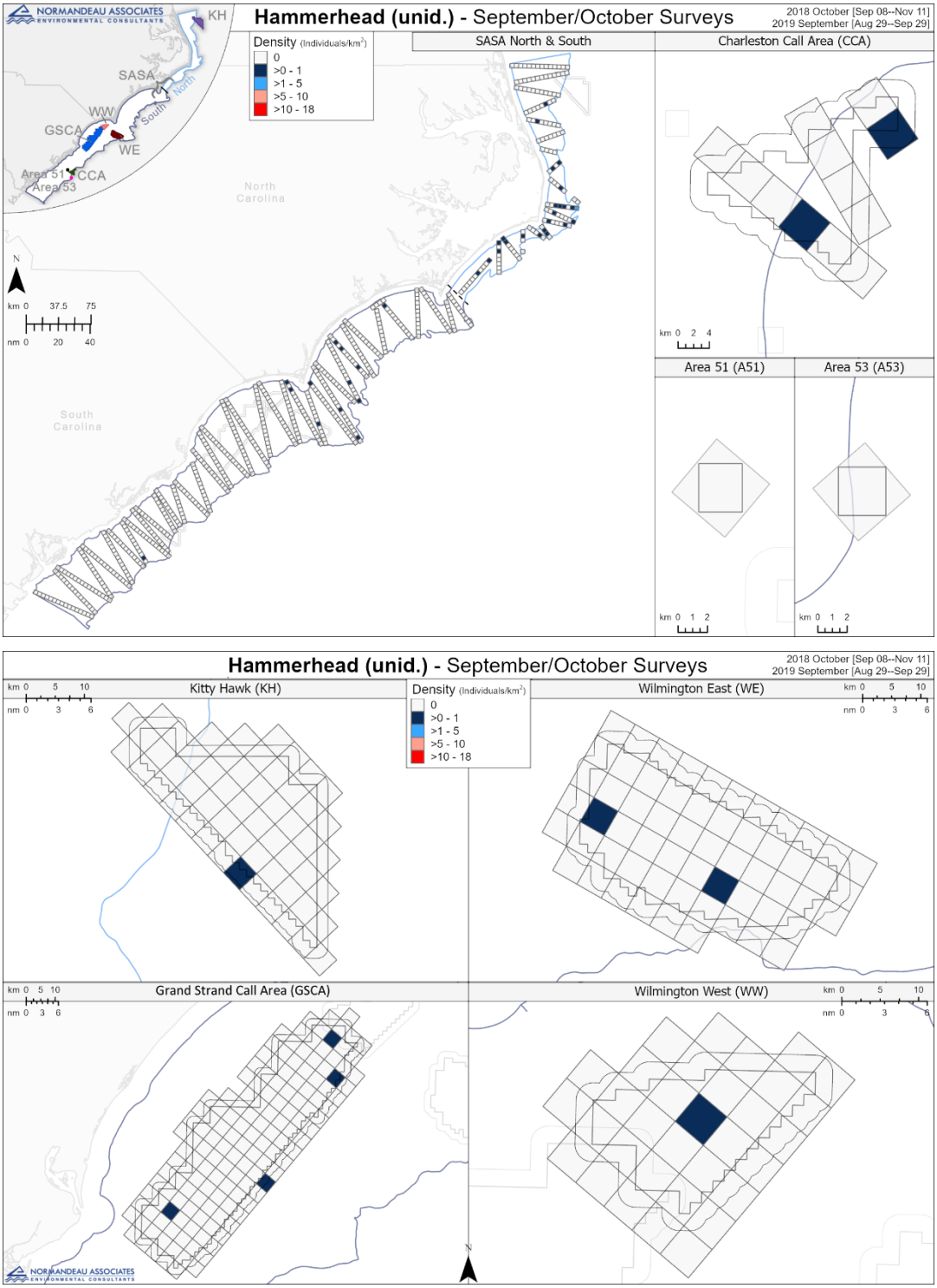

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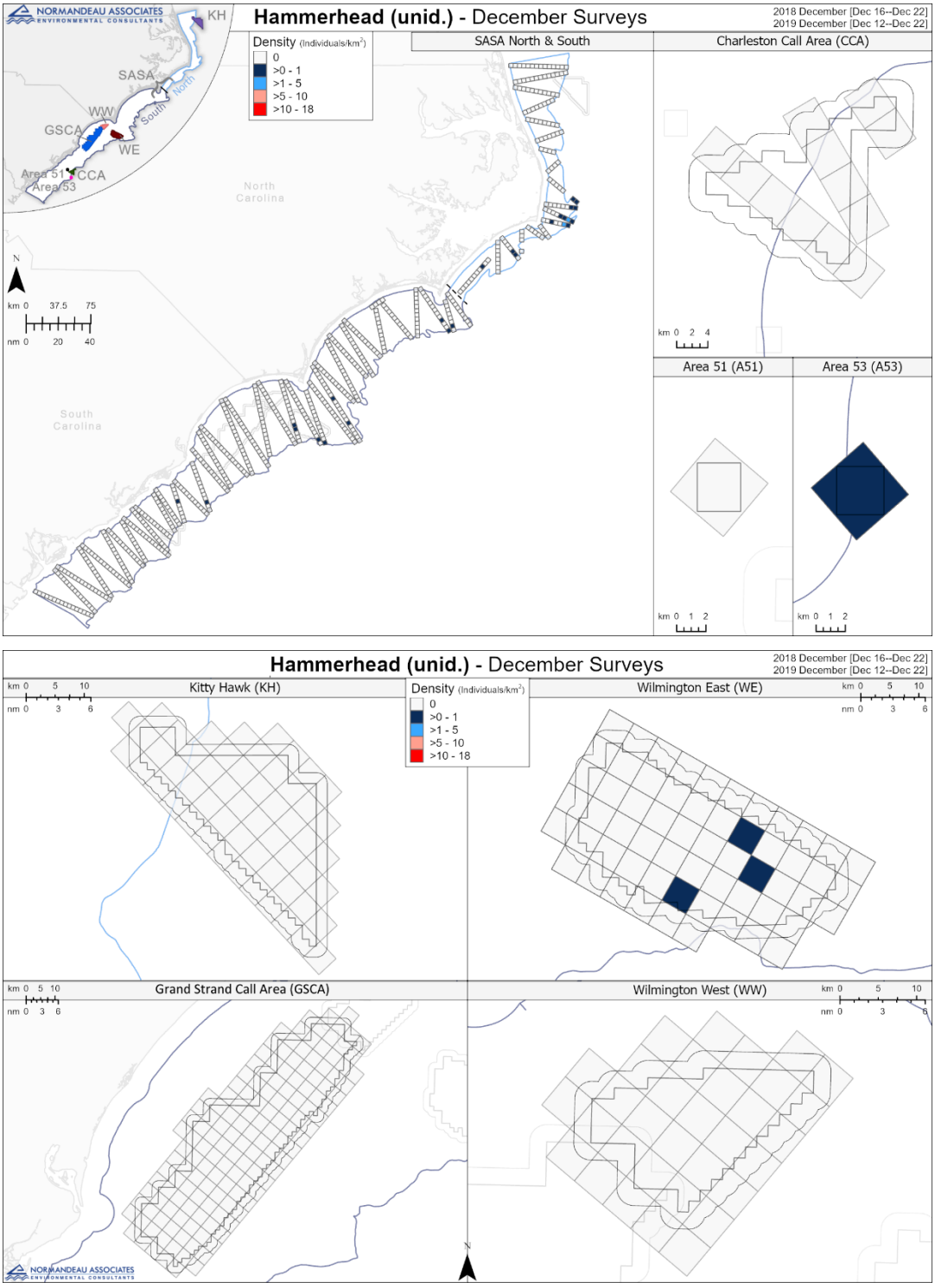

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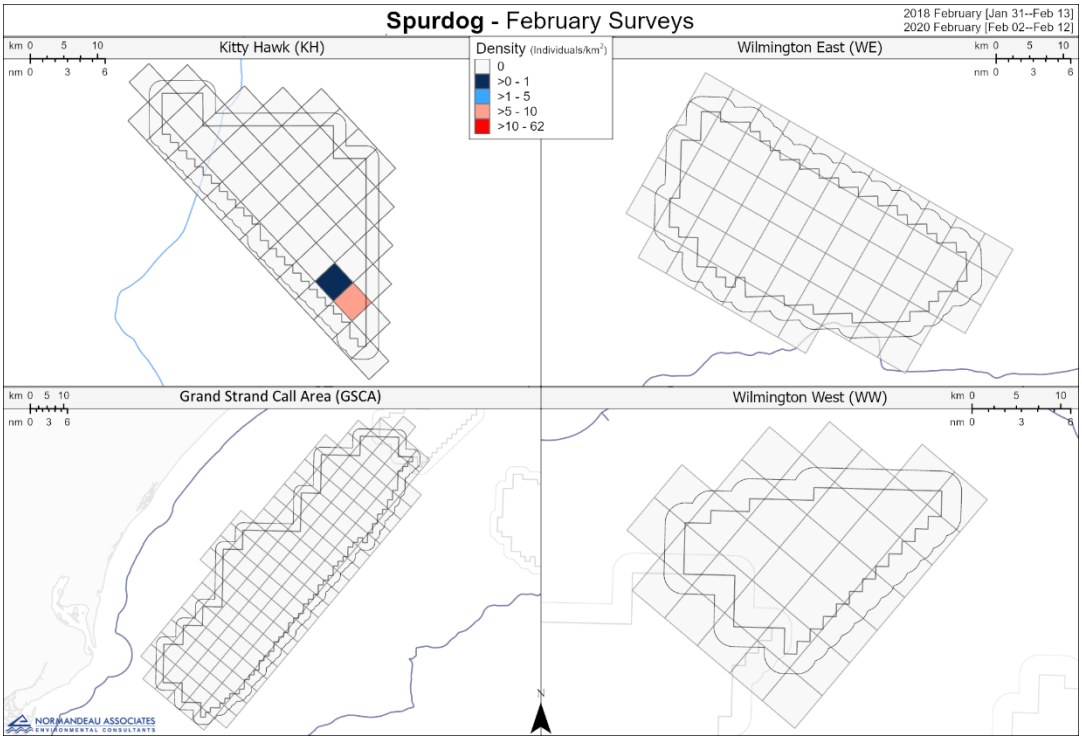

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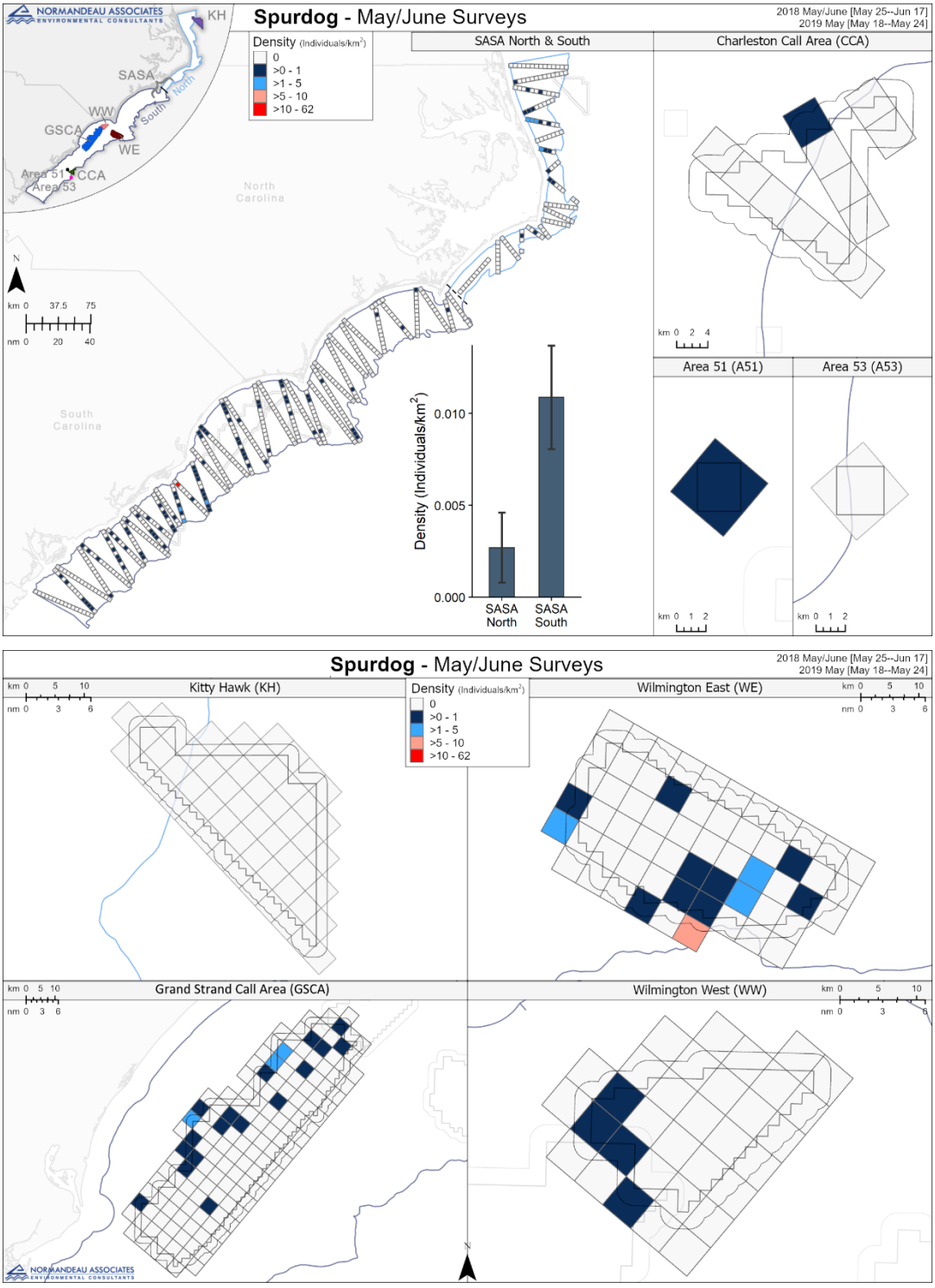

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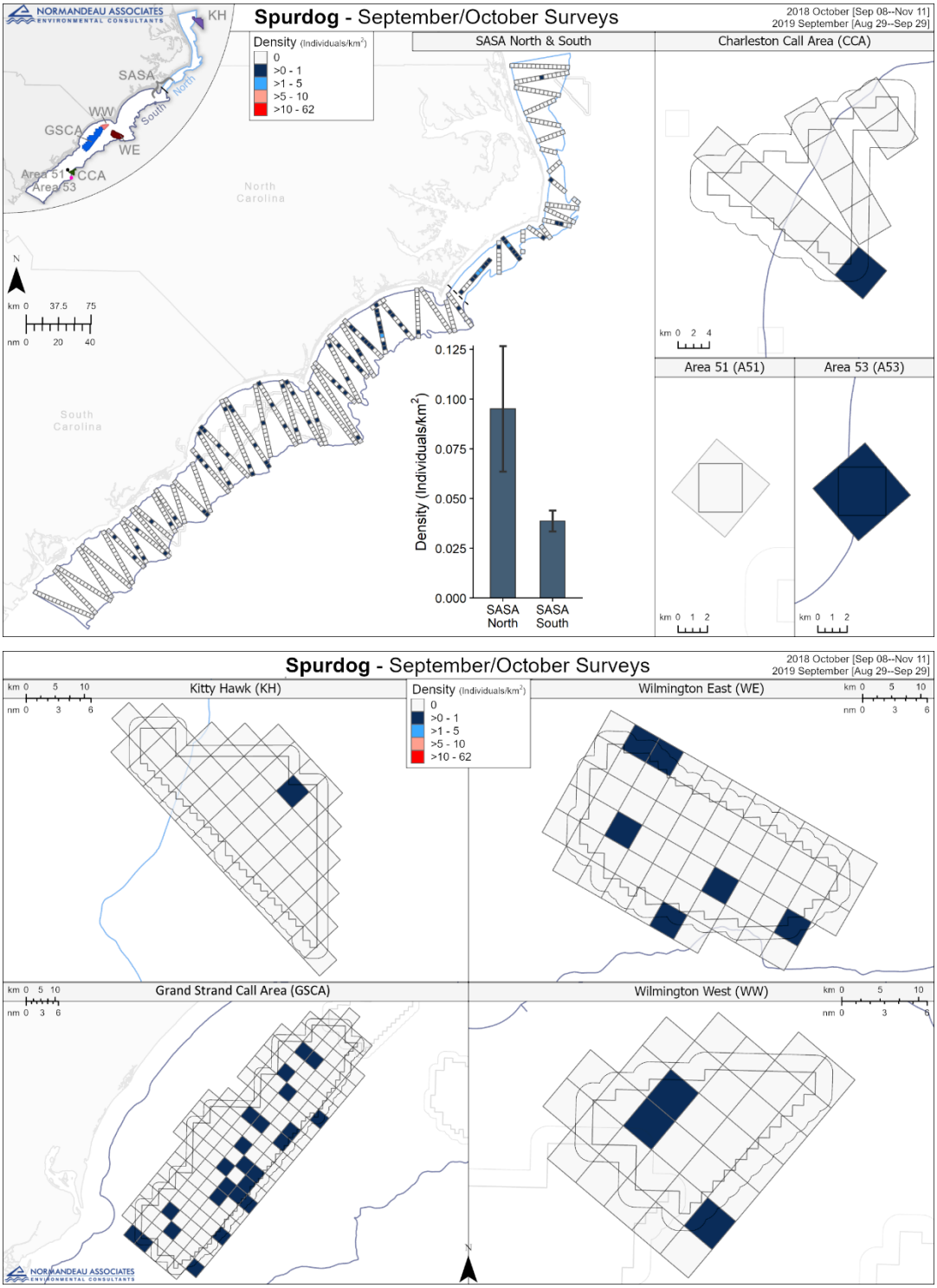

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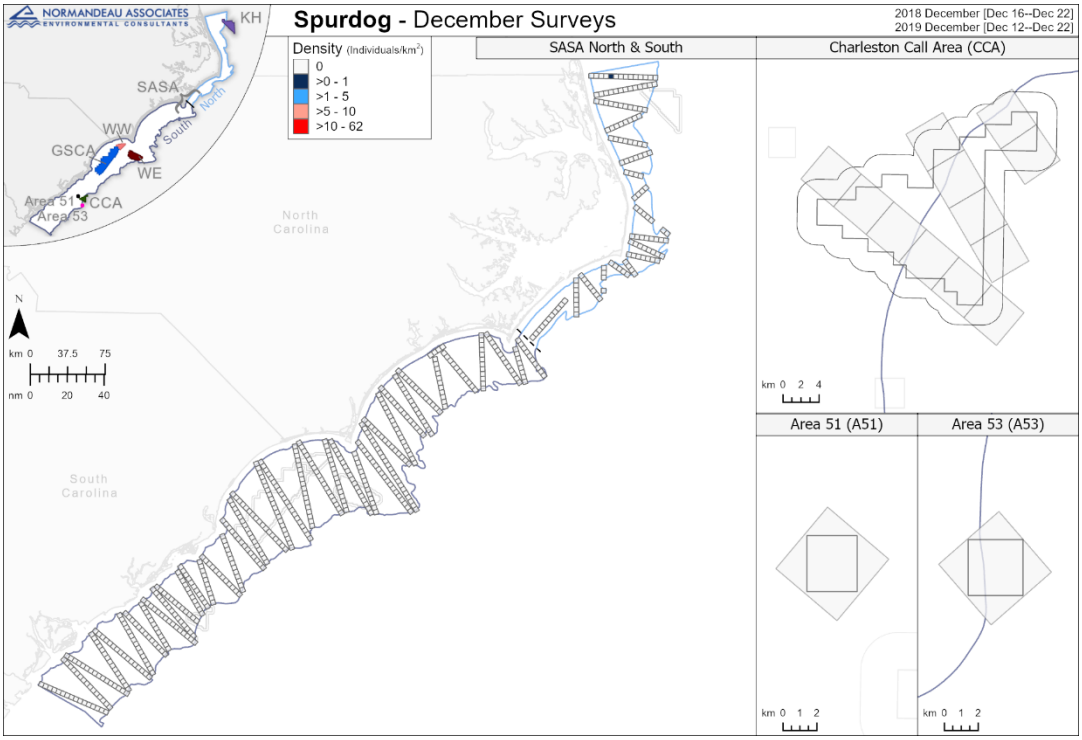

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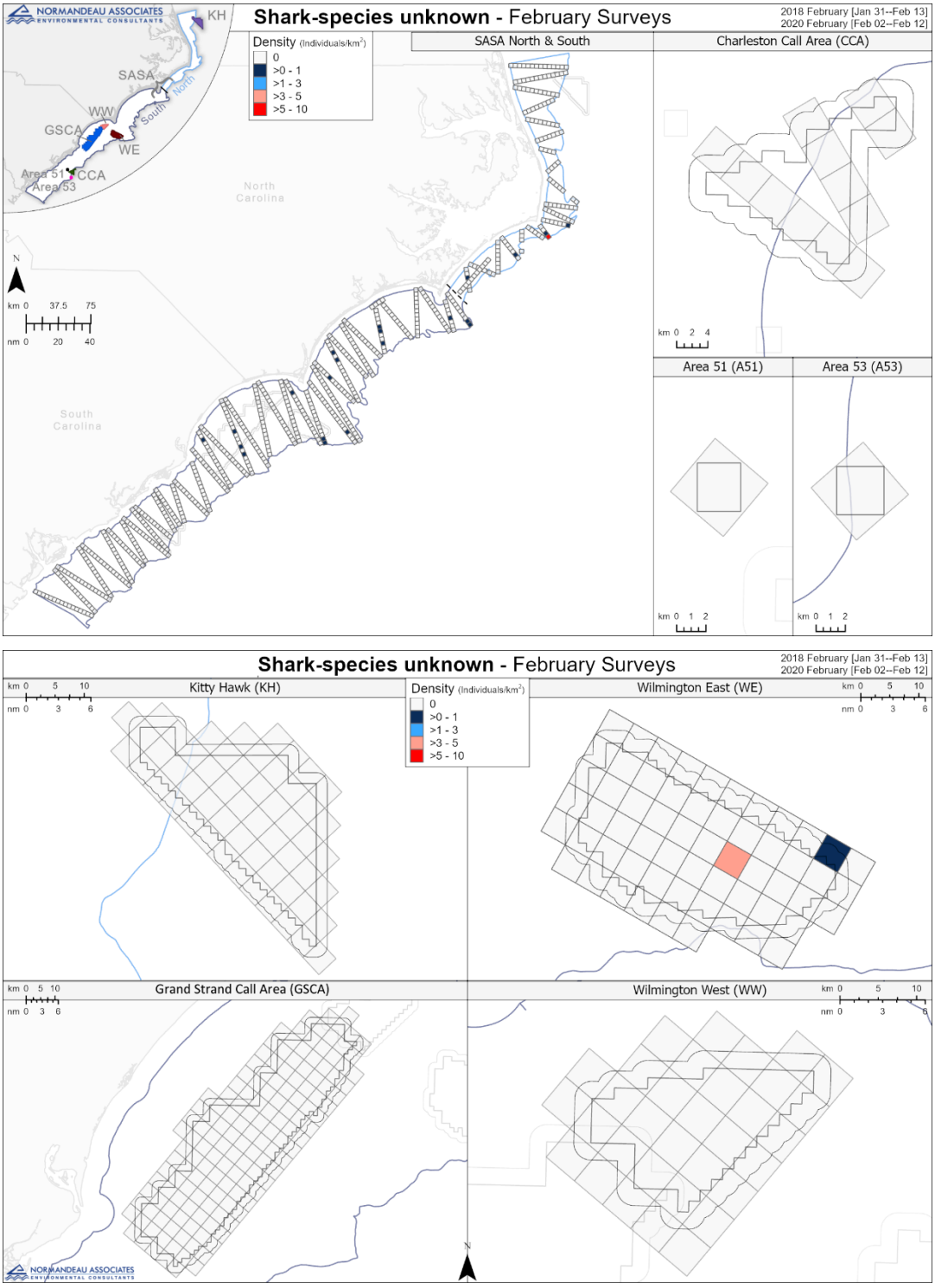

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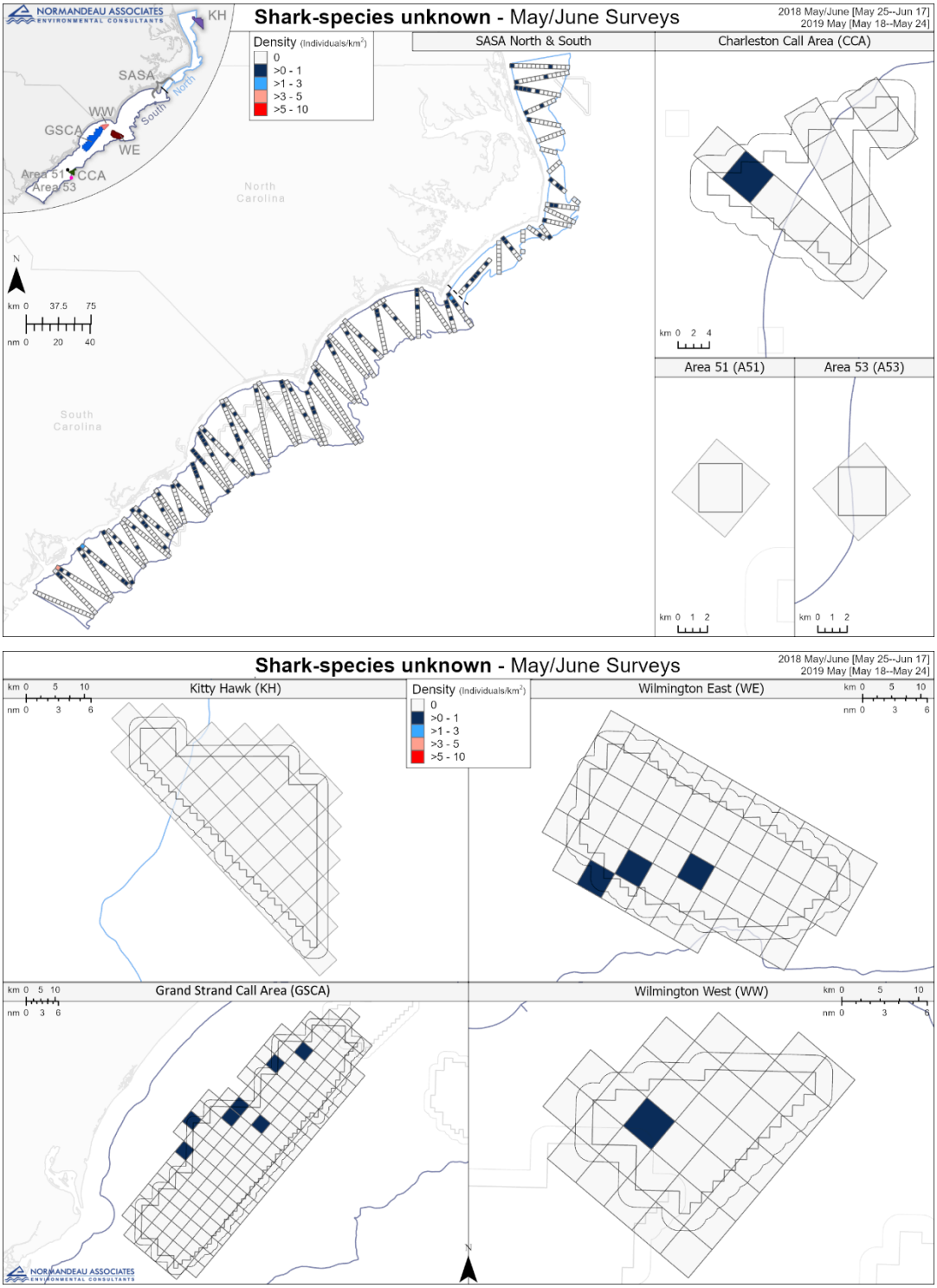

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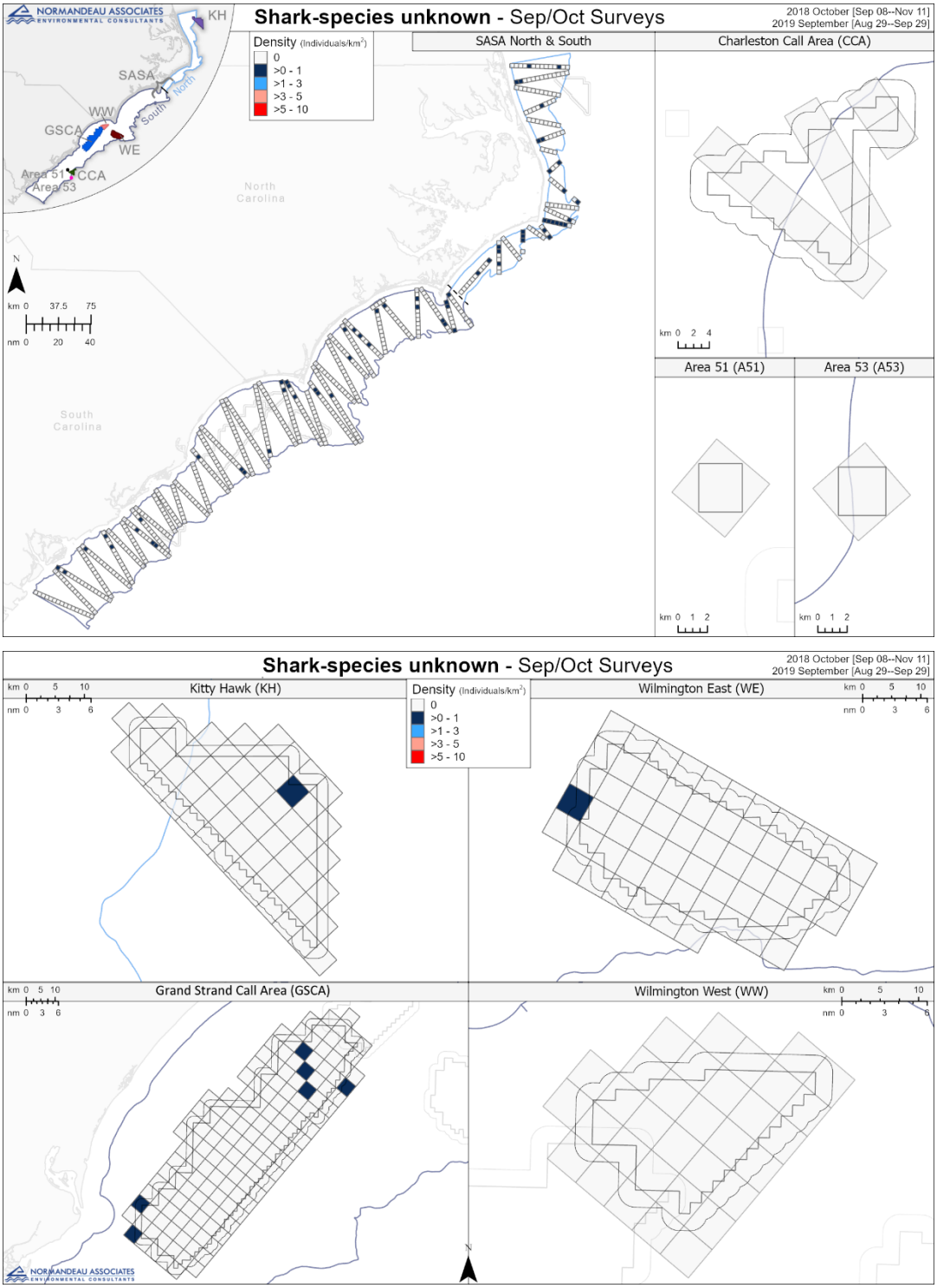

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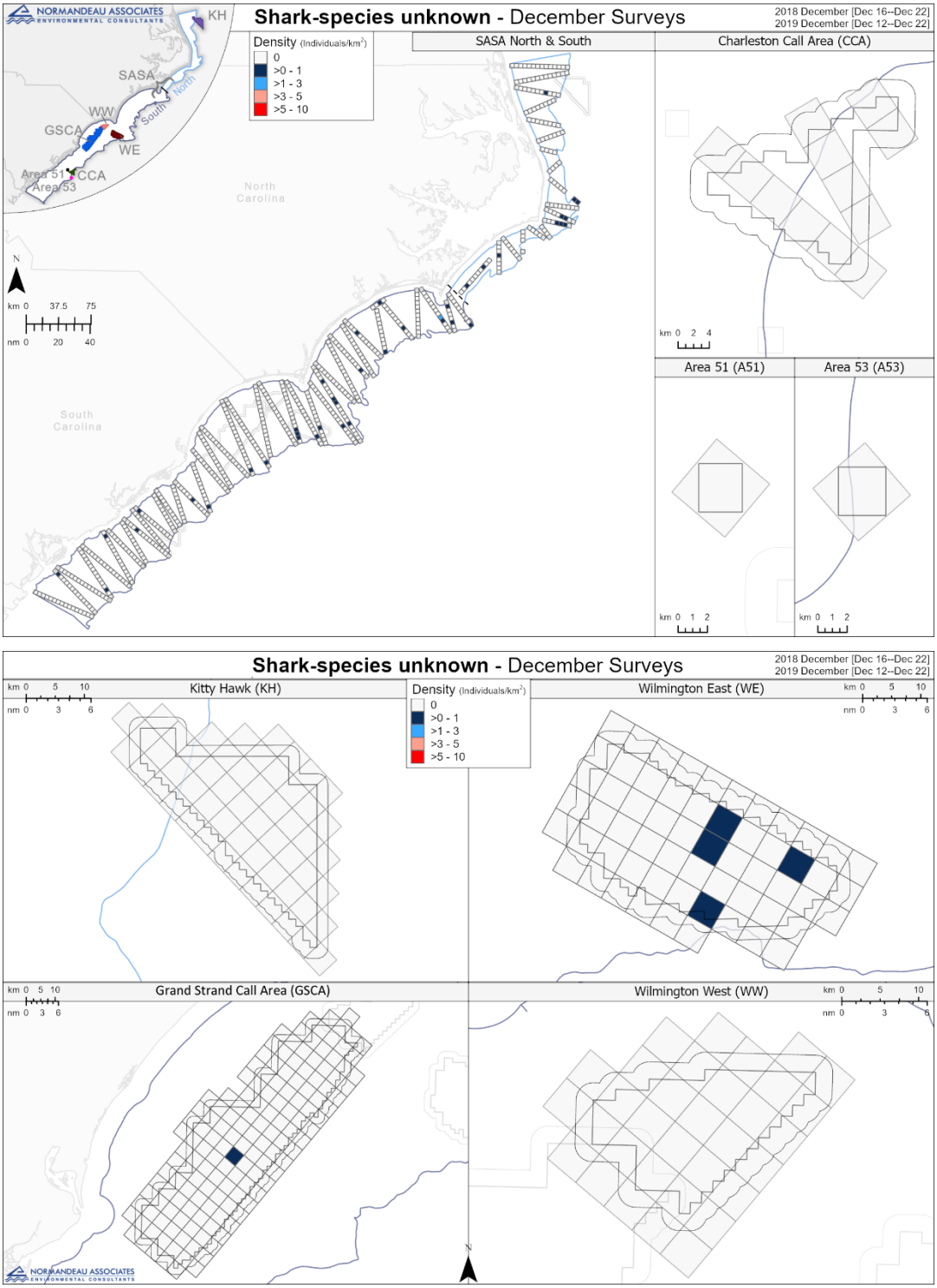

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Table G–1. Large bony fishes identified in the February 2018 through February 2020 surveys across all areas combined

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Other Fish	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**4**	**—**	**—**	**—**	**—**	**—**	**—**	**4**
Flying Fish unid.	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	4
Cobia	**—**	**—**	**—**	**1**	**—**	**3**	**—**	**7**	**—**	**12**	**—**	**1**	**—**	**—**	**—**	**—**	**24**
Cobia	—	—	—	1	—	3	—	7	—	12	—	1	—	—	—	—	24
Mahi-Mahi	**—**	**415**	**—**	**79**	**1**	**3**	**151**	**693**	**—**	**135**	**—**	**450**	**—**	**23**	**—**	**5**	**1,803**
Mahi-Mahi	—	415	—	79	1	3	151	693	—	135	—	450	—	23	—	5	1,803
Tuna	**4**	**10**	**—**	**198**	**—**	**107**	**68**	**502**	**—**	**389**	**—**	**178**	**2**	**15**	**—**	**50**	**1,449**
Atlantic bluefin tuna *	4	7	—	13	—	—	2	2	—	210	—	1	2	13	—	—	246
species unknown	—	3	—	185	—	107	66	500	—	179	—	177	—	2	—	50	1,203
Billfish	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**—**	**1**	**—**	**—**	**—**	**—**	**3**
Blue marlin	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
species unknown	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	2
Sunfish	**4**	**39**	**2**	**101**	**—**	**1**	**—**	**15**	**1**	**239**	**—**	**17**	**—**	**38**	**—**	**95**	**545**
Ocean Sunfish	2	35	1	87	—	1	—	15	—	202	—	17	—	30	—	92	479
Sharptail Sunfish	1	2	—	—	—	—	—	—	—	1	—	—	—	—	—	—	3
species unknown	1	2	1	14	—	—	—	—	1	36	—	—	—	8	—	3	63
Remora	**—**	**—**	**—**	**1**	**—**	**—**	**2**	**7**	**1**	**47**	**1**	**29**	**—**	**1**	**—**	**—**	**85**
Remora unid.	—	—	—	1	—	—	2	7	1	47	1	29	—	1	—	—	85
Unid. Fish	**6**	**62**	**—**	**15**	**—**	**78**	**1**	**3**	**—**	**161**	**—**	**6**	**—**	**11**	**—**	**6**	**342**
species unknown	6	62	—	15	—	78	1	3	—	161	—	6	—	11	—	6	342
Totals	**14**	**526**	**2**	**395**	**1**	**192**	**222**	**1,227**	**2**	**989**	**1**	**682**	**2**	**88**	**—**	**156**	**4,255**

*Listed under the Endangered Species Act

Table G–2. Large bony fishes identified in the February 2018 through February 2020 surveys in the South Atlantic Survey Area (SASA; counts include all of A51, part of A53, and part of CCA)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Cobia	**—**	**—**	**—**	**—**	**—**	**3**	**—**	**4**	**—**	**12**	**—**	**1**	**—**	**—**	**—**	**—**	**20**
Cobia	—	—	—	—	—	3	—	4	—	12	—	1	—	—	—	—	21
Mahi-Mahi	**—**	**402**	**—**	**51**	**—**	**2**	**151**	**559**	**—**	**123**	**—**	**369**	**—**	**23**	**—**	**5**	**1,534**
Mahi-Mahi	—	402	—	51	—	2	151	559	—	123	—	369	—	23	—	5	1,534
Tuna	**4**	**10**	**—**	**149**	**—**	**90**	**68**	**422**	**—**	**388**	**—**	**167**	**2**	**15**	**—**	**7**	**1,248**
Atlantic bluefin tuna *	4	7	—	13	—	—	2	2	—	209	—	1	2	13	—	—	245
species unknown	—	3	—	136	—	90	66	420	—	179	—	166	—	2	—	7	1,003
Billfish	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**—**	**1**	**—**	**—**	**—**	**—**	**3**
Blue marlin	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
species unknown	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	2
Sunfish	**3**	**35**	**2**	**96**	**—**	**—**	**—**	**13**	**1**	**225**	**—**	**14**	**—**	**36**	**—**	**92**	**511**
Ocean Sunfish	1	31	1	83	—	—	—	13	—	188	—	14	—	28	—	89	446
Sharptail Sunfish	1	2	—	—	—	—	—	—	—	1	—	—	—	—	—	—	3
species unknown	1	2	1	13	—	—	—	—	1	36	—	—	—	8	—	3	62
Remora	**—**	**—**	**—**	**1**	**—**	**—**	**2**	**7**	**1**	**46**	**1**	**29**	**—**	**—**	**—**	**—**	**83**
Remora unid.	—	—	—	1	—	—	2	7	1	46	1	29	—	—	—	—	83
Unid. Fish	**6**	**62**	**—**	**15**	**—**	**49**	**1**	**3**	**—**	**155**	**—**	**5**	**—**	**11**	**—**	**6**	**306**
species unknown	6	62	—	15	—	49	1	3	—	155	—	5	—	11	—	6	306
Totals	**13**	**509**	**2**	**312**	**—**	**144**	**222**	**1,008**	**2**	**951**	**1**	**586**	**2**	**85**	**—**	**110**	**3,705**

*Listed under the Endangered Species Act

Table G–3. Large bony fishes identified in the February 2018 through February 2020 surveys in Area A51

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Mahi-Mahi	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**3**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**3**
Mahi-Mahi	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	3
Totals	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**3**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**3**

Table G–4. Large bony fishes identified in the February 2018 through February 2020 surveys in Area A53

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Mahi-Mahi	**—**	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**—**	**3**
Mahi-Mahi	—	2	—	—	—	—	—	—	—	—	—	1	—	—	—	—	3
Tuna	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**5**	**—**	**—**	**—**	**—**	**5**
species unknown	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	5
Sunfish	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**
Ocean Sunfish	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Totals	**—**	**3**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**6**	**—**	**—**	**—**	**—**	**9**

Table G–5. Large bony fishes identified in the February 2018 through February 2020 surveys in the Charleston Call Area (CCA)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Mahi-Mahi	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**11**	**—**	**—**	**—**	**16**	**—**	**—**	**—**	**—**	**27**
Mahi-Mahi	—	—	—	—	—	—	—	11	—	—	—	16	—	—	—	—	27
Tuna	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**3**	**—**	**—**	**—**	**6**	**9**
species unknown	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	6	9
Sunfish	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**
species unknown	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Remora	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**1**
Remora unid.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Totals	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**11**	**—**	**—**	**—**	**19**	**—**	**1**	**—**	**6**	**38**

Table G–6. Large bony fishes identified in the February 2018 through February 2020 surveys in the Kitty Hawk (KH) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Mahi-Mahi	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**3**	**—**	**4**	**—**	**39**	**—**	**—**	**—**	**—**	**46**
Mahi-Mahi	—	—	—	—	—	—	—	3	—	4	—	39	—	—	—	—	46
Tuna	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**73**	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**74**
Atlantic bluefin tuna *	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
species unknown	—	—	—	—	—	—	—	73	—	—	—	—	—	—	—	—	73
Sunfish	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**2**	**—**	**14**	**—**	**3**	**—**	**—**	**—**	**2**	**22**
Ocean Sunfish	—	—	—	—	—	1	—	2	—	14	—	3	—	—	—	2	22
Totals	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**78**	**—**	**19**	**—**	**42**	**—**	**—**	**—**	**2**	**142**

*Listed under the Endangered Species Act

Table G–7. Large bony fishes identified in the February 2018 through February 2020 surveys in the Wilmington West (WW) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Mahi-Mahi	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**3**	**—**	**—**	**—**	**—**	**4**
Mahi-Mahi	—	—	—	—	—	—	—	—	—	1	—	3	—	—	—	—	4
Totals	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**3**	**—**	**—**	**—**	**—**	**4**

Table G–8. Large bony fishes identified in the February 2018 through February 2020 surveys in the Wilmington East (WE) Area

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Other Fish	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**4**	**—**	**—**	**—**	**—**	**—**	**—**	**4**
Flying Fish unid.	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	4
Mahi-Mahi	**—**	**—**	**—**	**20**	**—**	**—**	**—**	**124**	**—**	**5**	**—**	**4**	**—**	**—**	**—**	**—**	**153**
Mahi-Mahi	—	—	—	20	—	—	—	124	—	5	—	4	—	—	—	—	153
Tuna	**—**	**—**	**—**	**49**	**—**	**17**	**—**	**1**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**6**	**74**
species unknown	—	—	—	49	—	17	—	1	—	—	—	1	—	—	—	6	74
Sunfish	**1**	**3**	**—**	**2**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**5**
Ocean Sunfish	1	3	—	2	—	—	—	—	—	—	—	—	—	—	—	—	5
Unid. Fish	**—**	**—**	**—**	**—**	**—**	**29**	**—**	**—**	**—**	**4**	**—**	**—**	**—**	**—**	**—**	**—**	**33**
species unknown	—	—	—	—	—	29	—	—	—	4	—	—	—	—	—	—	33
Totals	**1**	**3**	**—**	**71**	**—**	**46**	**—**	**125**	**—**	**13**	**—**	**5**	**—**	**—**	**—**	**6**	**269**

Table G–9. Large bony fishes identified in the February 2018 through February 2020 surveys in the Grand Strand Call Area (GSCA; counts include part of WW)

Species	Raw Counts																Total
	Feb 2018		Feb 2020		May/Jun 2018		May 2019		Oct 2018		Sep 2019		Dec 2018		Dec 2019		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Cobia	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**3**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**4**
Cobia	—	—	—	1	—	—	—	3	—	—	—	—	—	—	—	—	4
Mahi-Mahi	**—**	**11**	**—**	**8**	**1**	**1**	**—**	**—**	**—**	**2**	**—**	**19**	**—**	**—**	**—**	**—**	**41**
Mahi-Mahi	—	11	—	8	1	1	—	—	—	2	—	19	—	—	—	—	41
Tuna	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**6**	**—**	**—**	**—**	**2**	**—**	**—**	**—**	**31**	**39**
species unknown	—	—	—	—	—	—	—	6	—	—	—	2	—	—	—	31	39
Sunfish	**—**	**—**	**—**	**3**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**—**	**1**	**6**
Ocean Sunfish	—	—	—	2	—	—	—	—	—	—	—	—	—	2	—	1	5
species unknown	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
Remora	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**1**	**—**	**—**	**—**	**—**	**—**	**—**	**1**
Remora unid.	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
Unid. Fish	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**2**	**—**	**1**	**—**	**—**	**—**	**—**	**3**
species unknown	—	—	—	—	—	—	—	—	—	2	—	1	—	—	—	—	3
Totals	**—**	**11**	**—**	**12**	**1**	**1**	**—**	**9**	**—**	**5**	**—**	**22**	**—**	**2**	**—**	**32**	**94**

G.2 Species Composition and Density (per km^2) by Survey Area for Each Survey

Table G–10. Density (per km^2) of large bony fishes for each area during the February 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Mahi-Mahi											
Mahi-Mahi	0.2098		0.7692		0.2070				0.0553	0.0285	0.1776
Tuna											
Atlantic bluefin tuna*	0.0037				0.0036						0.0030
Tuna - species unknown	0.0016				0.0015						0.0013
Sunfish											
Ocean Sunfish	0.0162		0.3846		0.0164			0.0383		0.0078	0.0150
Sharptail Sunfish	0.0010				0.0010						0.0009
Sunfish - species unknown	0.0010				0.0010						0.0009
Unid. Fish											
Unid. Fish - species unknown	0.0324				0.0318						0.0265
Totals	**0.2656**	**—**	**1.1538**	**0.0000**	**0.2624**	**—**	**—**	**0.0383**	**0.0553**	**0.0363**	**0.2250**

*Listed under the Endangered Species Act

Table G–11. Density (per km^2) of large bony fishes for each area during the February 2020 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Cobia											
Cobia									0.0050	0.0026	0.0004
Mahi-Mahi											
Mahi-Mahi	0.0268				0.0263			0.2560	0.0403	0.0727	0.0340
Tuna											
Atlantic bluefin tuna*	0.0068				0.0067						0.0056
species unknown	0.0714				0.0701			0.6271		0.1272	0.0795
Sunfish											
Ocean Sunfish	0.0436				0.0428			0.0256	0.0101	0.0104	0.0374
species unknown	0.0068			0.0330	0.0067				0.0050	0.0026	0.0060
Remora											
Remora unid.	0.0005				0.0005						0.0004
Unid. Fish											
species unknown	0.0079				0.0077						0.0064
Totals	**0.1637**	**—**	**—**	**0.0330**	**0.1607**	**—**	**—**	**0.9086**	**0.0605**	**0.2154**	**0.1698**

*Listed under the Endangered Species Act

Table G–12. Density (per km^2) of large bony fishes for each area during the May/June 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Cobia											
Cobia	0.0017				0.0017						0.0014
Mahi-Mahi											
Mahi-Mahi	0.0012				0.0011				0.0049		0.0014
Tuna											
Tuna - species unknown	0.0519				0.0509			0.2170		0.0436	0.0496
Sunfish											
Ocean Sunfish						0.0136				0.0026	0.0005
Unid. Fish											
Unid. Fish - species unknown	0.0283				0.0277			0.3701		0.0745	0.0361
Totals	**0.0830**	**—**	**—**	**—**	**0.0814**	**0.0136**	**—**	**0.5871**	**0.0049**	**0.1232**	**0.0889**

Table G–13. Density (per km^2) of large bony fishes for each area during the May 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Cobia											
Cobia	0.0021				0.0021				0.0136	0.0074	0.0030
Mahi-Mahi											
Mahi-Mahi	0.2933	1.2712		0.3633	0.2915	0.0409		1.5869		0.3115	0.2950
Tuna											
Atlantic bluefin tuna*	0.0010				0.0010						0.0009
species unknown	0.2203				0.2163	0.9944		0.0128	0.0272	0.1962	0.2128
Sunfish											
Ocean Sunfish	0.0068				0.0067	0.0272				0.0049	0.0064
Remora											
Remora unid.	0.0037				0.0036						0.0030
Unid. Fish											
species unknown	0.0016				0.0015						0.0013
Totals	**0.5288**	**1.2712**	**—**	**0.3633**	**0.5228**	**1.0625**	**—**	**1.5997**	**0.0407**	**0.5201**	**0.5223**

*Listed under the Endangered Species Act

Table G–14. Density (per km^2) of large bony fishes for each area during the October 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Other Fish											
Flying Fish unid.								0.0511		0.0096	0.0018
Cobia											
Cobia	0.0066				0.0065						0.0053
Mahi-Mahi											
Mahi-Mahi	0.0680				0.0667	0.0543	0.0240	0.0638	0.0089	0.0287	0.0597
Tuna											
Atlantic bluefin tuna*	0.1156				0.1134	0.0136				0.0024	0.0928
Tuna - species unknown	0.0990				0.0971						0.0791
Billfish											
Blue marlin	0.0006				0.0005						0.0004
Billfish - species unknown	0.0006				0.0005						0.0004
Sunfish											
Ocean Sunfish	0.1040				0.1020	0.1902				0.0334	0.0893
Sharptail Sunfish	0.0006				0.0005						0.0004
Sunfish - species unknown	0.0199				0.0195						0.0159
Remora											
Remora unid.	0.0254				0.0250				0.0044	0.0024	0.0203
Unid. Fish											
Unid. Fish - species unknown	0.0857				0.0841			0.0511	0.0089	0.0143	0.0712
Totals	**0.5260**	**—**	**—**	**—**	**0.5159**	**0.2582**	**0.0240**	**0.1659**	**0.0222**	**0.0908**	**0.4372**

*Listed under the Endangered Species Act

Table G–15. Density (per km^2) of large bony fishes for each area during the September 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Cobia											
Cobia	0.0005				0.0005						0.0004
Mahi-Mahi											
Mahi-Mahi	0.1925		0.3846	0.5284	0.1972	0.5313	0.0852	0.0512	0.0960	0.1689	0.1926
Tuna											
Atlantic bluefin tuna	0.0005				0.0005						0.0004
species unknown	0.0866		1.9231	0.0991	0.0891			0.0128	0.0101	0.0078	0.0757
Billfish											
species unknown	0.0005				0.0005						0.0004
Sunfish											
Ocean Sunfish	0.0073				0.0072	0.0409				0.0078	0.0073
Remora											
Remora unid.	0.0151				0.0149						0.0124
Unid. Fish											
species unknown	0.0026				0.0026				0.0051	0.0026	0.0026
Totals	**0.3057**	**—**	**2.3077**	**0.6275**	**0.3125**	**0.5721**	**0.0852**	**0.0640**	**0.1111**	**0.1871**	**0.2919**

Table G–16. Density (per km^2) of large bony fishes for each area during the December 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Mahi-Mahi											
Mahi-Mahi	0.0120				0.0118						0.0098
Tuna											
Atlantic bluefin tuna*	0.0068				0.0067						0.0055
Tuna - species unknown	0.0010				0.0010						0.0009
Sunfish											
Ocean Sunfish	0.0146				0.0144				0.0096	0.0050	0.0128
Sunfish - species unknown	0.0042				0.0041						0.0034
Remora											
Remora unid.				0.0329	0.0005						0.0004
Unid. Fish											
Unid. Fish - species unknown	0.0057				0.0056						0.0047
Totals	**0.0444**	**—**	**—**	**0.0329**	**0.0441**	**—**	**—**	**—**	**0.0096**	**0.0050**	**0.0375**

*Listed under the Endangered Species Act

Table G–17. Density (per km^2) of large bony fishes for each area during the December 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Mahi-Mahi											
Mahi-Mahi	0.0026				0.0026						0.0023
Tuna											
species unknown	0.0037			0.1982	0.0670			0.0768	0.2978	0.1364	0.0226
Sunfish											
Ocean Sunfish	0.0466				0.0458	0.0272			0.0096	0.0111	0.0415
species unknown	0.0016				0.0015						0.0014
Unid. Fish											
species unknown	0.0031				0.0031						0.0027
Totals	**0.0576**	**—**	**—**	**0.1982**	**0.0597**	**0.0272**	**—**	**0.0768**	**0.3075**	**0.1475**	**0.0704**

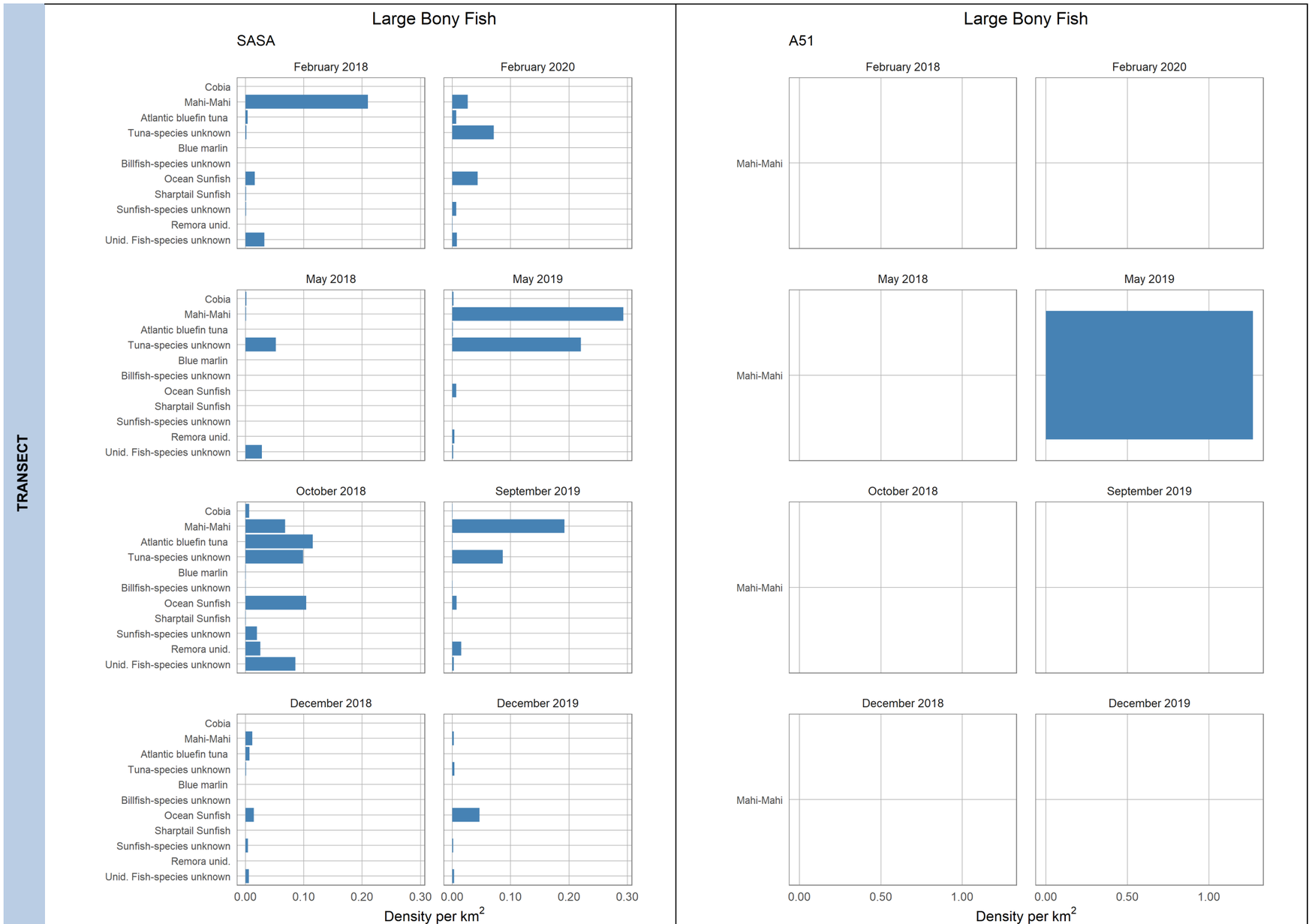

Figure G–1. Density (per km^2) of large bony fishes encountered during the February 2018 through February 2020 surveys for each area by survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

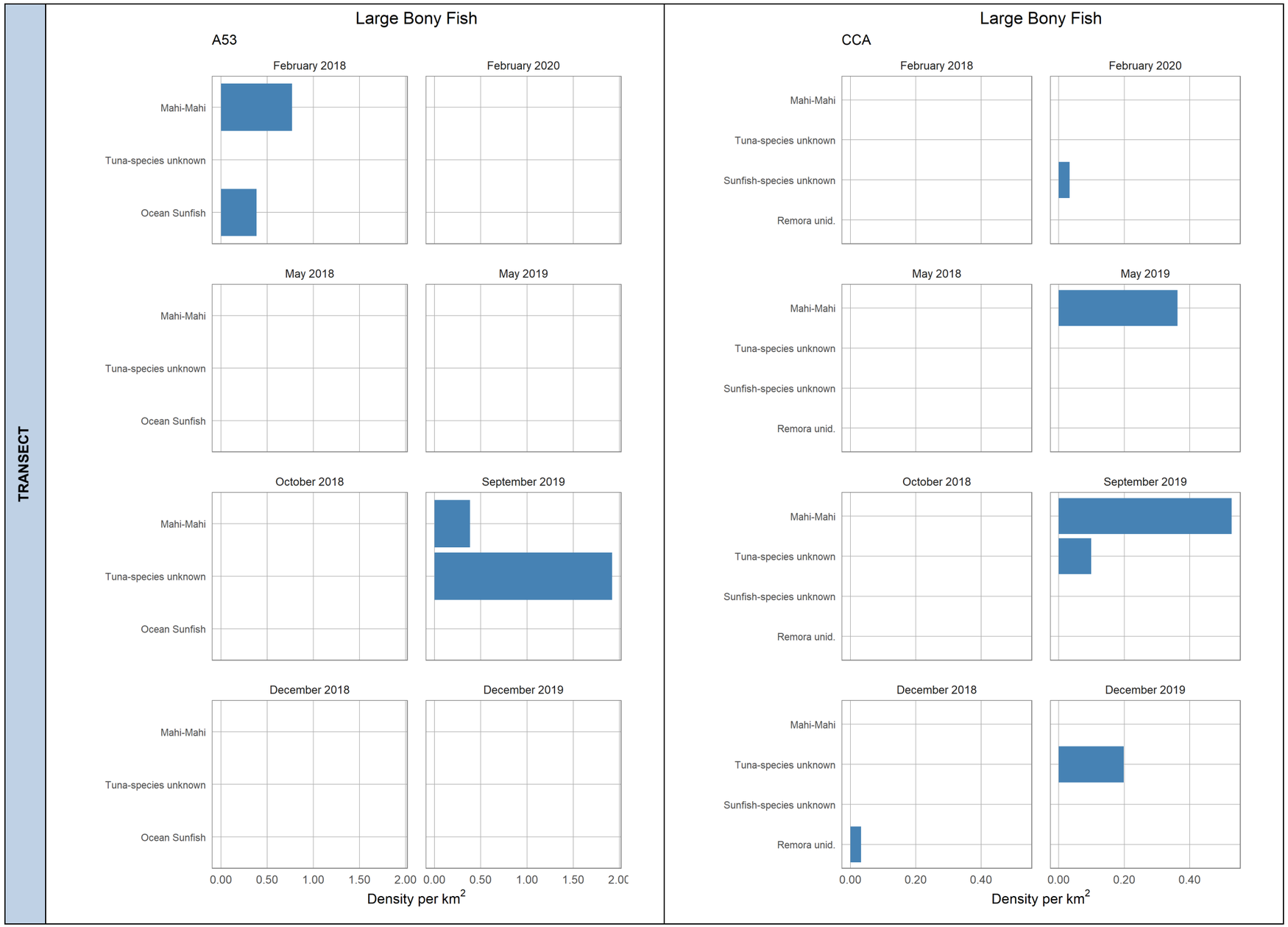

Figure G–1. (Continued)

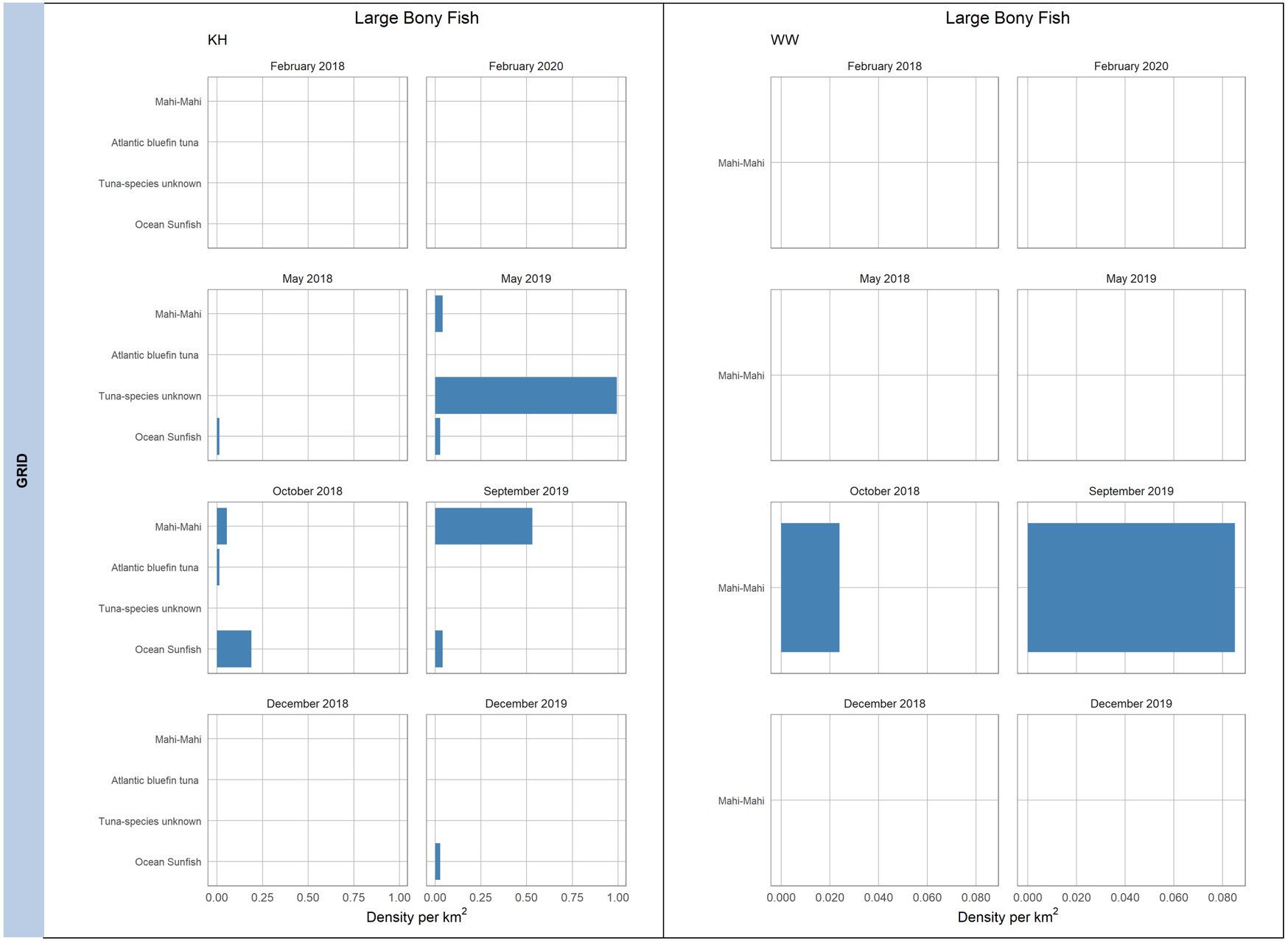

Figure G–1. (Continued)

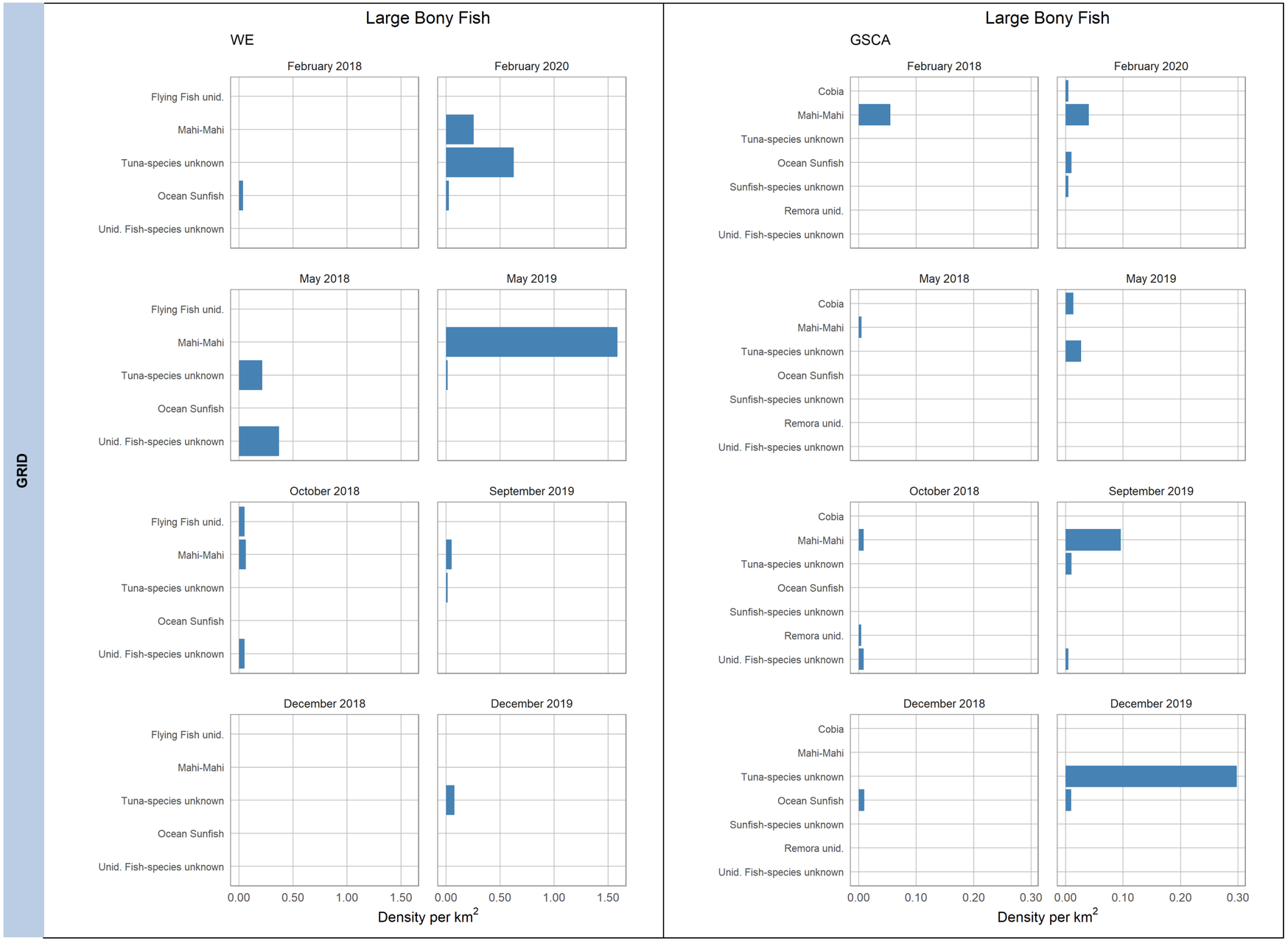

Figure G–1. (Continued)

G.3 Large Bony Fishes Spatial Distribution Maps

G.3.1 Cobia

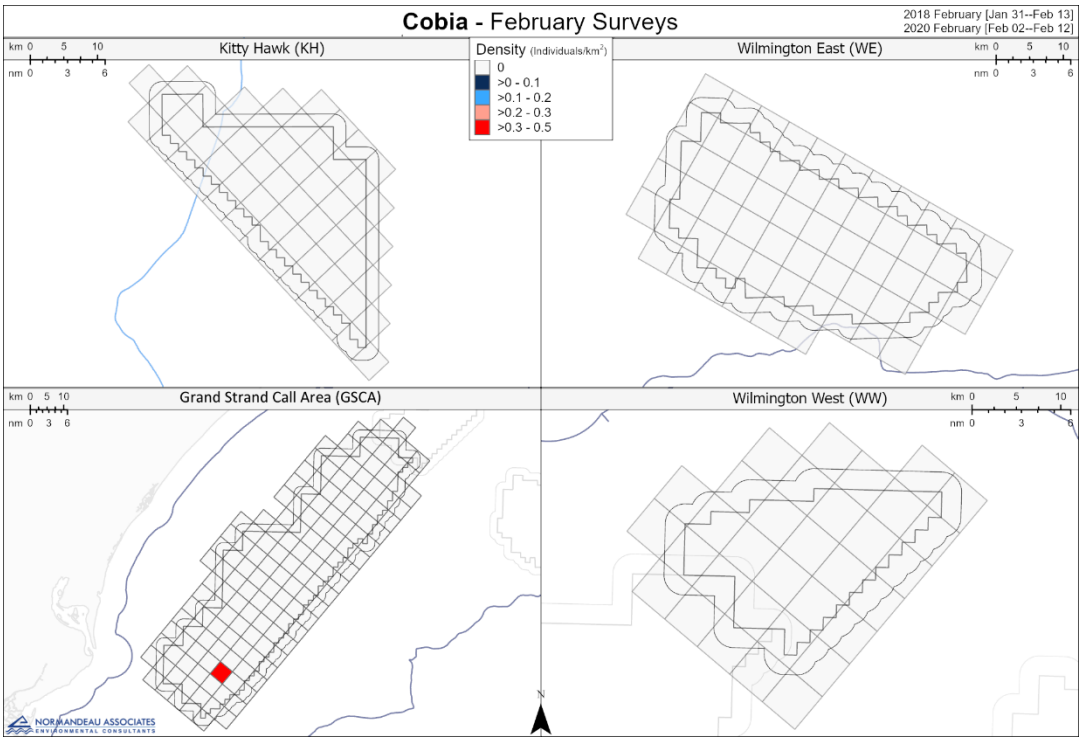

Figure G–2. Spatial distribution of cobia during the February surveys for all areas

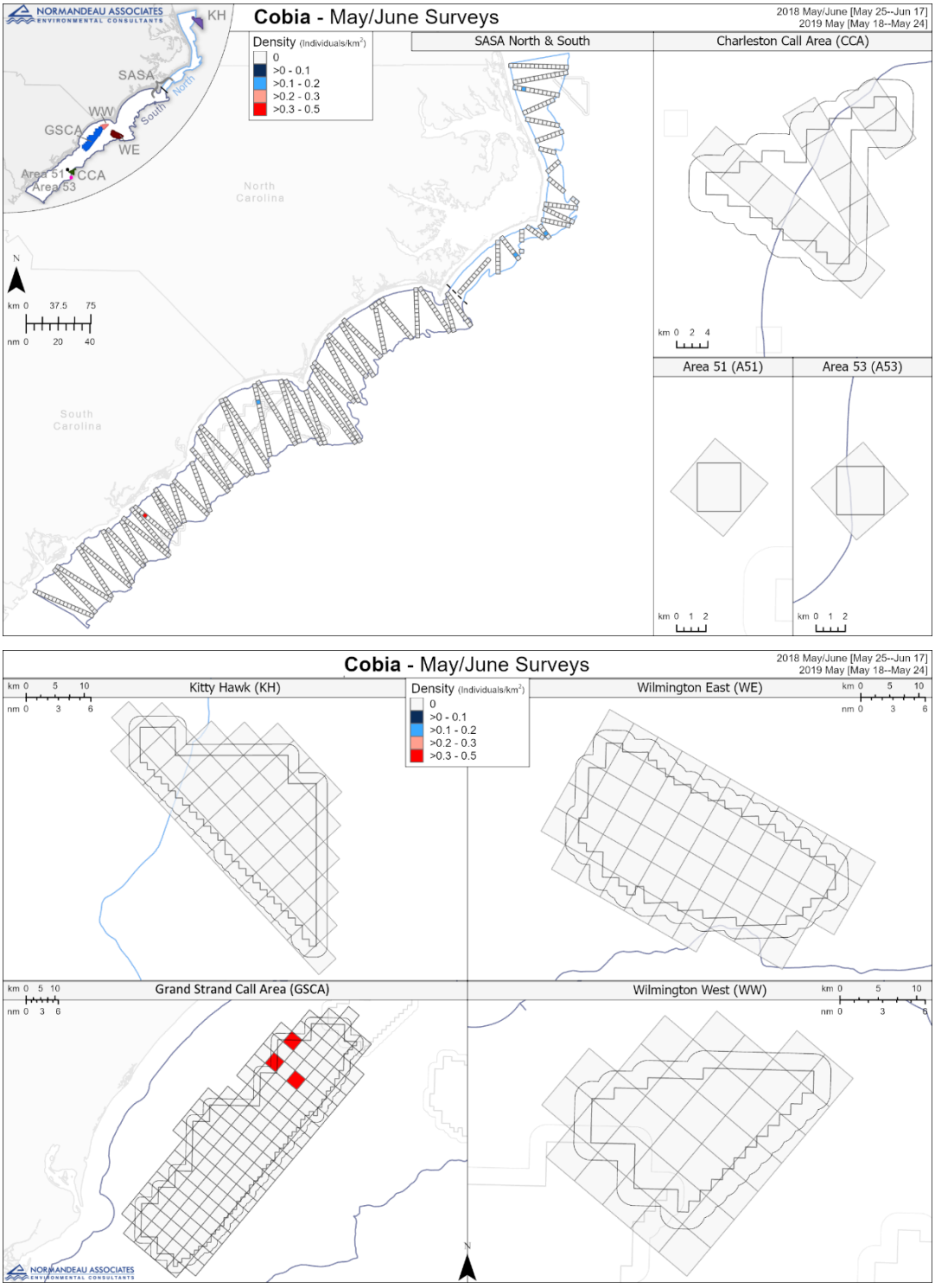

Figure G–3. Spatial distribution of cobia during the May/June surveys for all areas

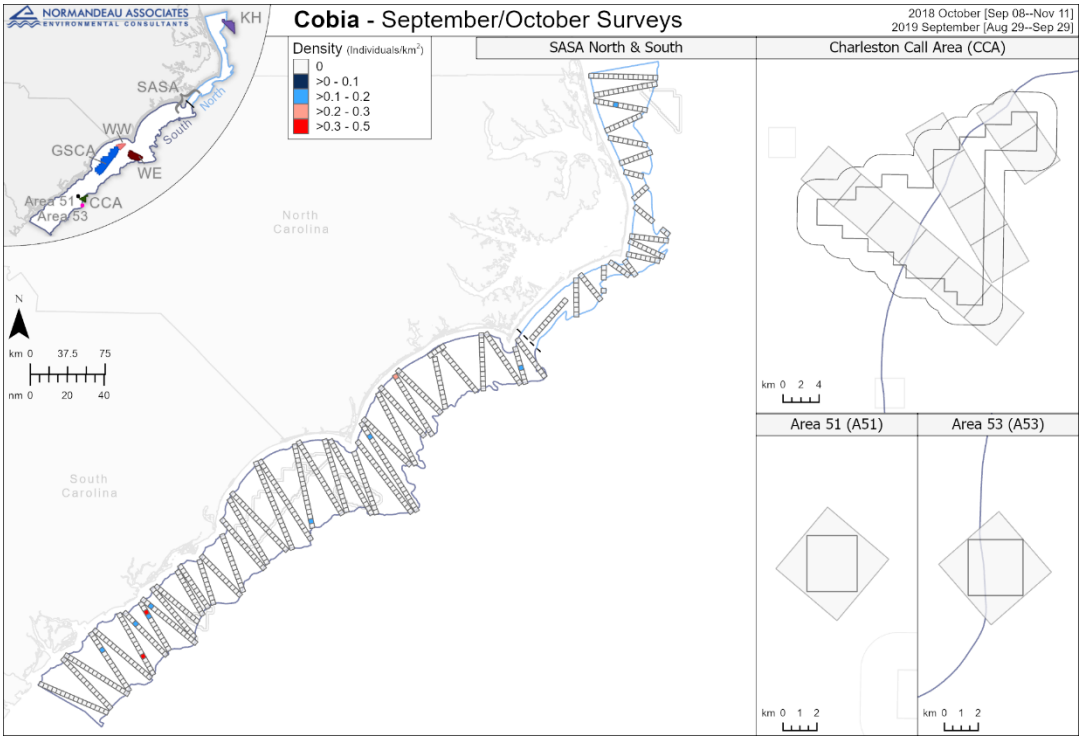

Figure G–4. Spatial distribution of cobia during the September/October surveys for all areas

G.3.2 Mahi-Mahi

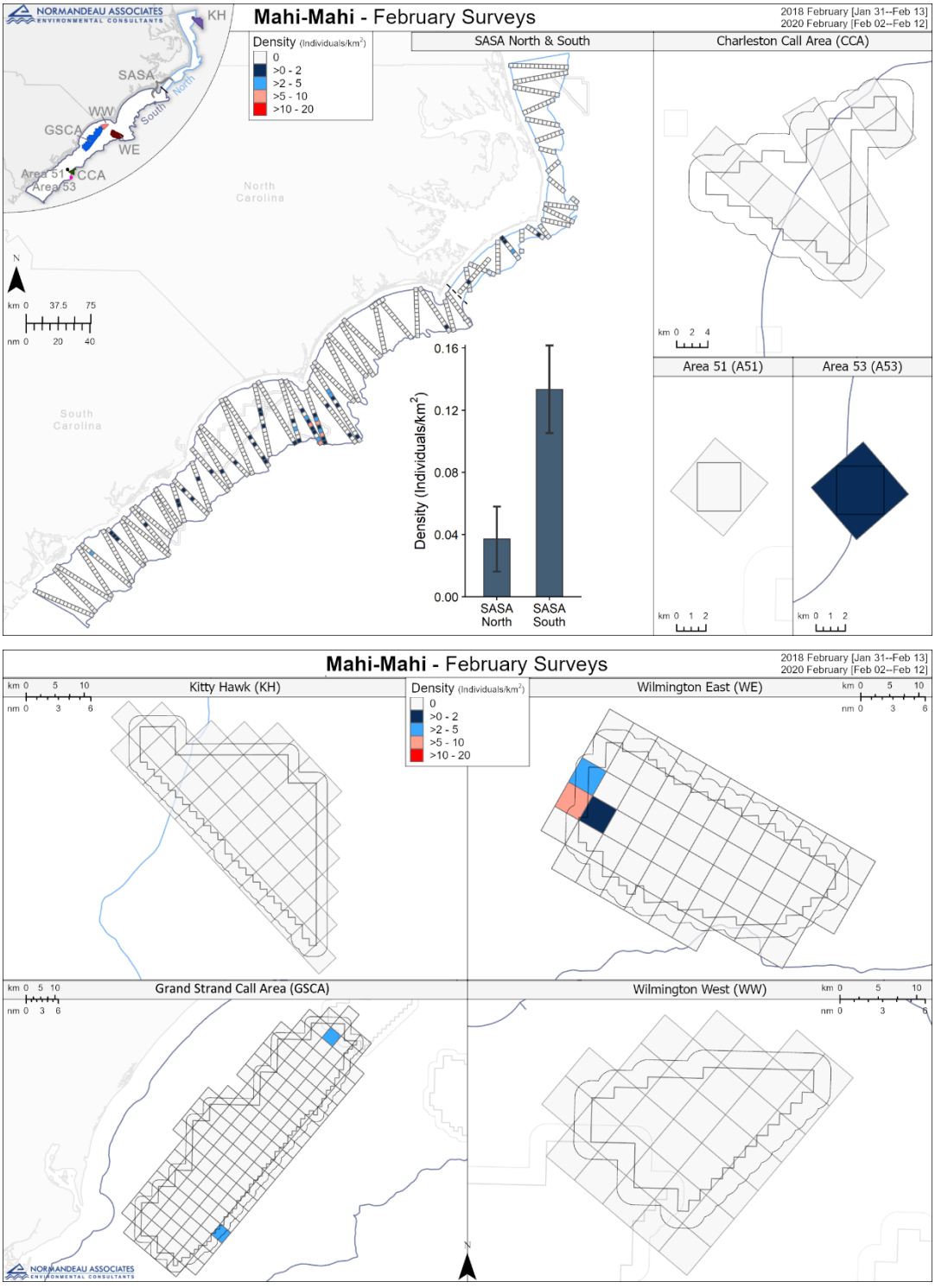

Figure G–5. Spatial distribution of mahi-mahi during the February surveys for all areas

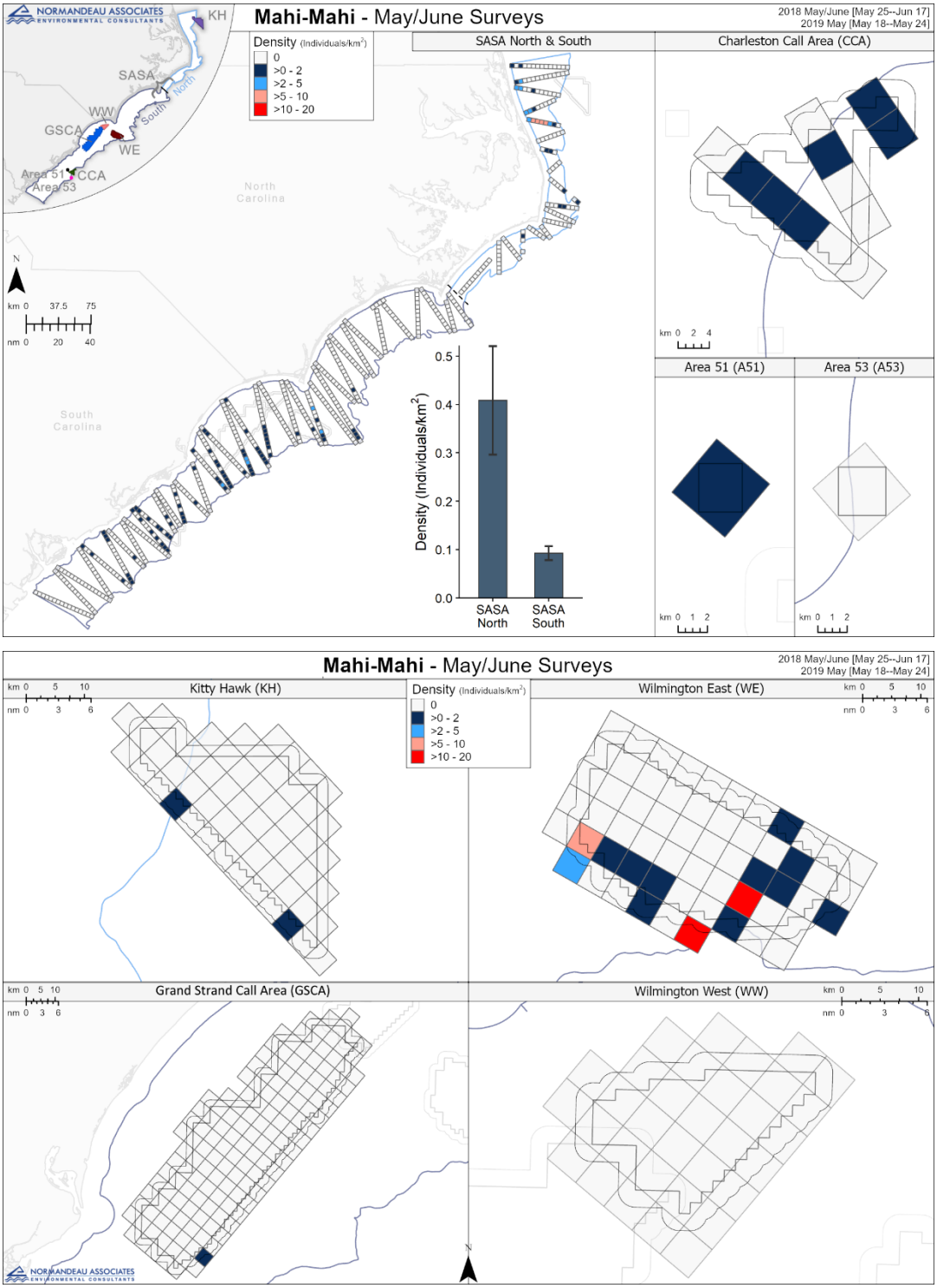

Figure G–6. Spatial distribution of mahi-mahi during the May/June surveys for all areas

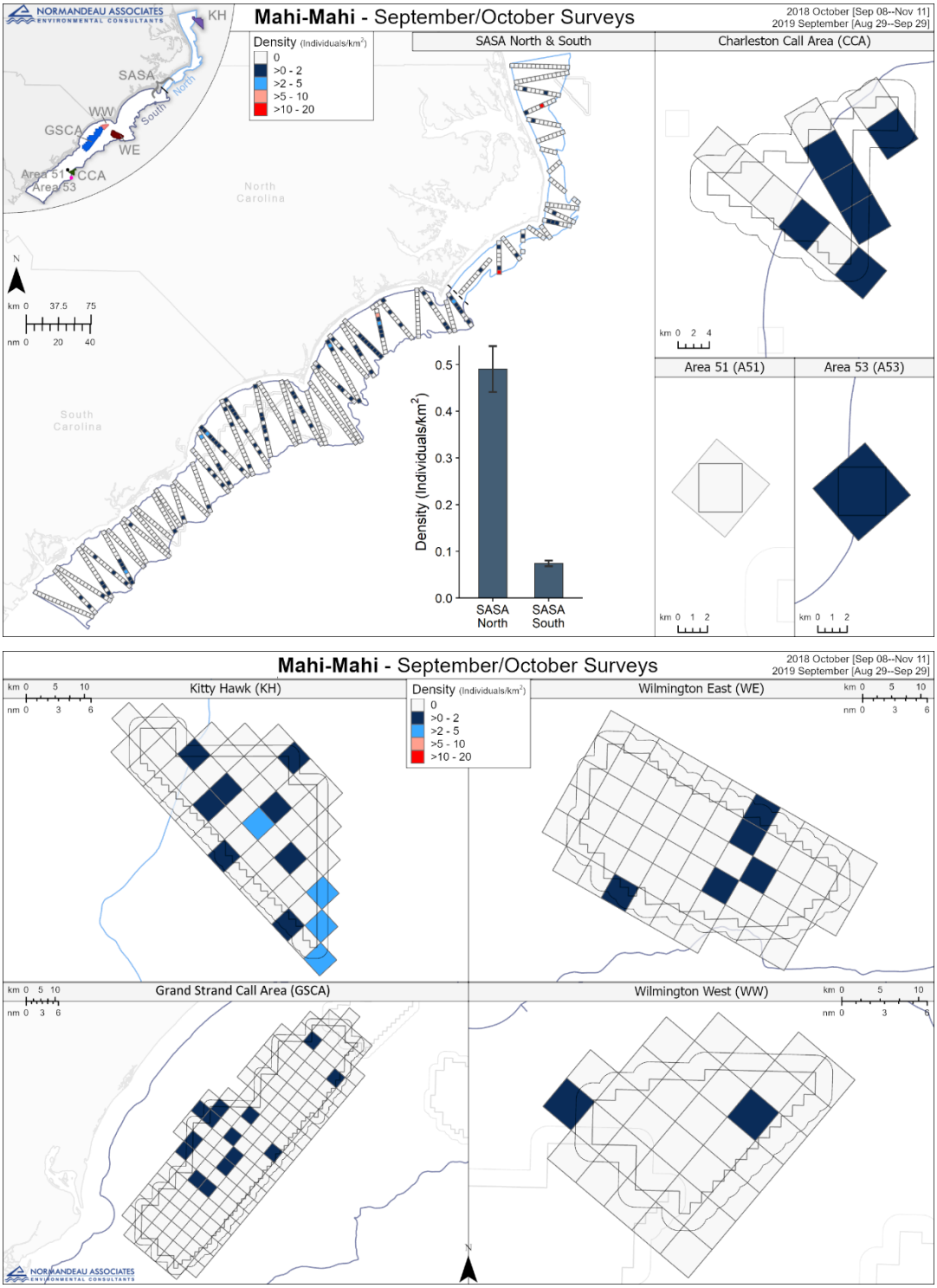

Figure G–7. Spatial distribution of mahi-mahi during the September/October surveys for all areas

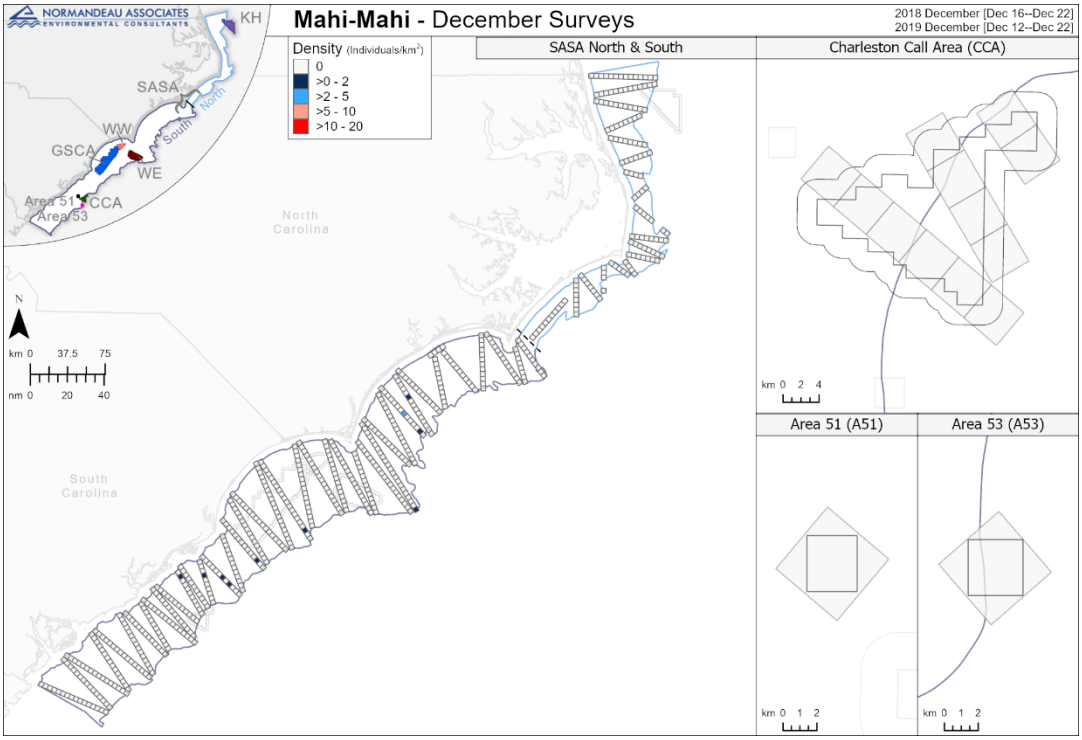

Figure G–8. Spatial distribution of mahi-mahi during the December surveys for all areas

G.3.3 Tuna

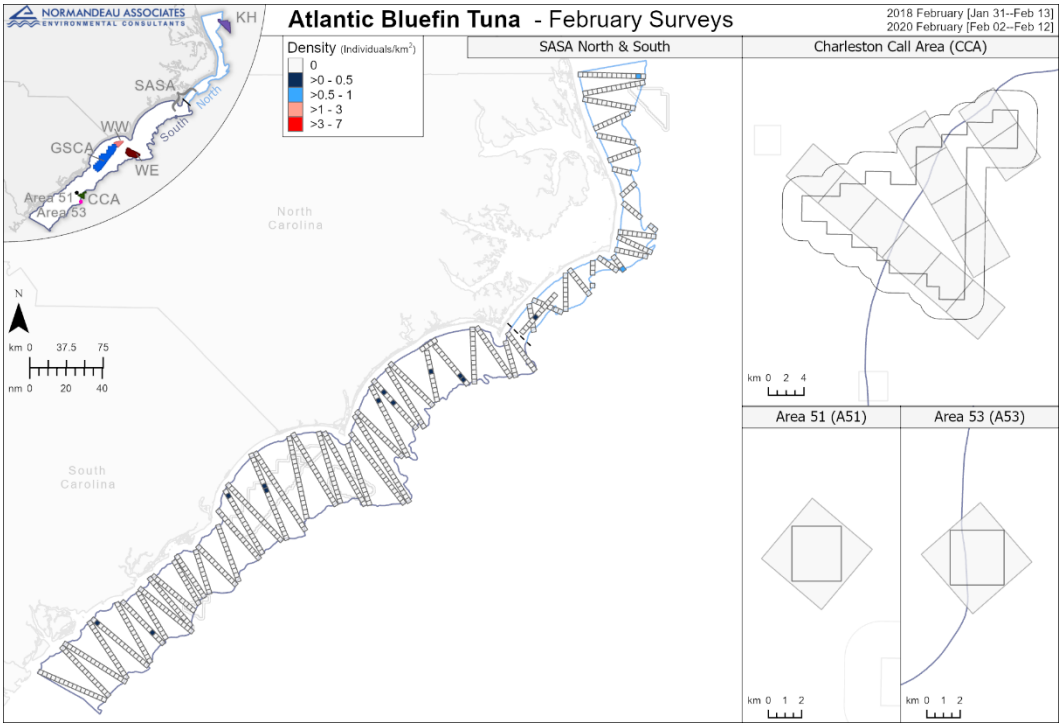

Figure G–9. Spatial distribution of Atlantic bluefin tuna during the February surveys for all areas

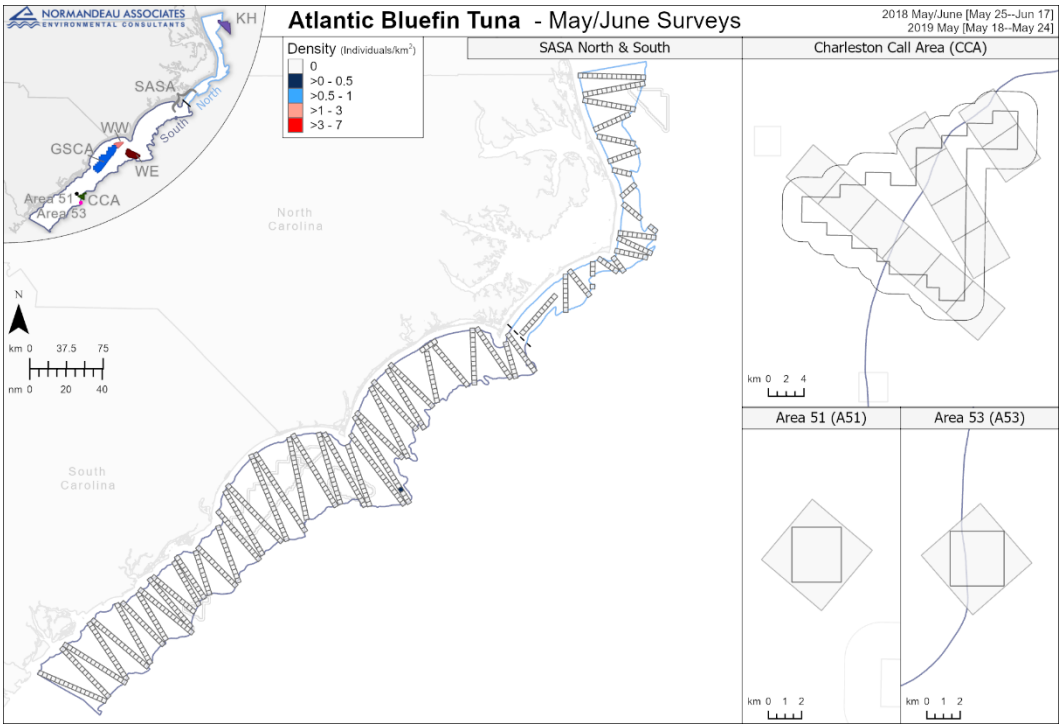

Figure G–10. Spatial distribution of Atlantic bluefin tuna during the May/June surveys for all areas

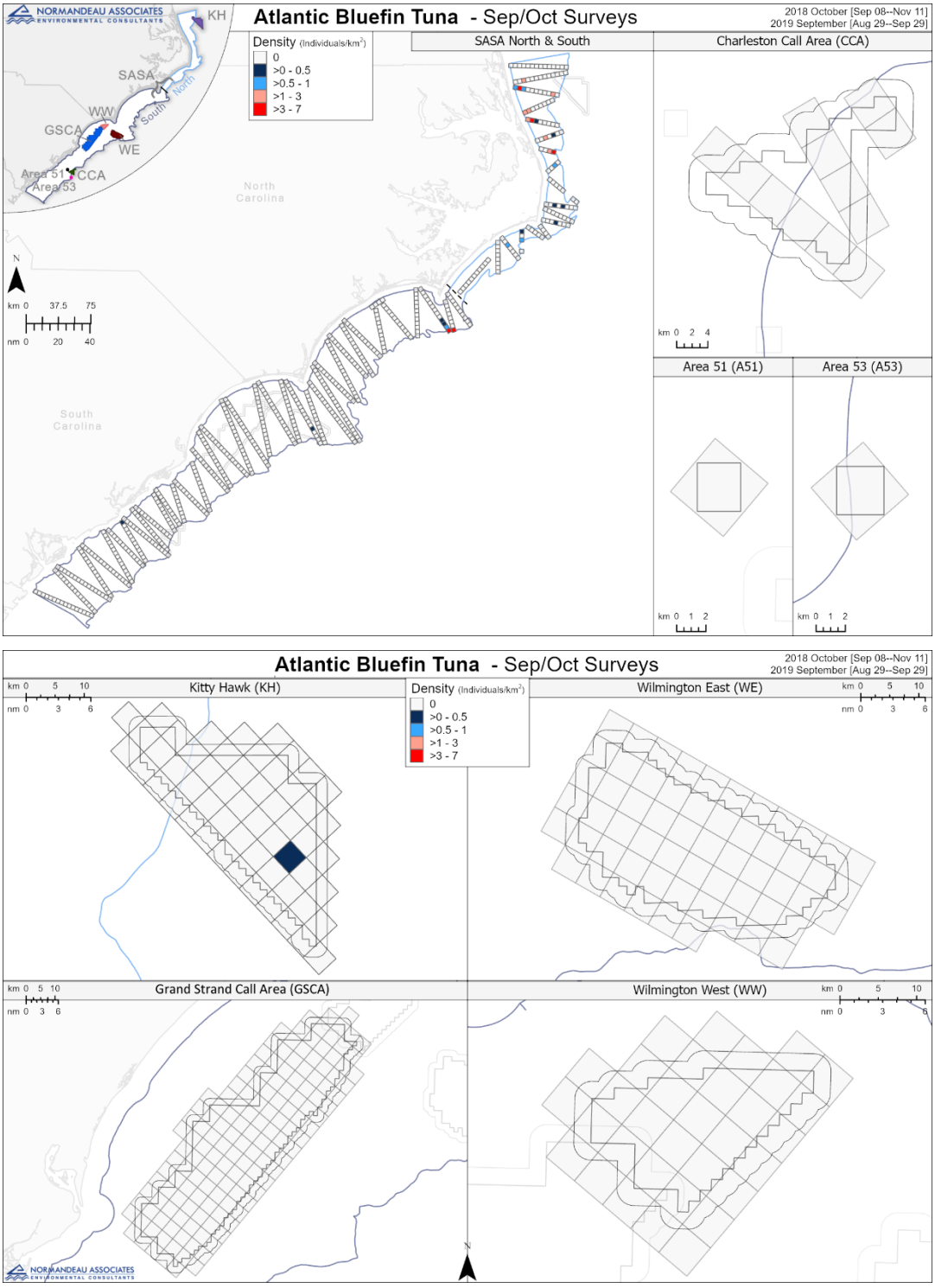

Figure G–11. Spatial distribution of Atlantic bluefin tuna during the September/ October surveys for all areas

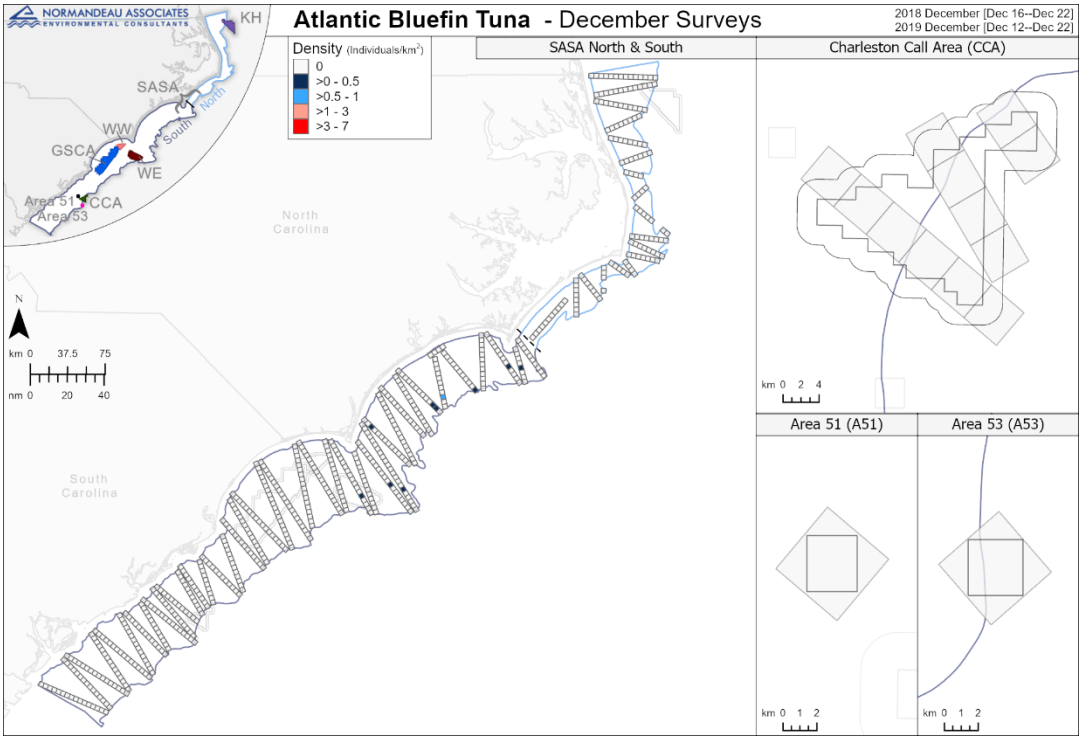

Figure G–12. Spatial distribution of Atlantic bluefin tuna during the December surveys for all areas

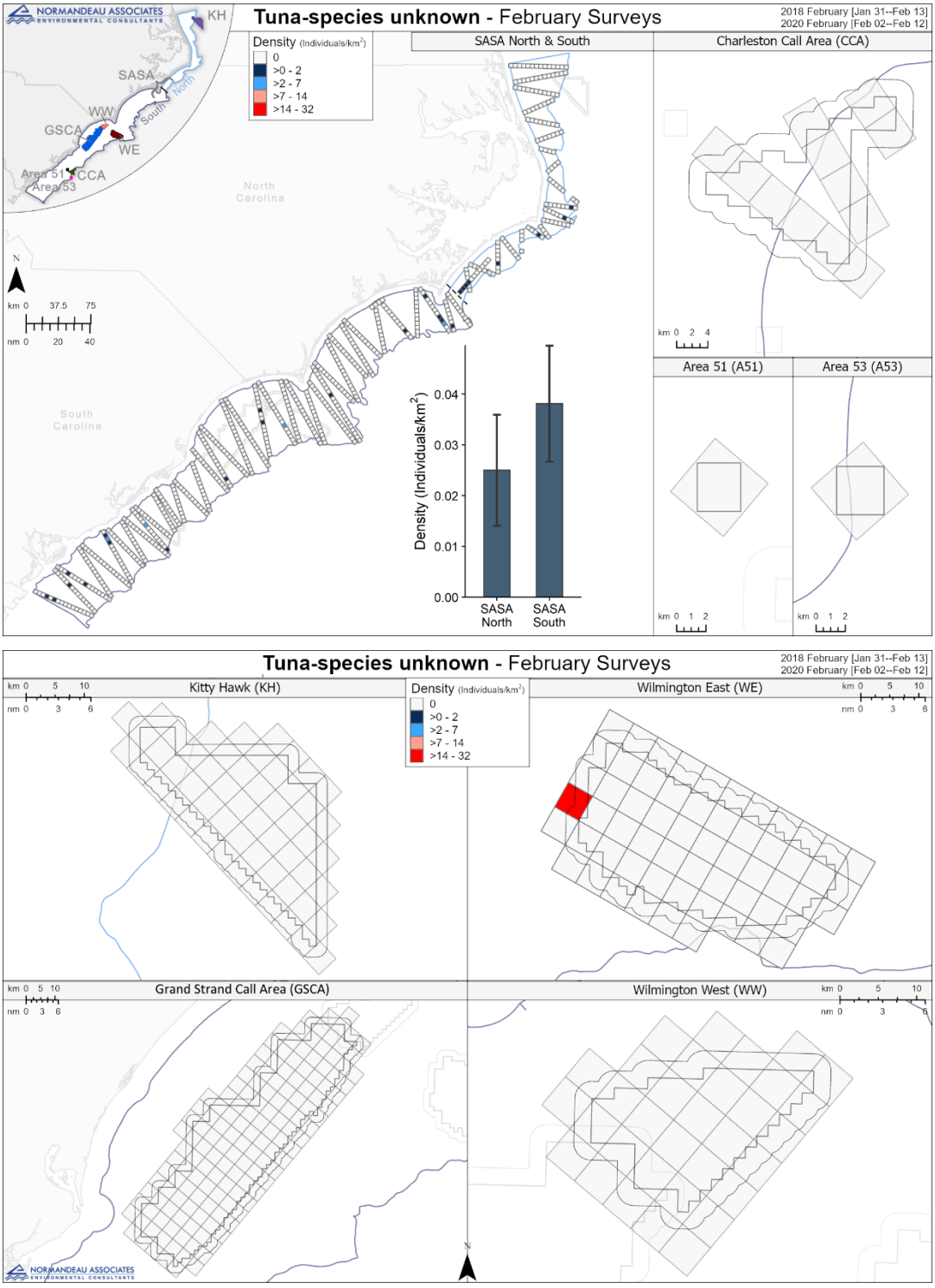

Figure G–13. Spatial distribution of tuna-species unknown during the February surveys for all areas

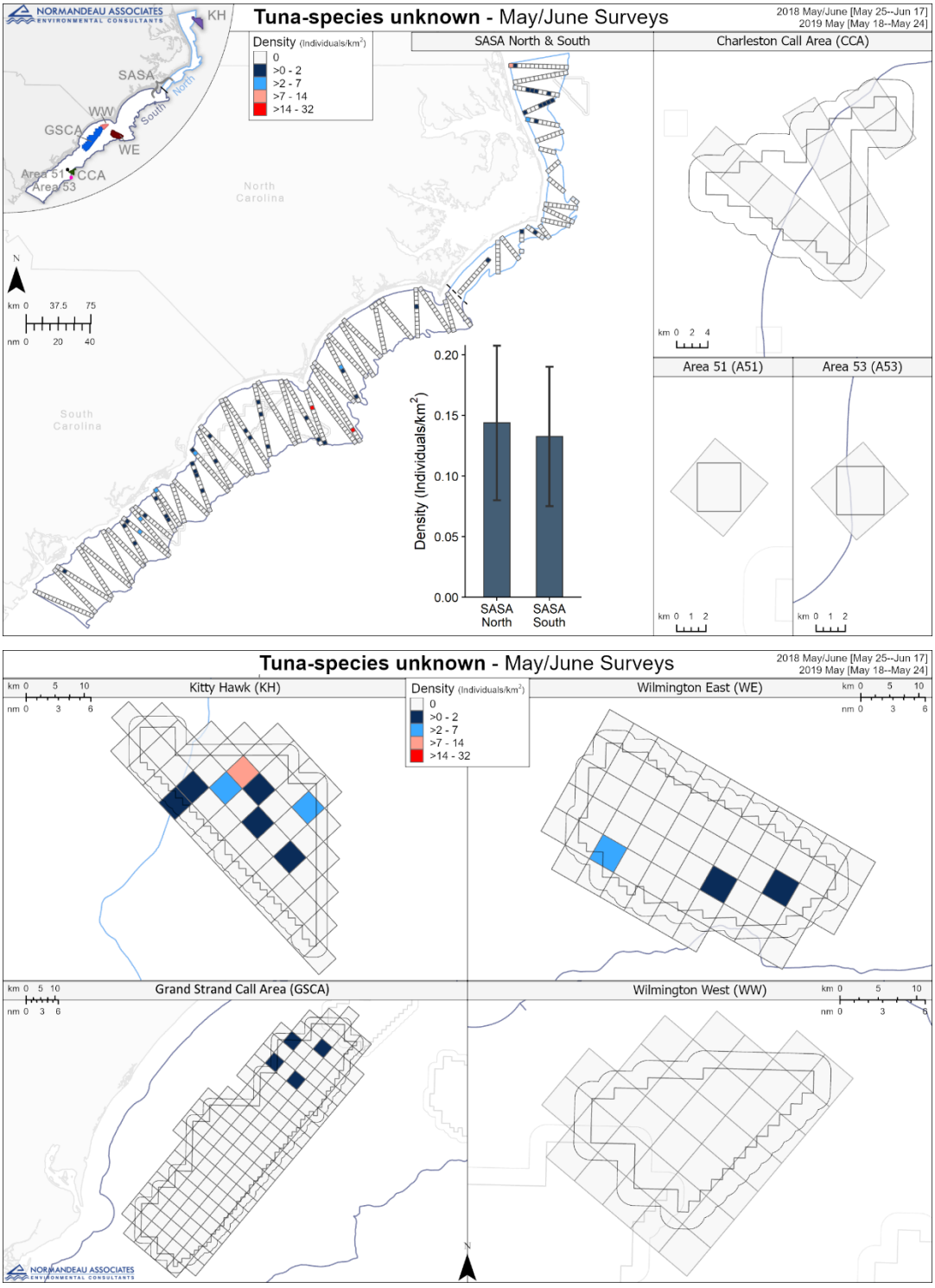

Figure G–14. Spatial distribution of tuna-species unknown during the May/June surveys for all areas

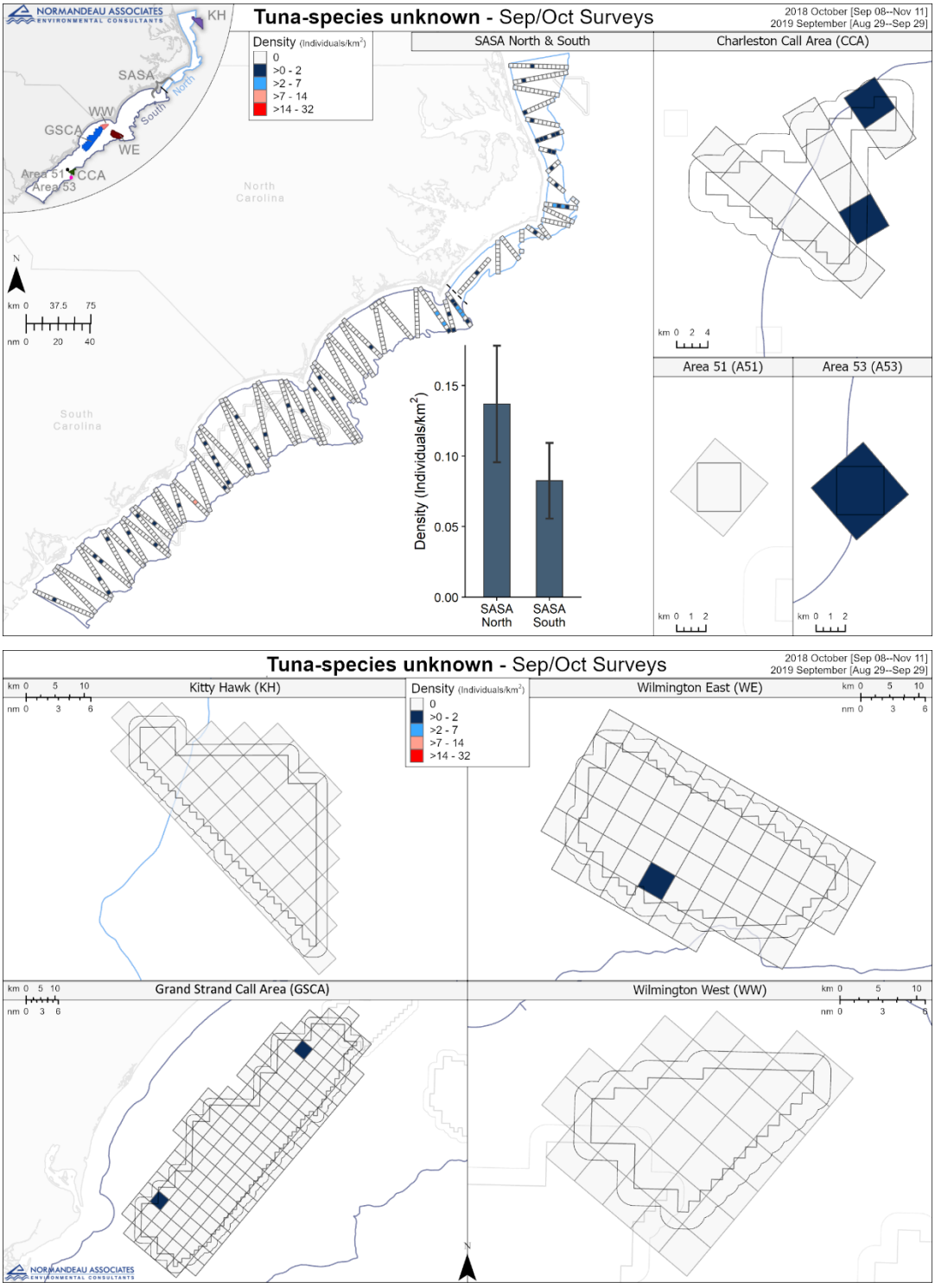

Figure G–15. Spatial distribution of tuna-species unknown during the September/ October surveys for all areas

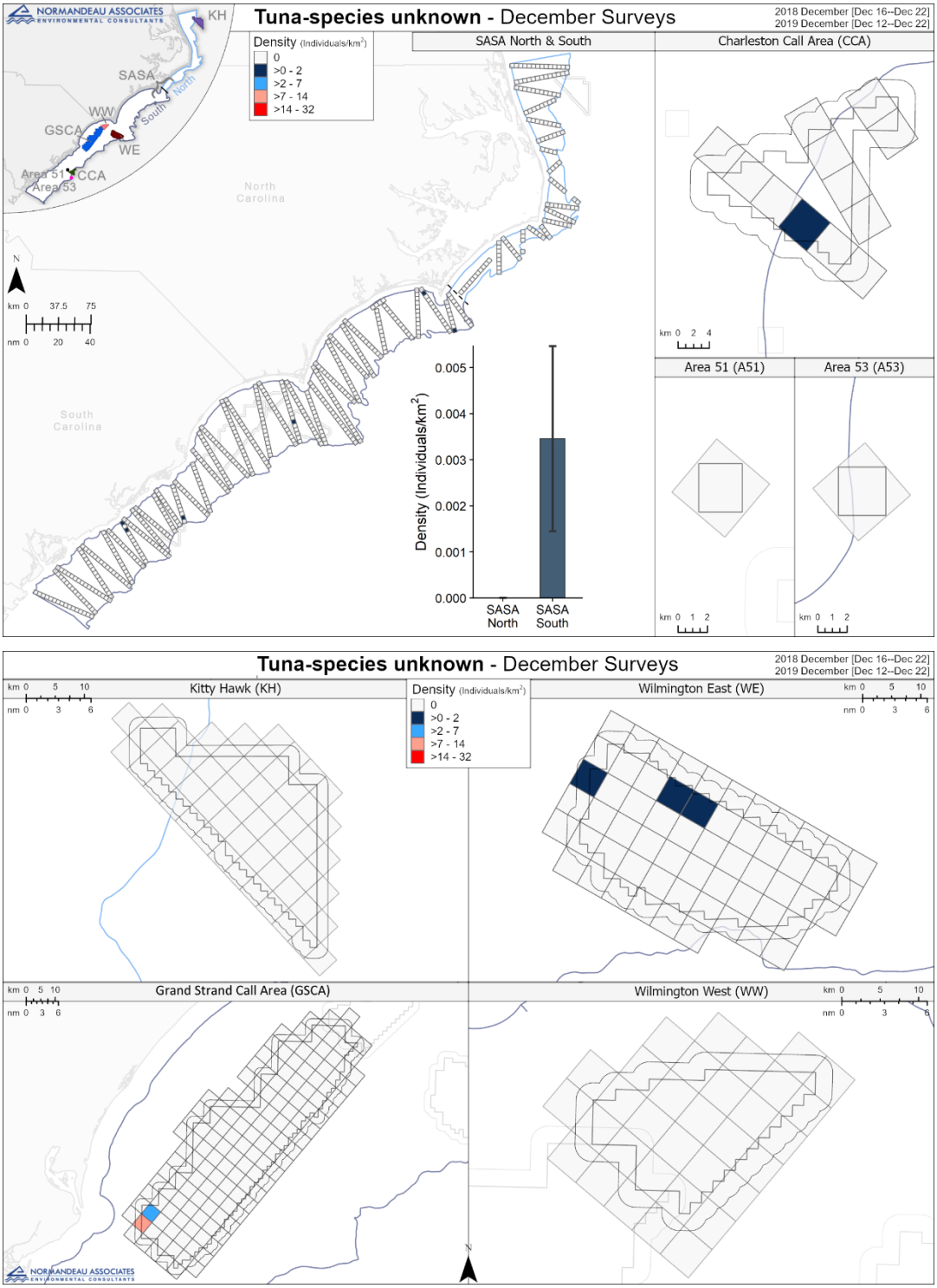

Figure G–16. Spatial distribution of tuna-species unknown during the December surveys for all areas

G.3.4 Billfish

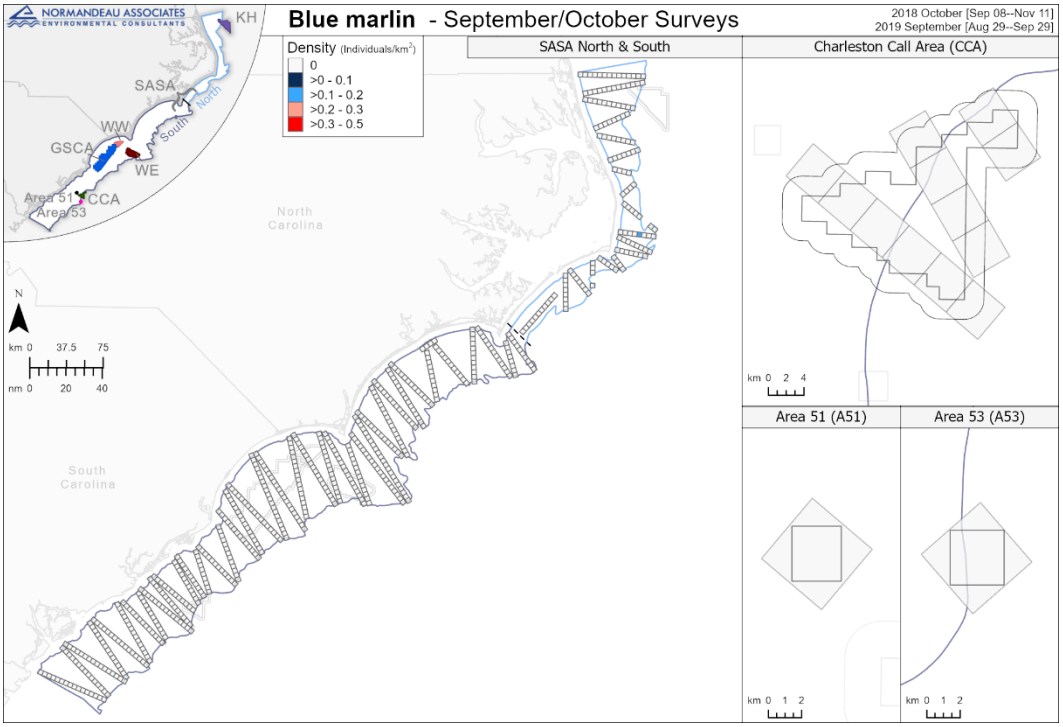

Figure G–17. Spatial distribution of blue marlin during the September/October surveys for all areas

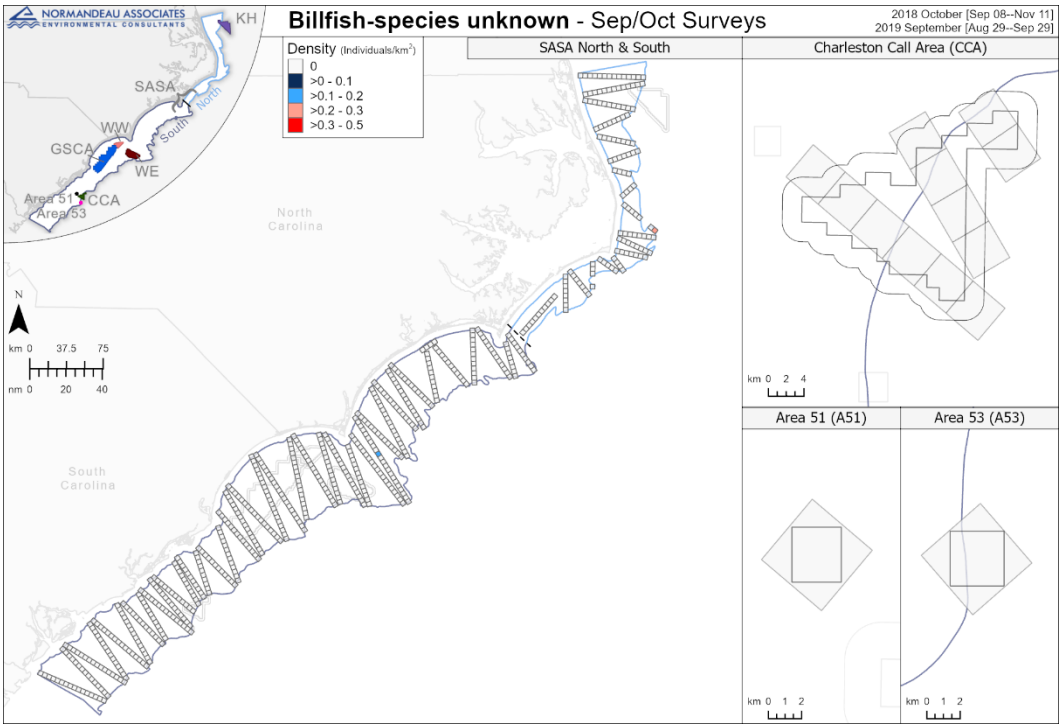

Figure G–18. Spatial distribution of billfish-species unknown during the September/October surveys for all areas

G.3.5 Sunfish

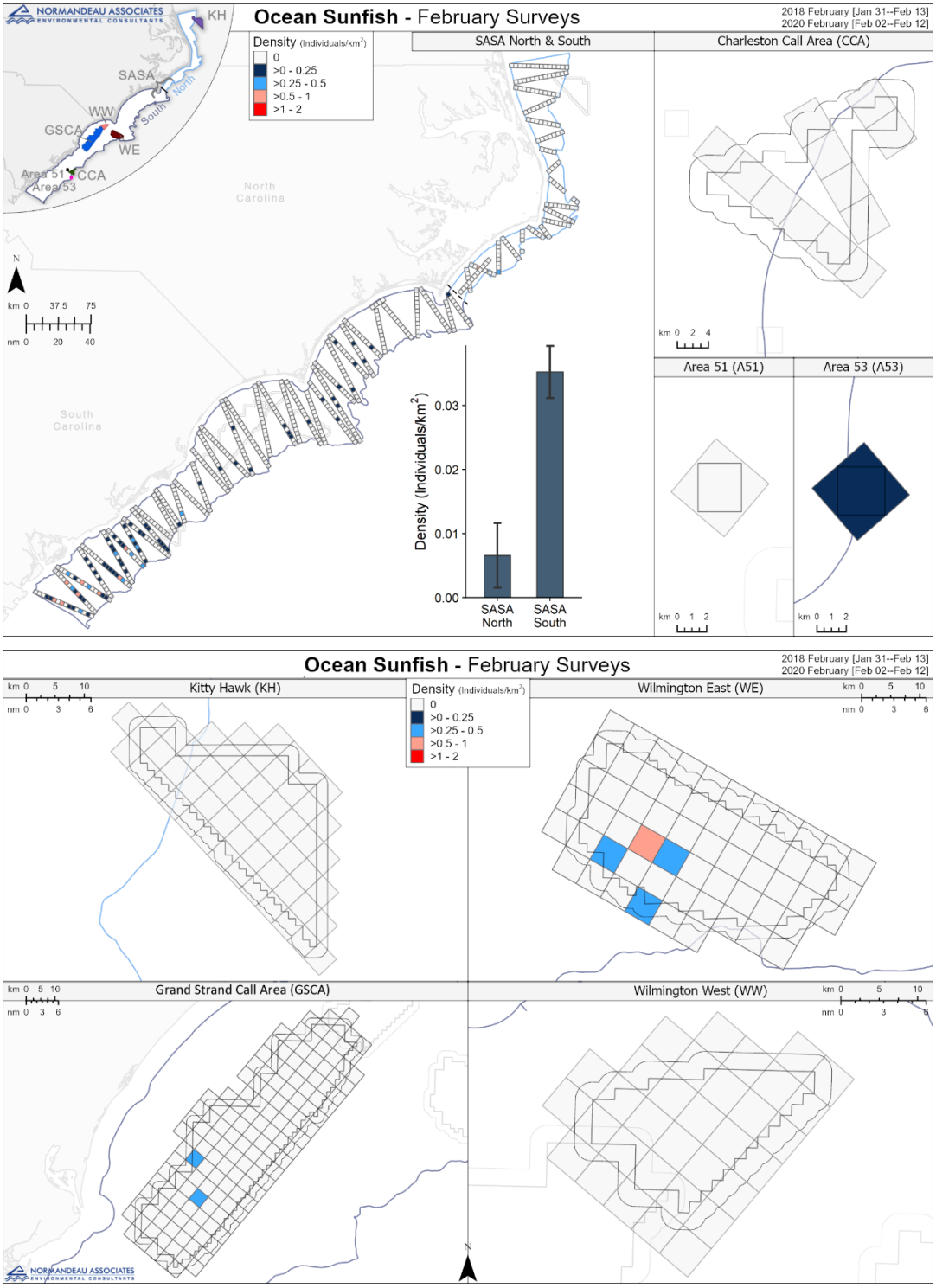

Figure G–19. Spatial distribution of ocean sunfish during the February surveys for all areas

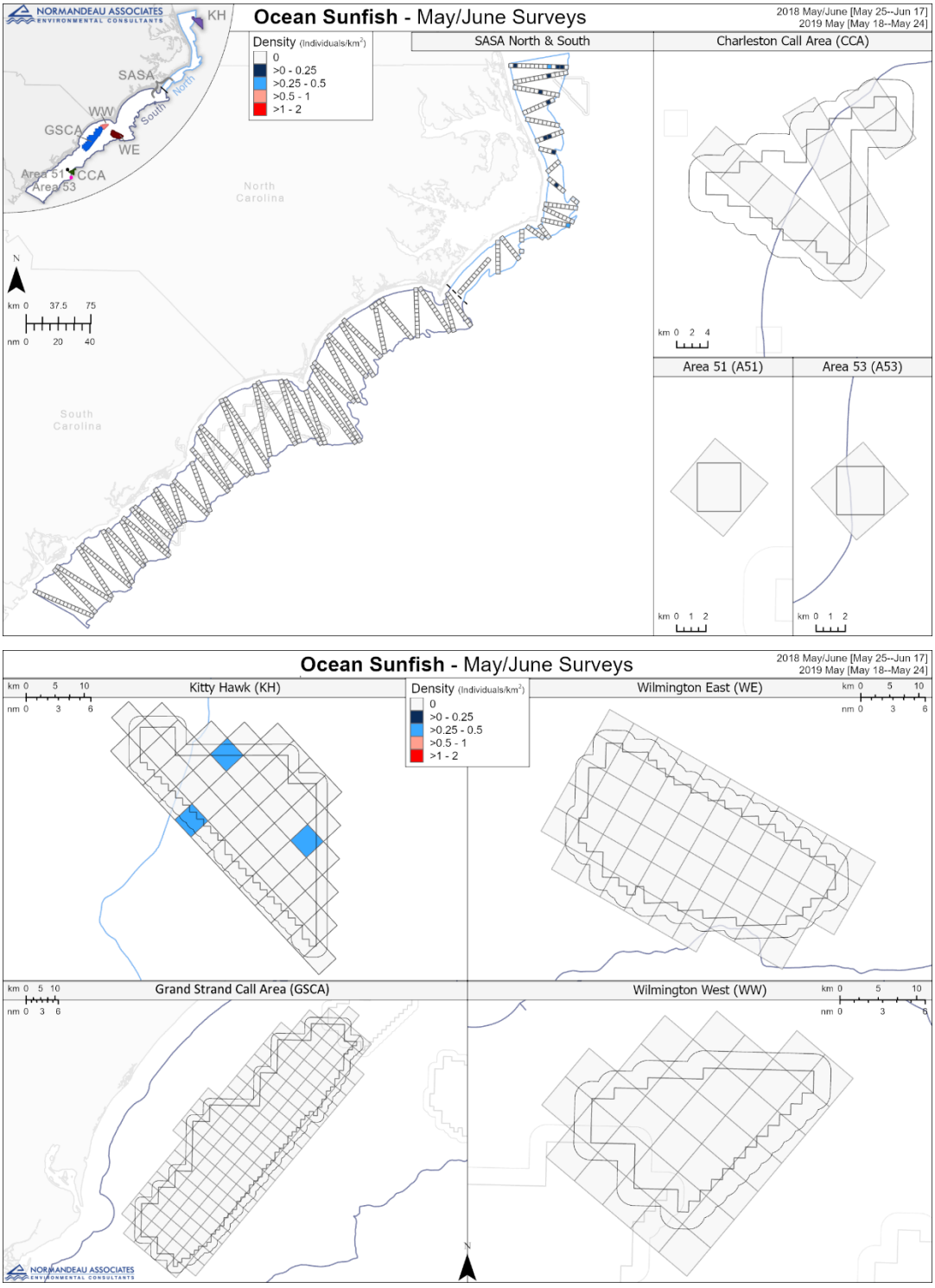

Figure G–20. Spatial distribution of ocean sunfish during the May/June surveys for all areas

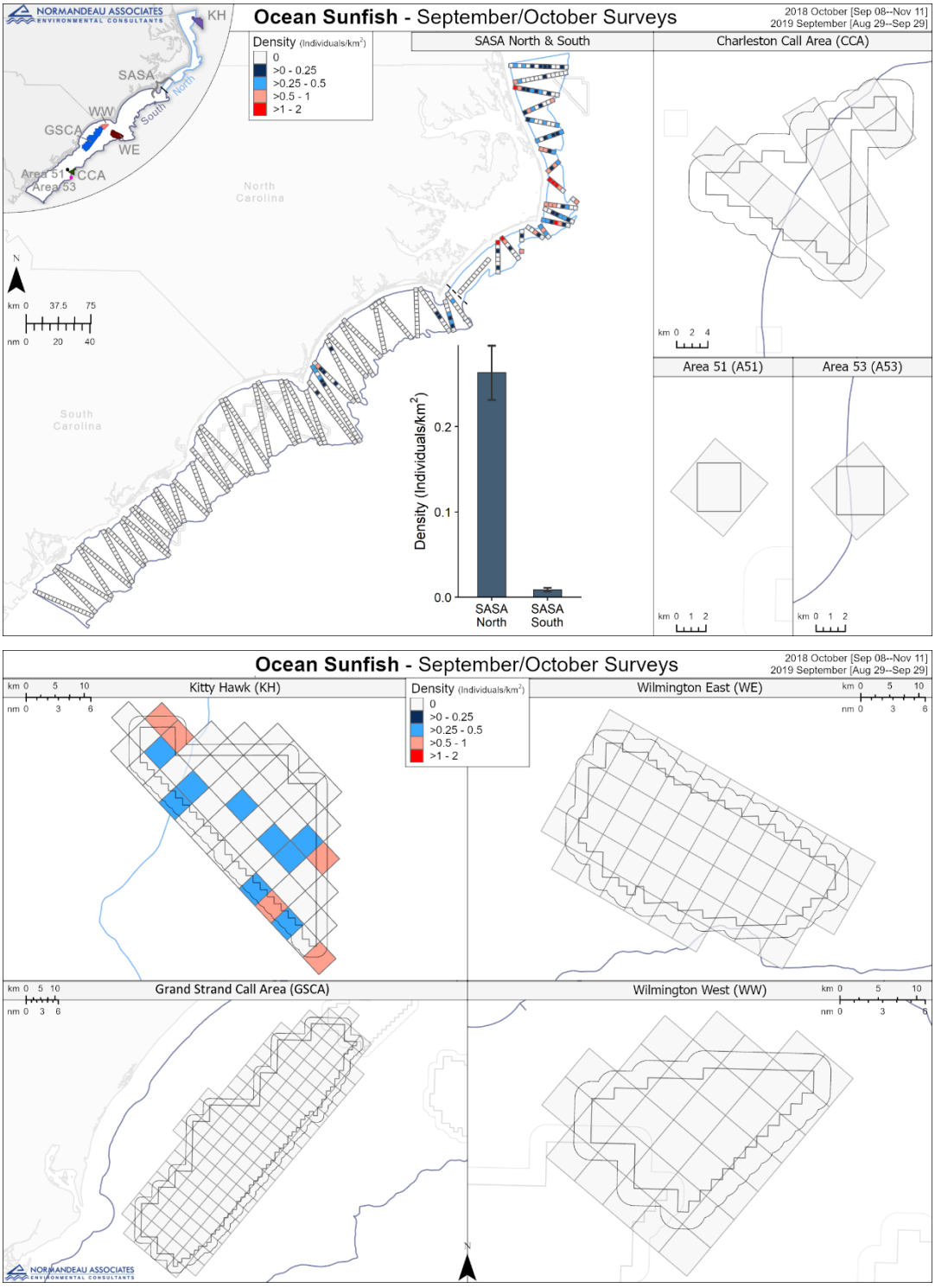

Figure G–21. Spatial distribution of ocean sunfish during the September/October surveys for all areas

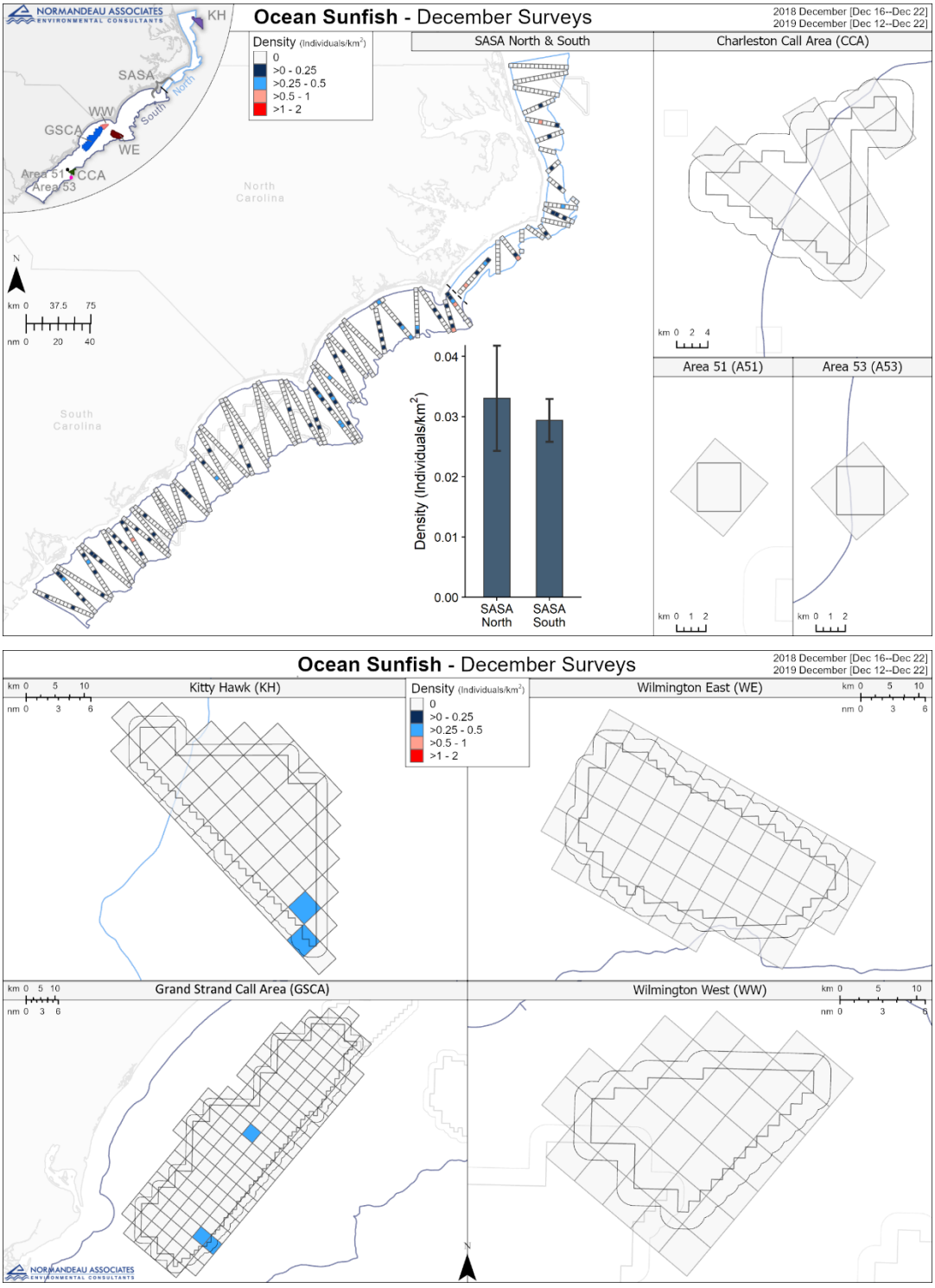

Figure G–22. Spatial distribution of ocean sunfish during the December surveys for all areas

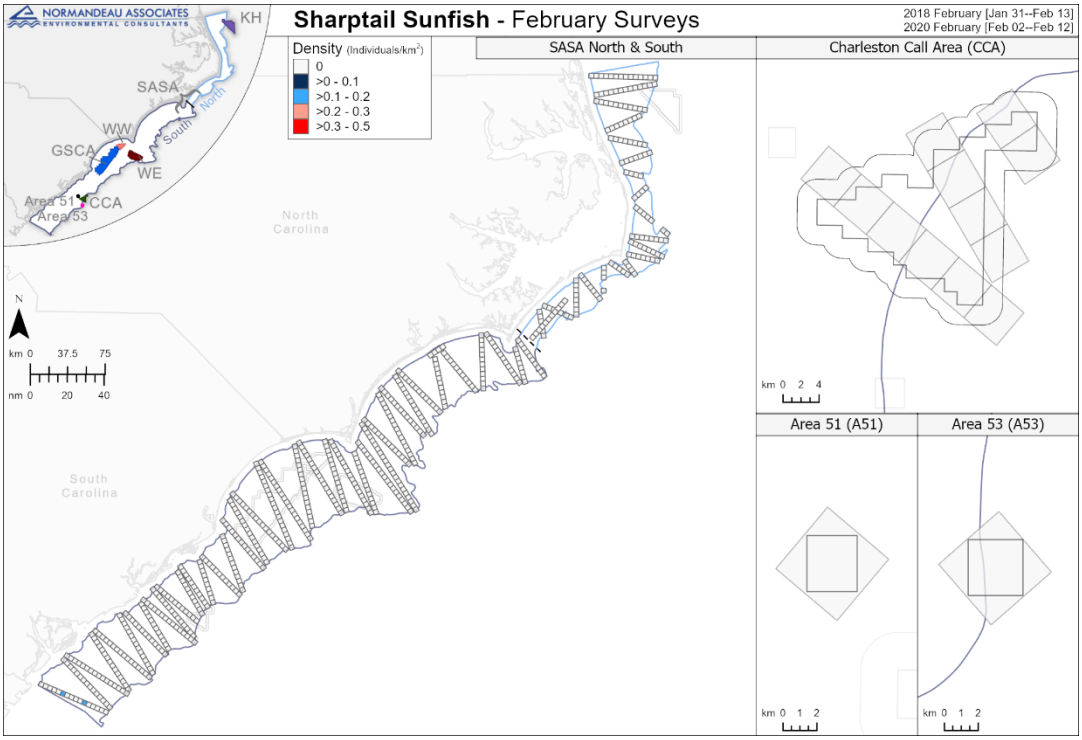

Figure G–23. Spatial distribution of sharptail sunfish during the February surveys for all areas

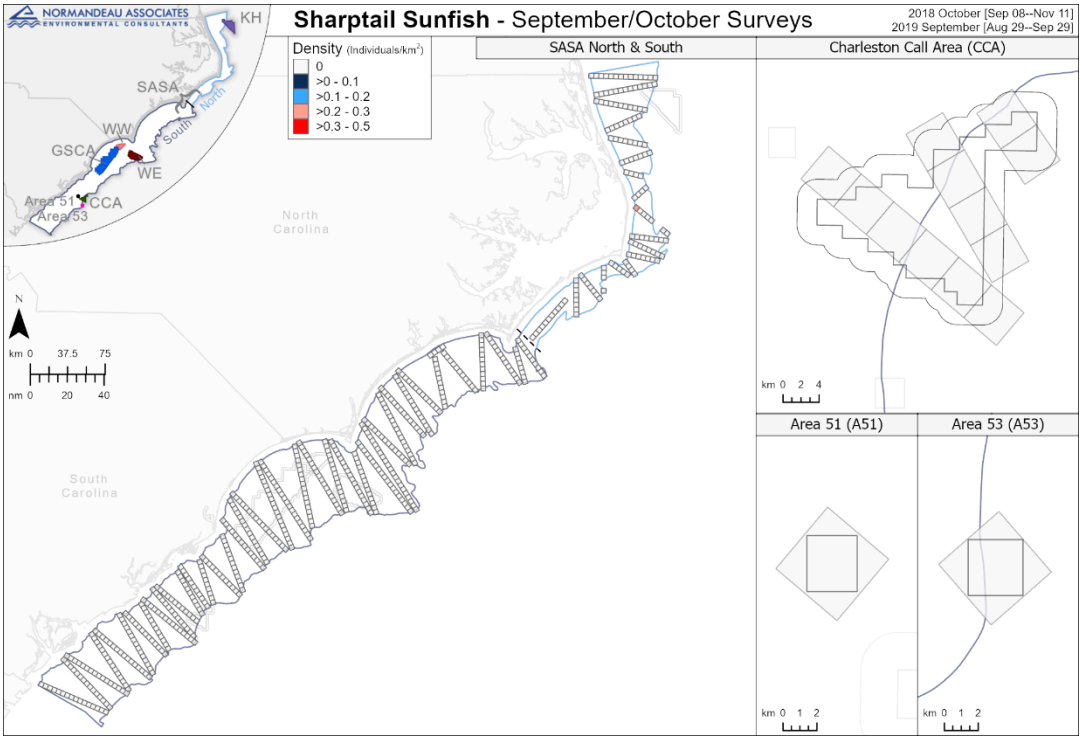

Figure G–24. Spatial distribution of sharptail sunfish during the September/October surveys for all areas

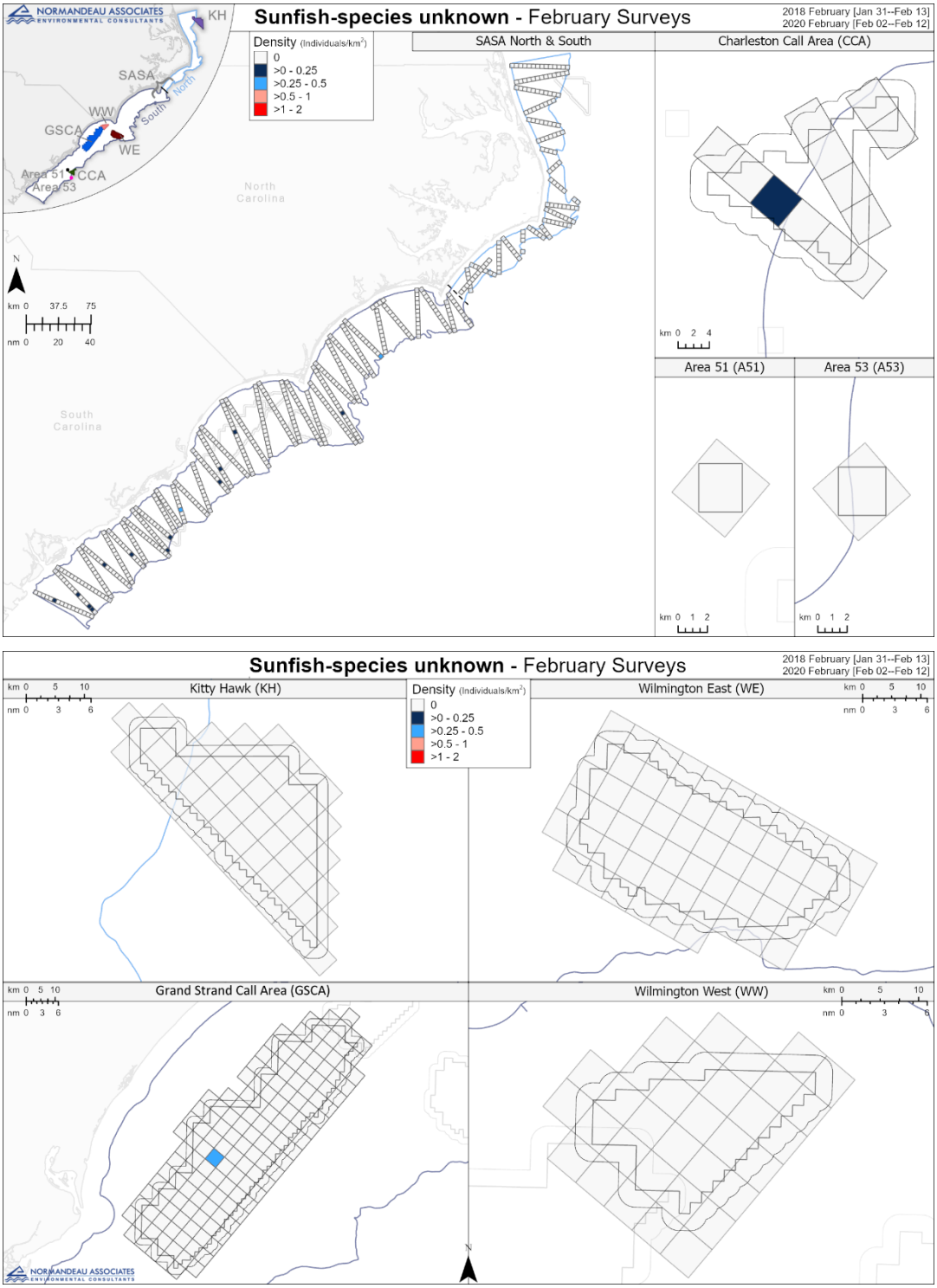

Figure G–25. Spatial distribution of sunfish-species unknown during the February surveys for all areas

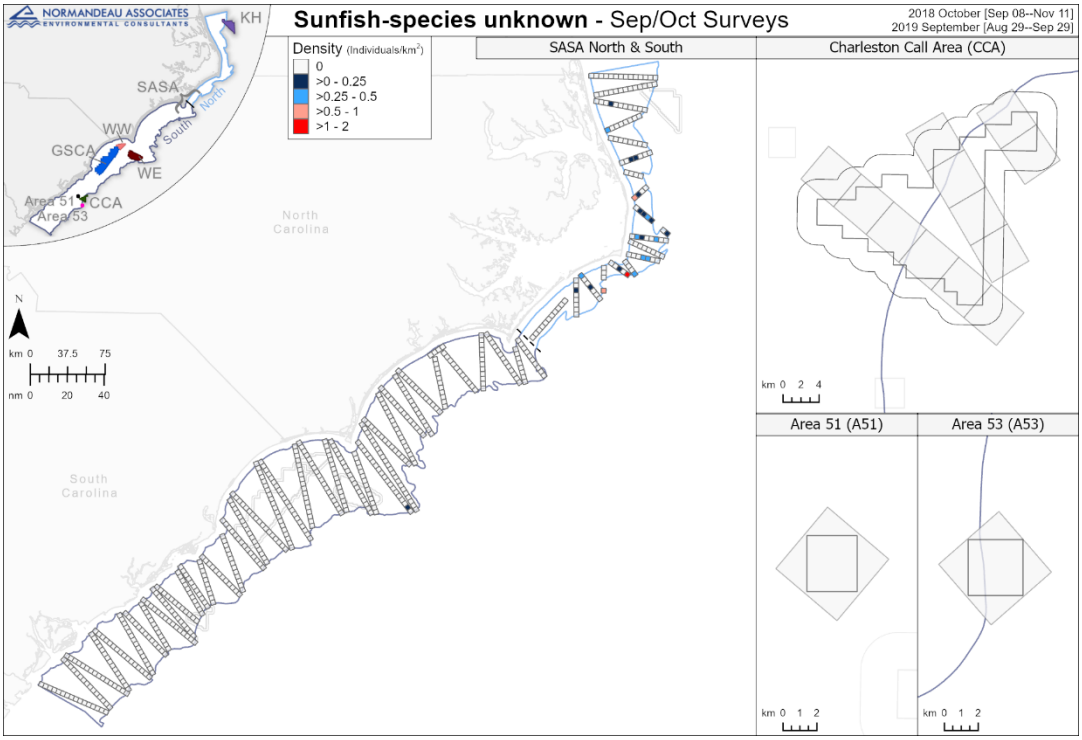

Figure G–26. Spatial distribution of sunfish-species unknown during the September/October surveys for all areas

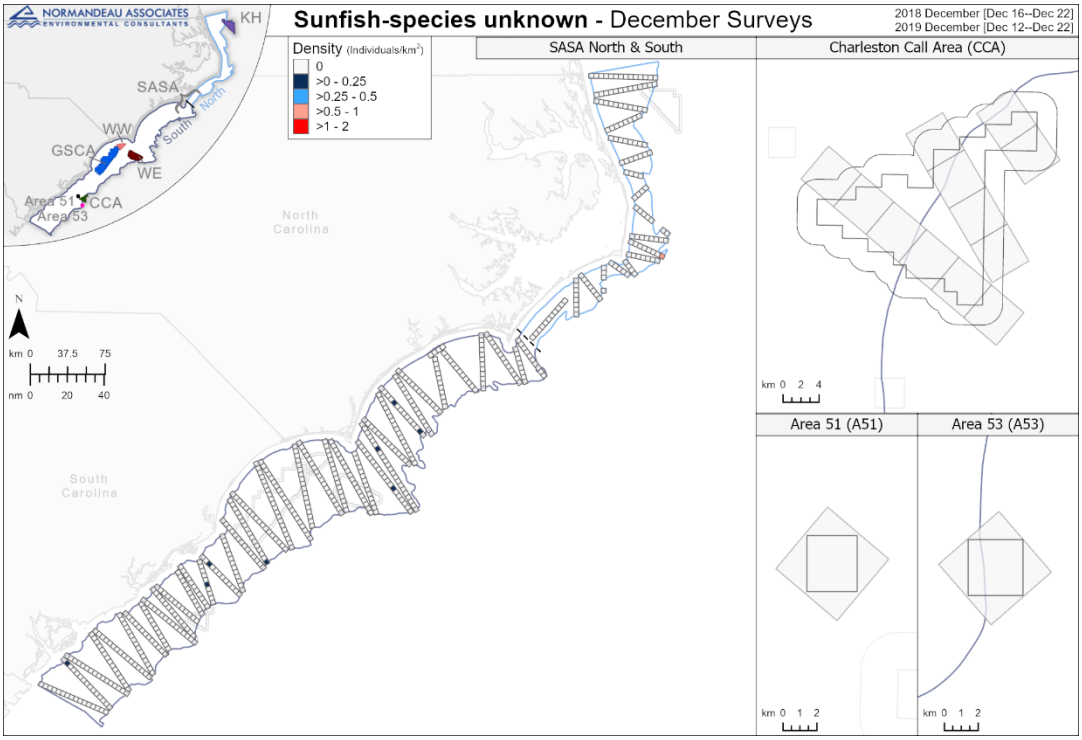

Figure G–27. Spatial distribution of sunfish-species unknown during the December surveys for all areas

G.3.6 Remora

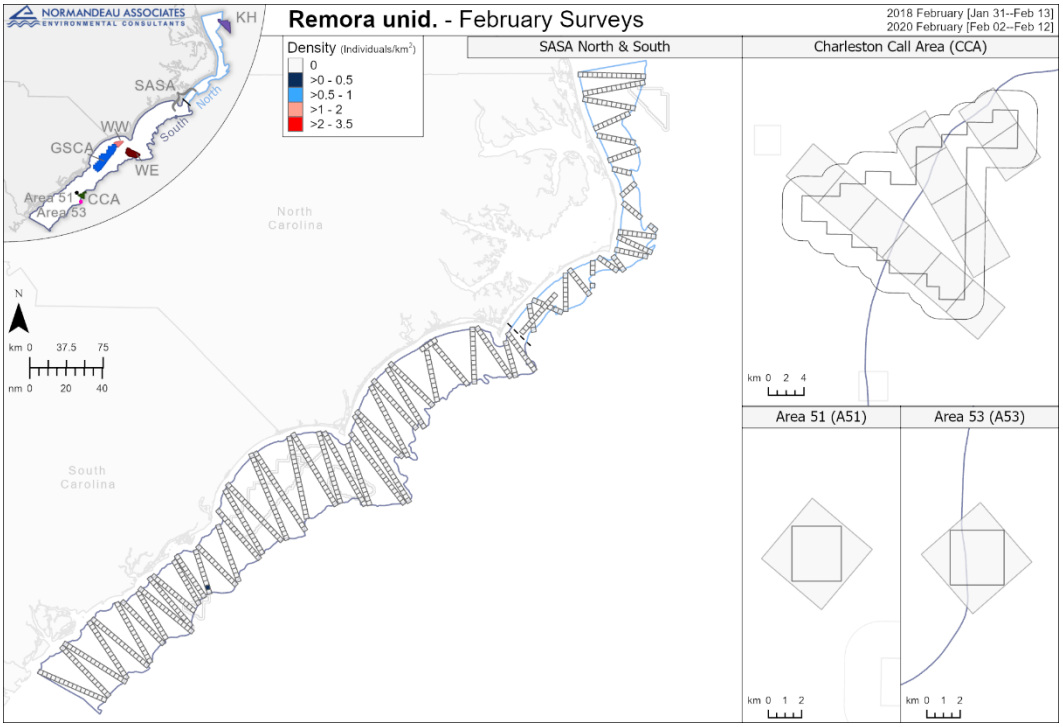

Figure G–28. Spatial distribution of remora unid. during the February surveys for all areas

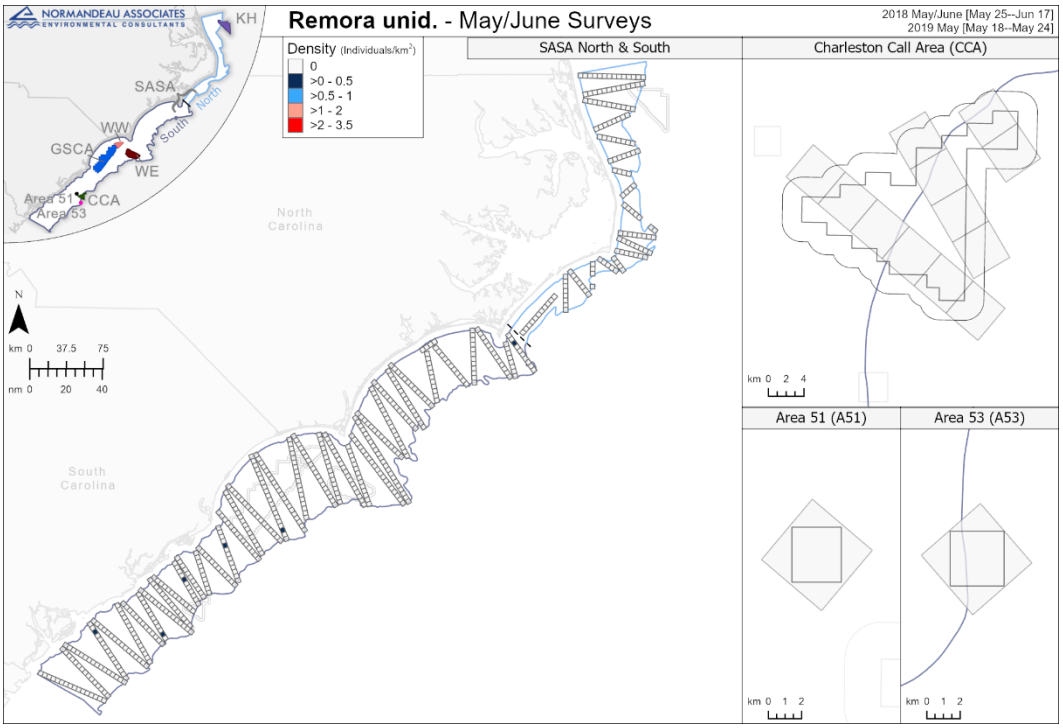

Figure G–29. Spatial distribution of remora unid. during the May/June surveys for all areas

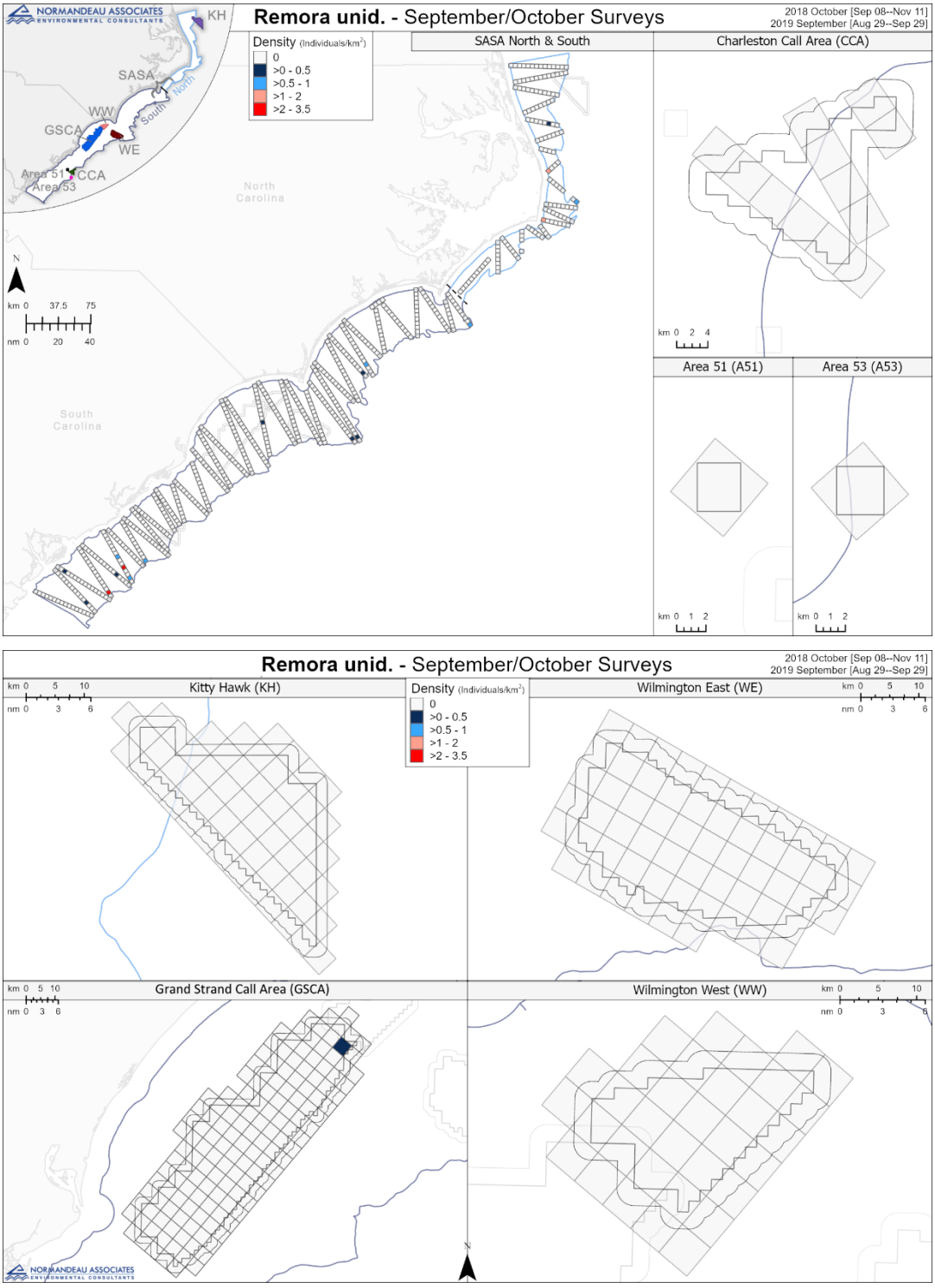

Figure G–30. Spatial distribution of remora unid. during the September/October surveys for all areas

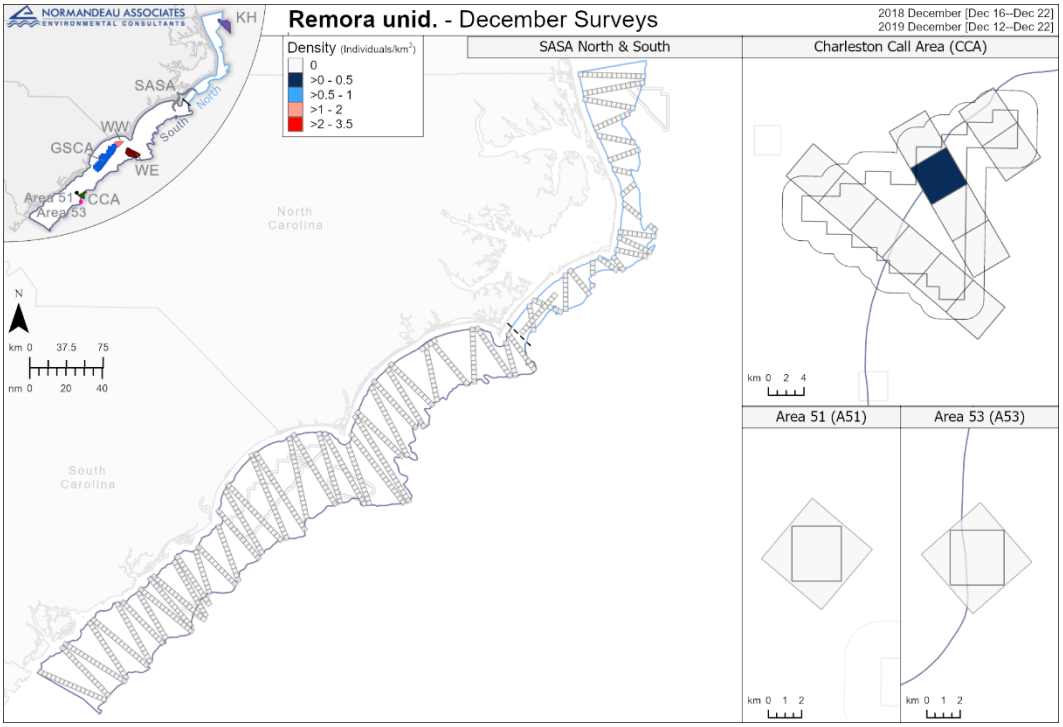

Figure G–31. Spatial distribution of remora unid. during the December surveys for all areas

G.3.7 Other Fish

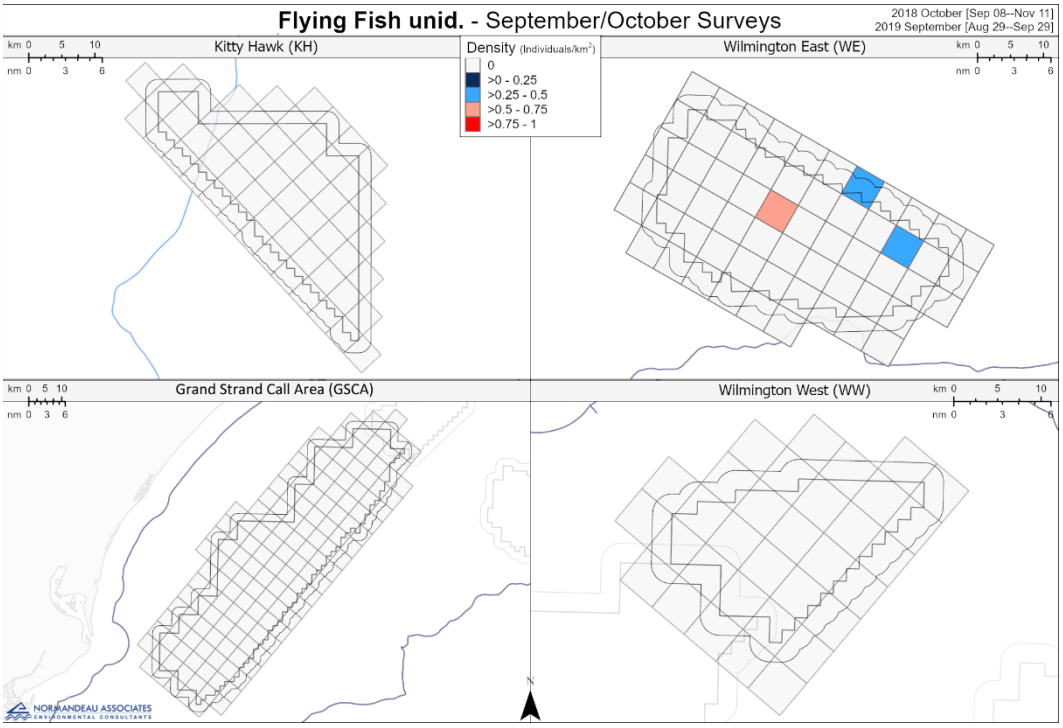

Figure G–32. Spatial distribution of flying fish unid. during the September/October surveys for all areas

G.3.8 Unidentified Fish

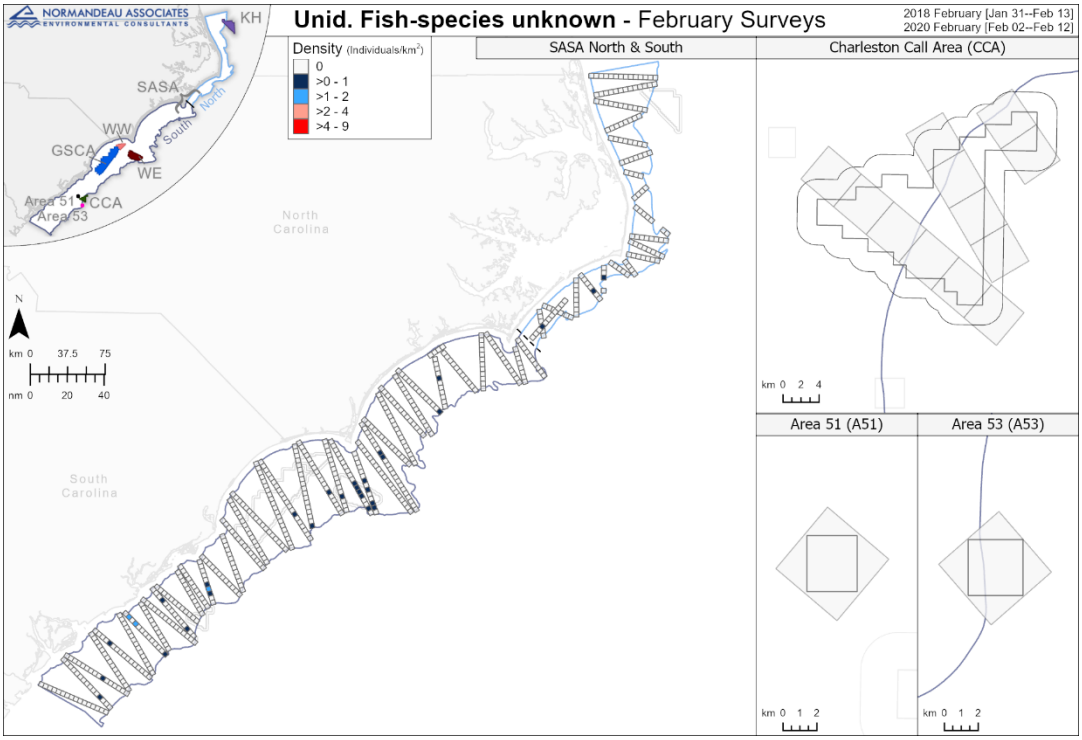

Figure G–33. Spatial distribution of fish-species unknown during the February surveys for all areas

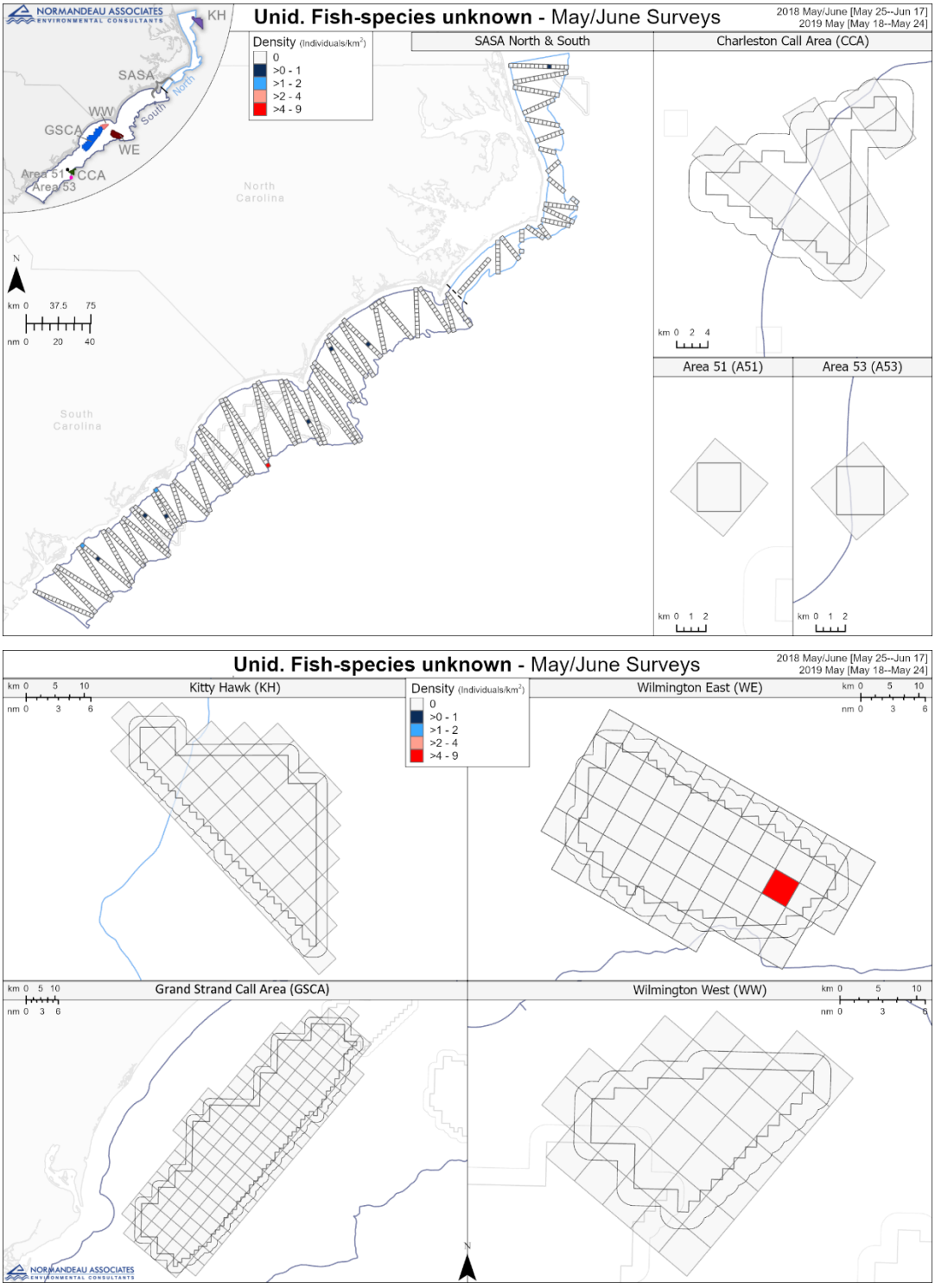

Figure G–34. Spatial distribution of fish-species unknown during the May/June surveys for all areas

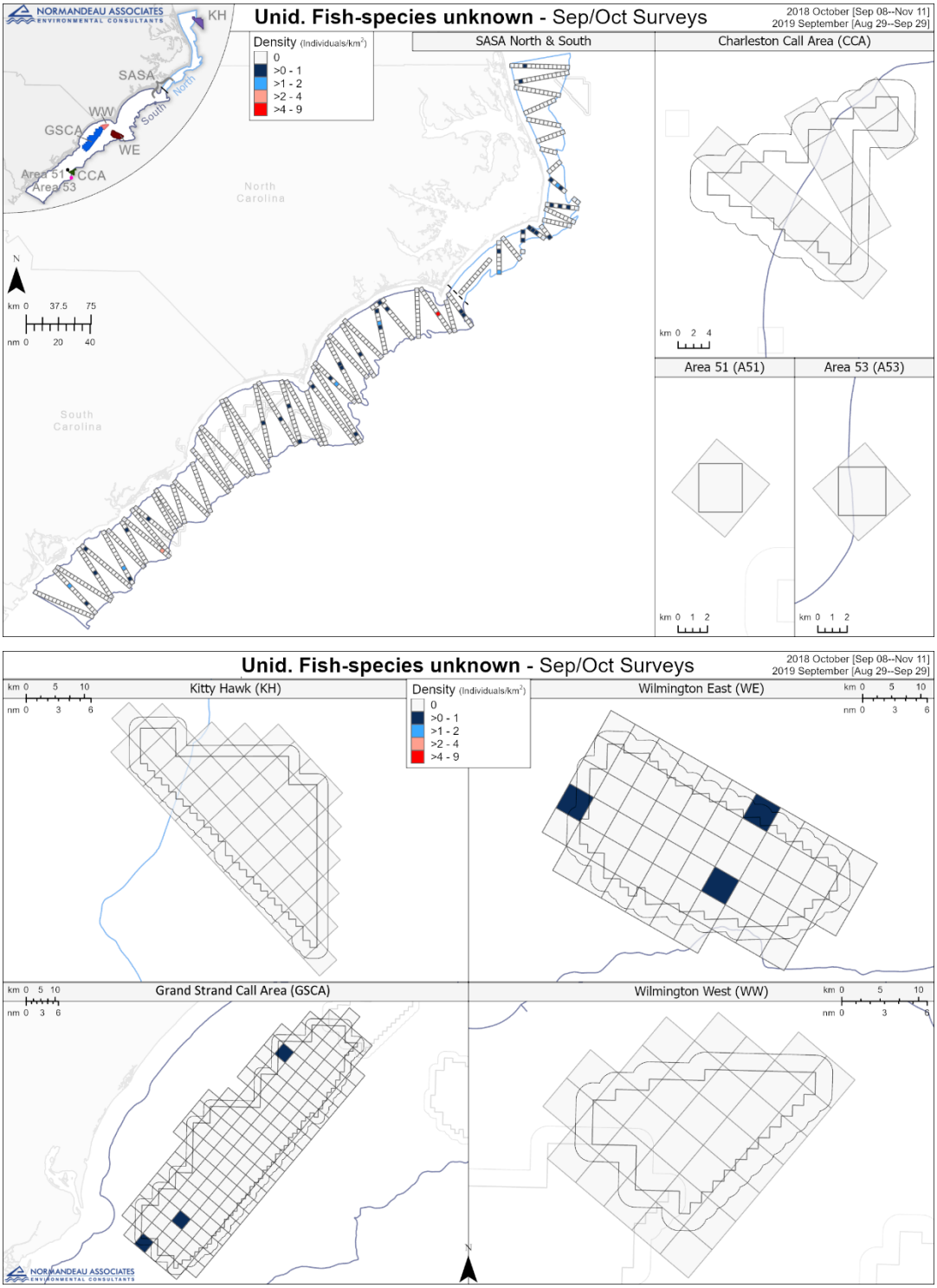

Figure G–35. Spatial distribution of fish-species unknown during the September/ October surveys for all areas

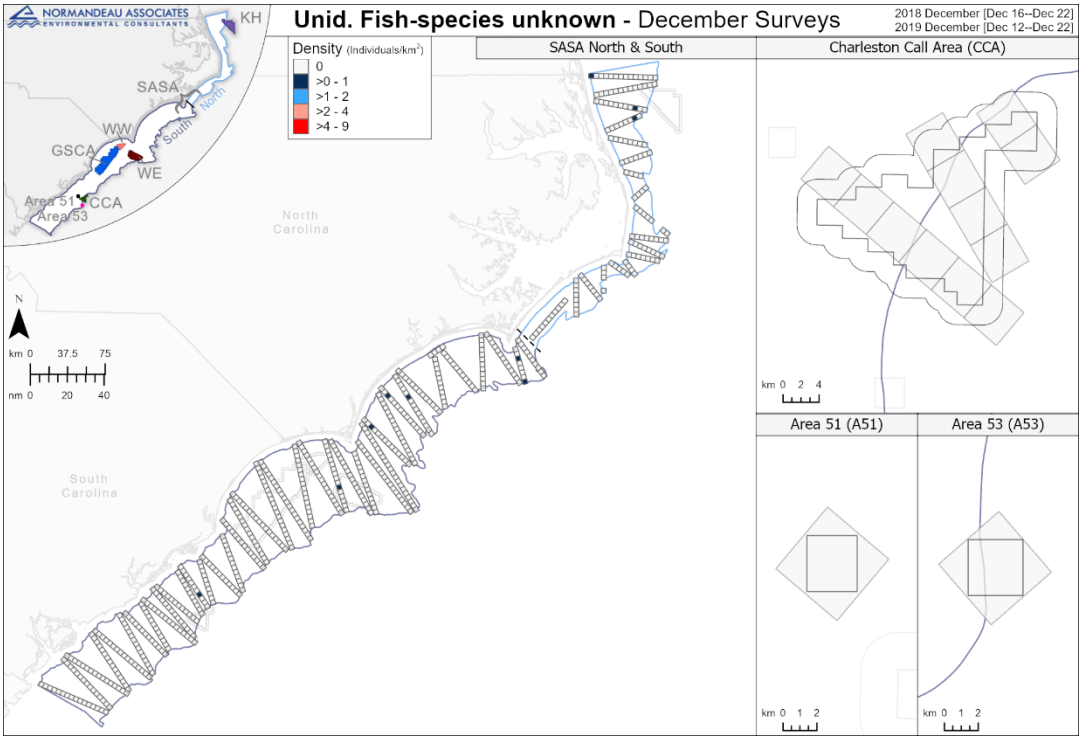

Figure G–36. Spatial distribution of fish-species unknown during the December surveys for all areas

Appendix H: Threatened and Endangered Species

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H.1 Raw Counts of Threatened and Endangered Species Identified in the February 2018 through February 2020 Surveys

Table H–1. ESA and State-listed species identified in the February 2018 through February 2020 surveys across all areas combined

Species	Raw Counts								Species Total
	Feb 2018	Feb 2020	May/Jun 2018	May 2019	Oct 2018	Sep 2019	Dec 2018	Dec 2019	
Avian–*Sterna* Tern									
species unknown*	—	2	41	—	40	7	—	16	106
Total	**—**	**2**	**41**	**—**	**40**	**7**	**—**	**16**	**106**
Turtles									
Leatherback Turtle*	23	2	2	19	15	11	1	2	75
Loggerhead Turtle*	148	110	172	207	192	112	114	130	1,185
Loggerhead/Kemp's Turtle*	40	54	24	71	45	34	23	61	352
Green Turtle*	2	1	—	—	1	—	—	2	6
Kemp's Ridley Turtle*	133	90	10	26	61	11	141	197	669
species unknown*	33	96	33	98	80	68	66	288	762
Totals	**379**	**353**	**241**	**421**	**394**	**236**	**345**	**680**	**3,049**
Whale									
North Atlantic Right Whale*	1	—	—	—	—	—	—	—	1
Humpback Whale*	1	2	—	—	1	—	1	2	7
Totals	**2**	**2**	**—**	**—**	**1**	**—**	**1**	**2**	**8**
Shark									
Whale Shark*	—	—	—	1	—	1	—	—	2
Scalloped Hammerhead*	6	—	6	36	7	3	2	21	81
Hammerhead (unid.)*	181	3	45	118	30	24	9	47	457
Totals	**187**	**3**	**51**	**155**	**37**	**28**	**11**	**68**	**540**

(continued)

Table H–1. (Continued)

Species	Raw Counts								Species Total
	Feb 2018	Feb 2020	May/Jun 2018	May 2019	Oct 2018	Sep 2019	Dec 2018	Dec 2019	
Ray									
Giant Manta Ray*	1	—	5	6	2	10	—	—	24
Totals	**1**	**—**	**5**	**6**	**2**	**10**	**—**	**—**	**24**
Large Bony Fish–Tuna									
Atlantic bluefin tuna *	7	13	—	2	210	1	13	—	246
Totals	**7**	**13**	**—**	**2**	**210**	**1**	**13**	**—**	**246**
TOTAL	**576**	**373**	**338**	**584**	**684**	**282**	**370**	**766**	**3,973**

H.2 Species Composition and Density (per km^2) by Survey Area for Each Survey

Table H–2. Density (per km^2) of ESA and State-listed species for each area during the February 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale											
North Atlantic Right Whale						0.0136				0.0026	0.0004
Humpback Whale	0.0005				0.0005						0.0004
Turtle											
Leatherback Turtle	0.0104		0.3846		0.0108			0.0255		0.0052	0.0098
Loggerhead Turtle	0.0736			0.1321	0.0733	0.0136		0.0255	0.0101	0.0130	0.0633
Loggerhead/Kemp's Turtle	0.0198				0.0195	0.0136			0.0050	0.0052	0.0171
Green Turtle	0.0010				0.0010						0.0009
Kemp's Ridley Turtle	0.0579	0.4237			0.0569	0.0136		0.2425	0.0101	0.0570	0.0569
Turtle - species unknown	0.0162				0.0159			0.0255		0.0052	0.0141
Shark											
Scalloped Hammerhead	0.0031				0.0031						0.0026
Hammerhead (unid.)	0.0945				0.0928						0.0774
Ray											
Giant Manta Ray	0.0005				0.0005						0.0004
Large Bony Fish-Tuna											
Atlantic bluefin tuna	0.0037				0.0036						0.0030
Totals	**0.2813**	**0.4237**	**0.3846**	**0.1321**	**0.2778**	**0.0543**	**—**	**0.3191**	**0.0252**	**0.0881**	**0.2464**

Table H–3. Density (per km^2) of ESA and State-listed species for each area during the February 2020 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
***Sterna* Tern**											
Sterna tern - species unknown								0.0128	0.0050	0.0052	0.0009
Whale											
Humpback Whale	0.0010				0.0010						0.0009
Turtle											
Leatherback Turtle								0.0128	0.0050	0.0052	0.0009
Loggerhead Turtle	0.0519		0.3846	0.0661	0.0520		0.0284	0.0256	0.0302	0.0234	0.0473
Loggerhead/Kemp's Turtle	0.0262			0.0330	0.0258			0.0128	0.0151	0.0104	0.0232
Green Turtle	0.0005				0.0005						0.0004
Kemp's Ridley Turtle	0.0388			0.0330	0.0386			0.0384	0.0605	0.0389	0.0387
Turtle - species unknown	0.0446			0.0661	0.0438	0.0136	0.0284	0.0256	0.0353	0.0286	0.0413
Shark											
Hammerhead (unid.)	0.0010				0.0010			0.0128		0.0026	0.0013
Large Bony Fish-Tuna											
Atlantic bluefin tuna	0.0068				0.0067						0.0056
Totals	**0.1711**	**—**	**0.3846**	**0.1982**	**0.1695**	**0.0136**	**0.0568**	**0.1408**	**0.1511**	**0.1142**	**0.1603**

Table H–4. Density (per km^2) of ESA and State-listed species for each area during the May/June 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
***Sterna* Tern**											
Sterna Tern - species unknown	0.0225			0.0330	0.0226				0.0049	0.0026	0.0190
Turtle											
Leatherback Turtle	0.0012				0.0011						0.0009
Loggerhead Turtle	0.0721	0.4237		0.0330	0.0706	0.5163		0.0511	0.0247	0.1207	0.0797
Loggerhead/Kemp's Turtle	0.0121				0.0119	0.0408				0.0077	0.0111
Kemp's Ridley Turtle	0.0058				0.0057						0.0046
Turtle - species unknown	0.0156				0.0153	0.0815				0.0154	0.0153
Shark											
Scalloped Hammerhead	0.0029				0.0028			0.0128		0.0026	0.0028
Hammerhead (unid.)	0.0219			0.0330	0.0215			0.0893		0.0180	0.0208
Ray											
Giant Manta Ray	0.0017				0.0017				0.0099	0.0051	0.0023
Totals	**0.1557**	**0.4237**	**—**	**0.0991**	**0.1532**	**0.6386**	**—**	**0.1532**	**0.0395**	**0.1720**	**0.1566**

Table H–5. Density (per km^2) of ESA and State-listed species for each area during the May 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Turtle											
Leatherback Turtle	0.0084				0.0082	0.0409				0.0074	0.0081
Loggerhead Turtle	0.0708			0.0661	0.0701	0.8037	0.0568	0.0256	0.0407	0.1742	0.0881
Loggerhead/Kemp's Turtle	0.0304				0.0299	0.1498			0.0091	0.0319	0.0302
Kemp's Ridley Turtle	0.0131				0.0129	0.0136				0.0025	0.0111
Turtle - species unknown	0.0435			0.0330	0.0433	0.1635			0.0091	0.0343	0.0417
Shark											
Whale Shark	0.0005				0.0005						0.0004
Scalloped Hammerhead	0.0163			0.0661	0.0170			0.0128	0.0091	0.0074	0.0153
Hammerhead (unid.)	0.0525				0.0515	0.0409	0.0284	0.0768	0.0362	0.0442	0.0502
Ray											
Giant Manta Ray	0.0031				0.0031						0.0026
Large Bony Fish-Tuna											
Atlantic bluefin tuna	0.0010				0.0010						0.0009
Totals	**0.2397**	**—**	**—**	**0.1651**	**0.2375**	**1.2124**	**0.0852**	**0.1152**	**0.1041**	**0.3017**	**0.2486**

Table H–6. Density (per km^2) of ESA and State-listed species for each area during the October 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
***Sterna* Tern**											
Sterna Tern - species unknown	0.0199				0.0195				0.0178	0.0096	0.0177
Whale											
Humpback Whale	0.0006				0.0005						0.0004
Turtle											
Leatherback Turtle	0.0077				0.0076				0.0044	0.0024	0.0066
Loggerhead Turtle	0.0962				0.0944	0.0543	0.0240	0.0383	0.0444	0.0430	0.0849
Loggerhead/Kemp's Turtle	0.0238				0.0233	0.0136	0.0240			0.0048	0.0199
Green Turtle	0.0006				0.0005						0.0004
Kemp's Ridley Turtle	0.0254				0.0250	0.1902		0.0128		0.0358	0.0270
Turtle - species unknown	0.0431		0.7722		0.0423				0.0089	0.0048	0.0354
Shark											
Scalloped Hammerhead	0.0033				0.0033		0.0240			0.0024	0.0031
Hammerhead (unid.)	0.0160				0.0157			0.0128		0.0024	0.0133
Ray											
Giant Manta Ray	0.0011				0.0011						0.0009
Large Bony Fish-Tuna											
Atlantic bluefin tuna	0.1156				0.1134	0.0136				0.0024	0.0928
Totals	**0.3534**	**—**	**0.7722**	**—**	**0.3467**	**0.2717**	**0.0721**	**0.0638**	**0.0755**	**0.1075**	**0.3024**

Table H–7. Density (per km^2) of ESA and State-listed species for each area during the September 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
***Sterna* Tern**											
Sterna Tern - species unknown	0.0037				0.0036						0.0030
Turtle											
Leatherback Turtle	0.0031				0.0031	0.0681				0.0130	0.0047
Loggerhead Turtle	0.0459	0.4237		0.0330	0.0451	0.2588		0.0128	0.0202	0.0624	0.0479
Loggerhead/Kemp's Turtle	0.0141				0.0138	0.0409			0.0202	0.0182	0.0146
Kemp's Ridley Turtle	0.0052				0.0051	0.0136				0.0026	0.0047
Turtle - species unknown	0.0287			0.0661	0.0292	0.0817	0.0284	0.0128	0.0152	0.0286	0.0291
Shark											
Whale Shark	0.0005				0.0005						0.0004
Scalloped Hammerhead	0.0010				0.0010				0.0051	0.0026	0.0013
Hammerhead (unid.)	0.0073			0.0991	0.0087	0.0136	0.0284	0.0128	0.0202	0.0182	0.0103
Ray											
Giant Manta Ray	0.0052				0.0051						0.0043
Large Bony Fish-Tuna											
Atlantic bluefin tuna	0.0005				0.0005						0.0004
Totals	**0.1153**	**0.4237**	**—**	**0.1982**	**0.1158**	**0.4768**	**0.0568**	**0.0384**	**0.0808**	**0.1456**	**0.1207**

Table H–8. Density (per km^2) of ESA and State-listed species for each area during the December 2018 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
Whale											
Humpback Whale	0.0005				0.0005						0.0004
Turtle											
Leatherback Turtle	0.0005				0.0005						0.0004
Loggerhead Turtle	0.0569			0.0987	0.0574			0.0128	0.0048	0.0050	0.0486
Loggerhead/Kemp's Turtle	0.0104				0.0103	0.0136			0.0096	0.0076	0.0098
Kemp's Ridley Turtle	0.0710				0.0697			0.0255	0.0144	0.0126	0.0601
Turtle - species unknown	0.0313			0.0329	0.0313	0.0272		0.0383		0.0126	0.0281
Shark											
Scalloped Hammerhead	0.0010				0.0010						0.0009
Hammerhead (unid.)	0.0042		0.3831		0.0046						0.0038
Large Bony Fish-Tuna											
Atlantic bluefin tuna	0.0068				0.0067						0.0055
Totals	**0.1828**	**—**	**0.3831**	**0.1315**	**0.1820**	**0.0408**	**—**	**0.0766**	**0.0288**	**0.0378**	**0.1576**

Table H–9. Density (per km^2) of ESA and State-listed species for each area during the December 2019 survey

Species	Density per km^2										
	TRANSECT (Coverage Varies)					GRID (≈10%)					SURVEY DENSITY TOTAL
	SASA (6%)	A51 (34%)	A53 (34%)	CCA (11%)	ALL AREAS	KH	WW	WE	GSCA	ALL AREAS	
***Sterna* Tern**											
Sterna tern - species unknown								0.1920	0.0096	0.0590	0.0072
Whale											
Humpback Whale	0.0005				0.0005				0.0096	0.0037	0.0009
Turtle											
Leatherback Turtle	0.0010				0.0010						0.0009
Loggerhead Turtle	0.0613		0.3876		0.0607	0.0136	0.0644	0.0384	0.0673	0.0442	0.0587
Loggerhead/Kemp's Turtle	0.0262				0.0257	0.0272		0.0384	0.0576	0.0406	0.0275
Green Turtle	0.0010				0.0010						0.0009
Kemp's Ridley Turtle	0.0859				0.0844			0.1280	0.2210	0.1217	0.0890
Turtle - species unknown	0.1342			0.0661	0.1328	0.0136		0.1152	0.1922	0.1106	0.1300
Shark											
Scalloped Hammerhead	0.0110				0.0108						0.0095
Hammerhead (unid.)	0.0231				0.0226			0.0384		0.0111	0.0212
Totals	**0.3443**	**—**	**0.3876**	**0.0661**	**0.3396**	**0.0545**	**0.0644**	**0.5504**	**0.5573**	**0.3909**	**0.3459**

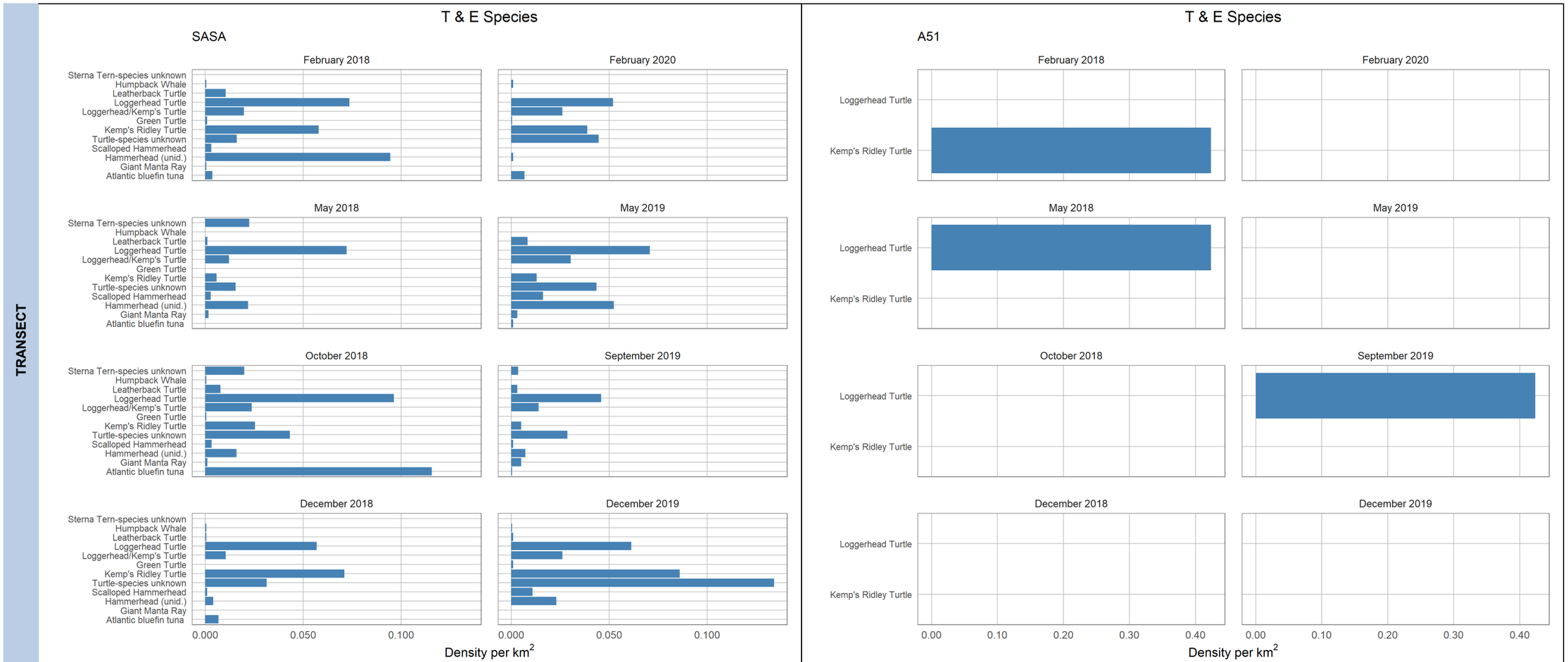


Figure H–1. Density (per km^2) of threatened and endangered species encountered during the February 2018 through February 2020 surveys for each area by survey (figure continued below)
Note: X-axes are scaled according to the maximum density for each area.

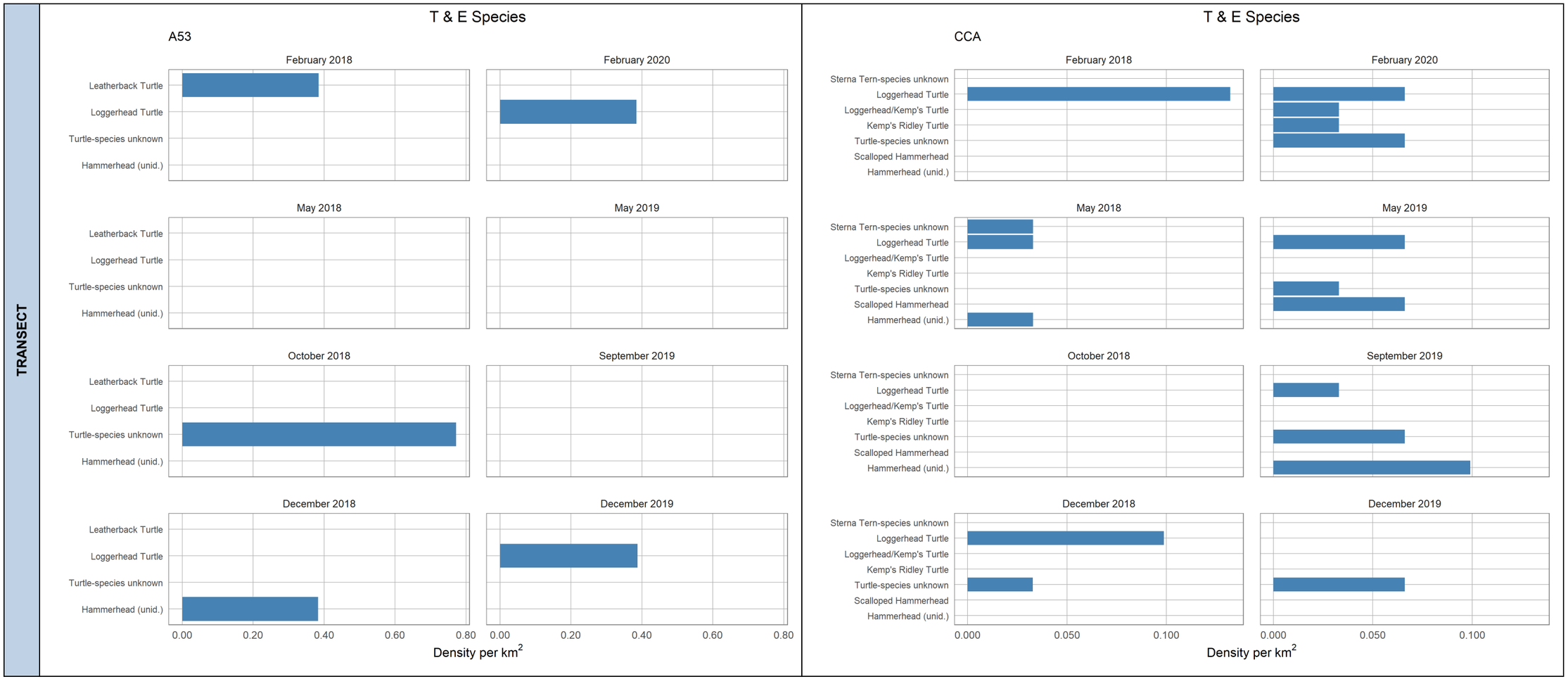


Figure H–1. (Continued)

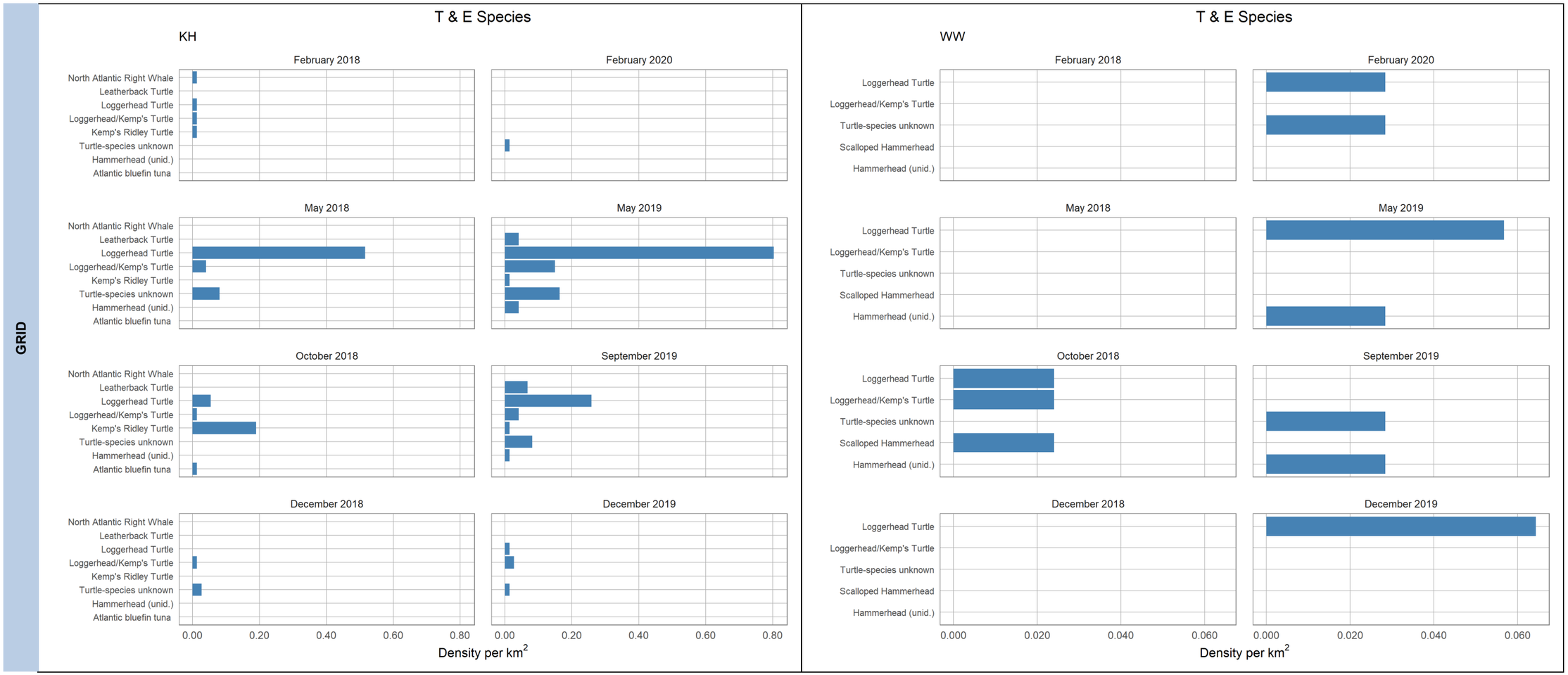


Figure H–1. (Continued)

GRID

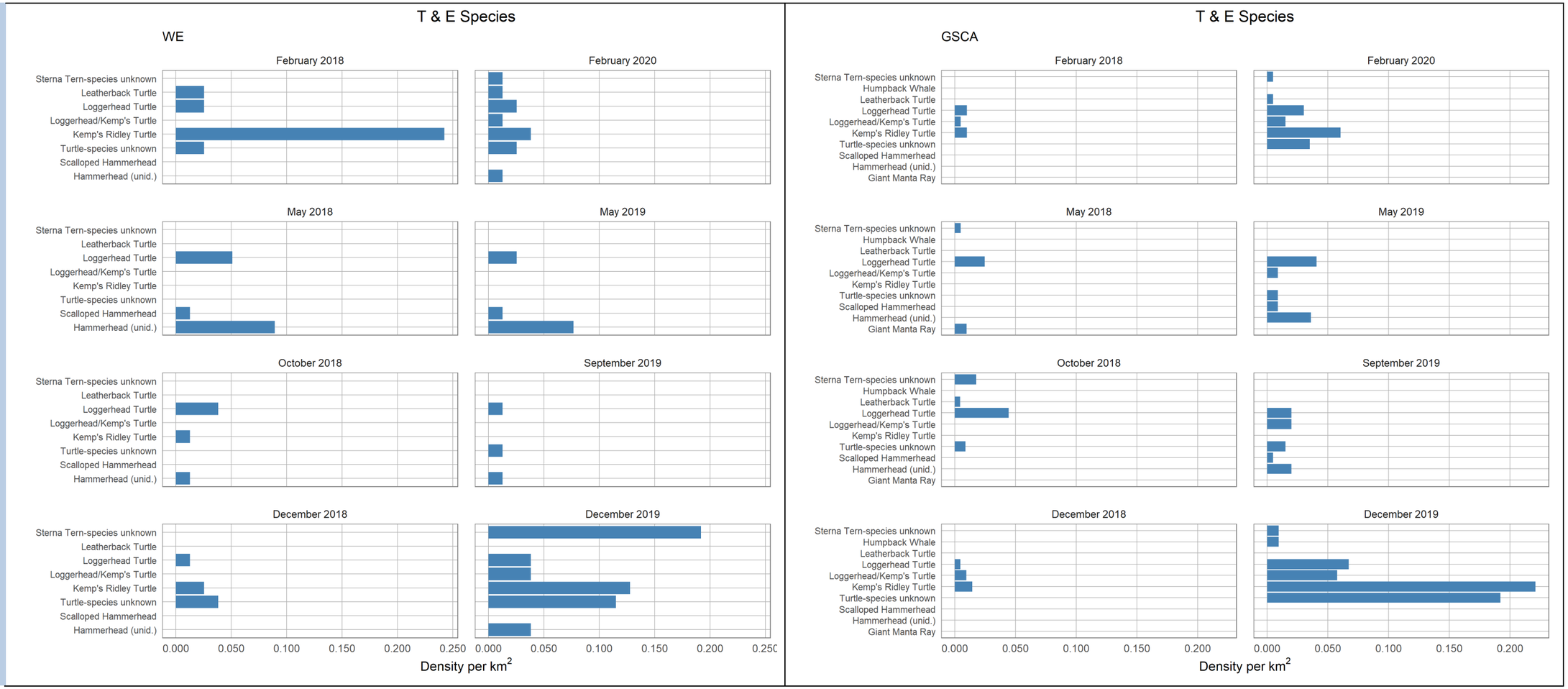


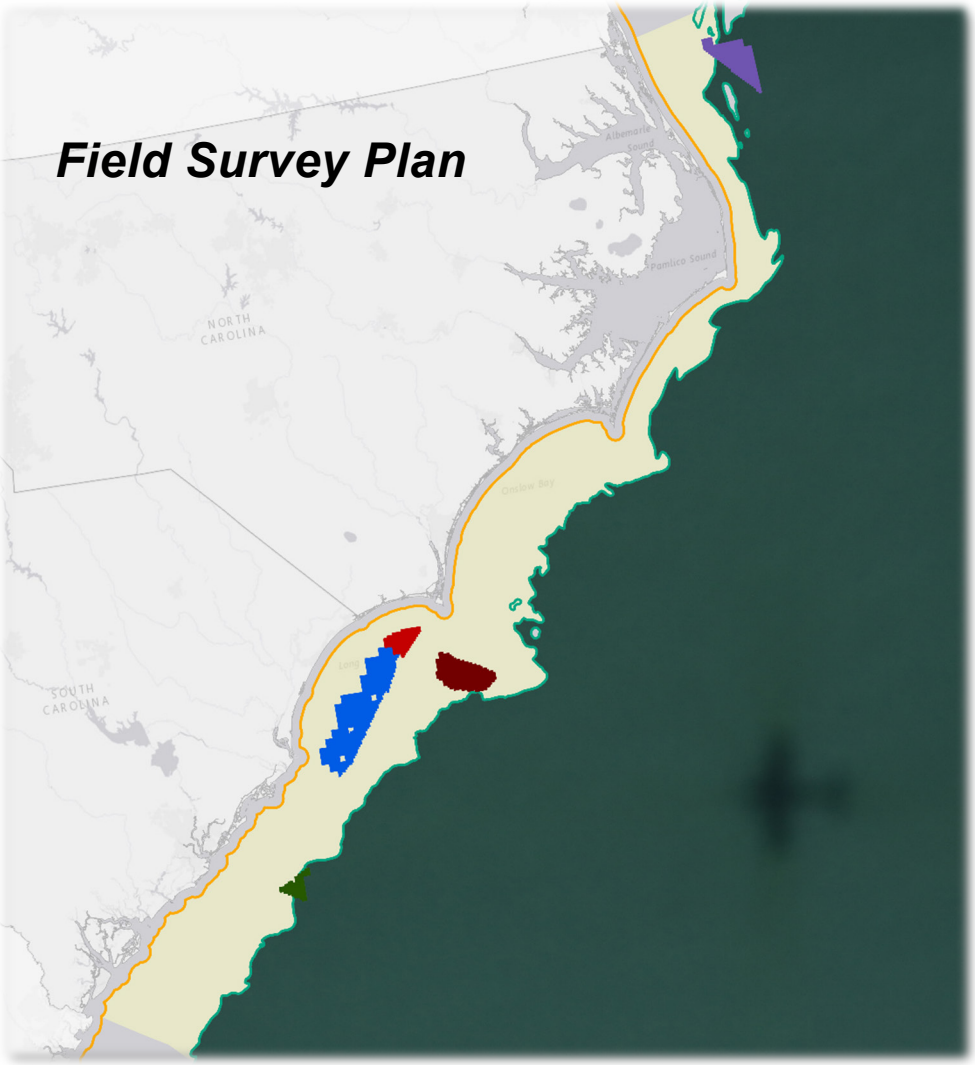
Figure H–1. (Continued)

Appendix I: Survey Plan

OCS Study
BOEM 20xx-xxx

Ecological Baseline Studies of the US Outer Continental Shelf

Develop a Field Plan for High-Resolution Aerial Wildlife Surveys in the South Atlantic



US Department of the Interior
Bureau of Ocean Energy Management
Environmental Studies Program

BOEM
Bureau of Ocean Energy Management

Ecological Baseline Studies of the US Outer Continental Shelf

Develop a Field Plan for High-Resolution Aerial Wildlife Surveys in the South Atlantic

Field Survey Plan

December 2017

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DISCLAIMER

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To download a PDF file of this report, go to the US Department of the Interior, Bureau of Ocean Energy Management Data and Information Systems webpage (http://www.boem.gov/Environmental-Studies-EnvData/), click on the link for the Environmental Studies Program Information System (ESPIS), and search on 20xx-xxx. The report is also available at the National Technical Reports Library at https://ntrl.ntis.gov/NTRL/.

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List of Abbreviations and Acronyms

APEM	APEM, Inc.
BOEM	Bureau of Ocean Energy Management
ESPIS	Environmental Studies Program Information System
GSD	Ground sampling distance
MARCO	Mid-Atlantic Regional Council on the Ocean
MOA	Military Operating Area
Normandeau	Normandeau Associates, Inc.
OBIS-SEAMAP	Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations
OCS	Outer Continental Shelf
OSW	Offshore wind
SASA	South Atlantic Survey Area
SPS	Standard Positioning Service
Team	Normandeau Associates, Inc., and APEM, Inc.
WEA	Wind Energy Area

1 Introduction

The Bureau of Ocean Energy Management (BOEM) promotes economic development, energy independence, and environmental protection through responsible, science-based management of offshore conventional and renewable energy and marine mineral resources.

There is growing interest in developing offshore wind (OSW) energy in the USA and elsewhere. However, it is still unclear what impacts such development could have on wildlife, including corals and other invertebrates, birds, bats, sea turtles, fish, and marine mammals. Data gaps and unmet research needs hamper the efforts of federal and state regulators to avoid or minimize potential impacts to wildlife from OSW development. There have been several efforts along the Atlantic coast to identify and fill these gaps in recent years, but many research needs are still unmet.

One of the most pressing research needs is baseline data on potential wildlife exposure. Knowledge about species presence and absence in development areas helps regulators form appropriate site-specific questions to be addressed by developers. Regional-scale baseline information on wildlife distributions, abundance, and movements by season can inform the relative biodiversity of the development sites. These types of surveys can also provide a better understanding of the potential effects of individual projects, as well as any potential cumulative effects of multiple projects.

To help address this information gap in the US South Atlantic Outer Continental Shelf (OCS), Normandeau Associates (Normandeau) and APEM Inc. (APEM) (Team) have been contracted by BOEM to complete quarterly high-altitude aerial digital surveys in a 12-month period. The Team proposes to conduct the first survey in February 2018 and complete all four surveys in the 2018 calendar year. The South Atlantic Survey area (SASA) is defined as the area of the ocean off the coast of North and South Carolina out to the 30-m contour line. The approximate size of the area is 11,000 square nautical miles. Transect surveys will cover a minimum of 5% of the SASA (Figure 1). In addition, a 20% transect resulting in a 10% grid-based survey of 3 Wind Energy Areas (WEAs)—Kitty Hawk, Wilmington East and Wilmington West—as well as the South Carolina–Grand Strand Call Area, plus a 1-nautical–mile buffer around each will also be completed (Figure 1). Although a fifth area (South Carolina–Charleston Call Area) lies only partially within the SASA, transects will be extended beyond the -30-m contour through entire Call Area providing at least 5% coverage (Figure 1). Additional areas of interest that were identified by BOEM include fish spawning special management zones. Two of these areas (Area 51 and Area 53) lie within the survey boundary and will have a flight line targeted through them (Figure 1). The planned image resolution of all the imagery for the project will be 1.5-cm ground sampling distance (GSD) at the surface of the ocean.

The following describes the general plan for the surveys over the next year. In addition to this document, there will also be a project-specific Health and Safety Plan that will be reviewed and updated as necessary for each quarterly survey as well as a survey-specific flight plan (Appendix A) completed prior to each survey. Following each quarterly survey, a Summary Report will be provided detailing the survey-specific information, including when the surveys occurred, the survey conditions, and any information that may be important for data analysis.

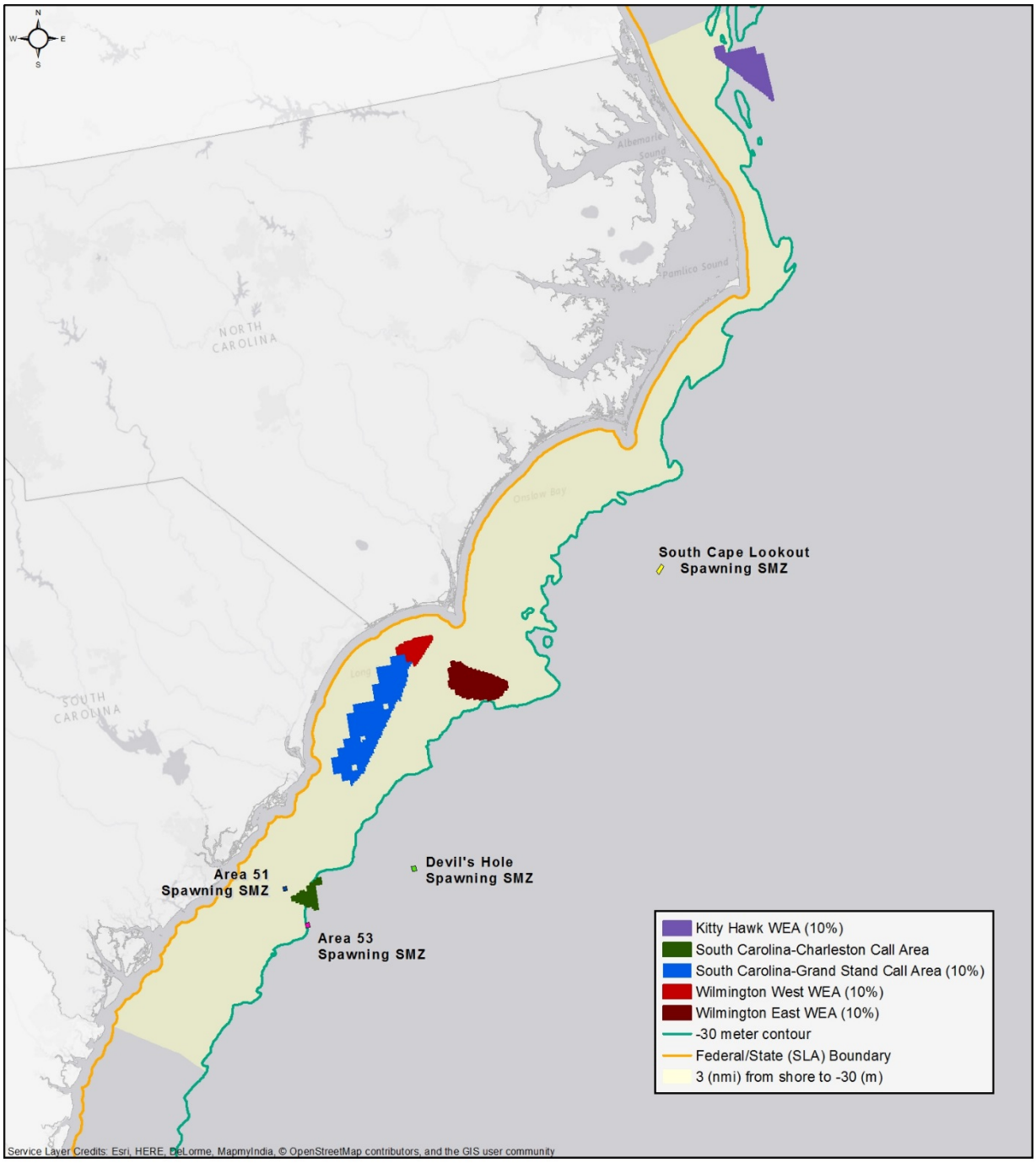

Figure 1. **Map showing South Atlantic Survey Area (SASA) to be covered by a 5% transect survey, 3 Wind Energy Areas (WEAs) and 1 Call Area (Grand Strand) to be covered by a 10% grid survey, and the additional area (Charleston Call Area and Spawning SMZ Areas 51 and 53) to be incorporated into the SASA surveys.**

2 Survey Design

2.1 Survey by Transect and Grid

For the SASA, linear transects will be flown to cover a minimum of 5% of the area's sea surface. The transects will follow a saw tooth pattern along the coastline such that the outbound and inbound line will be essentially perpendicular to the shoreline. This will consist of approximately 47–60 transects of an approximate total length of 2,880 km (Figure 2; Appendix B) depending on the survey design chosen. Please note that the number of transect lines may differ in the final flight plan as the values in this document are representations of the survey design. Imagery will be generated across a 702-m–wide swath with abutting imagery for a total image footprint of 0.077 km^2 or 2,022 km^2 overall.

For the SASA, there are two designs proposed: one of which takes into account the restricted access around the three Military Operating Areas (MOAs)—Hatteras Foxtrot MOA, Core MOA, and Pamlico B MOA—that make up the Marine Corps Air Station Cherry Point airspace. Figure 2 represents the survey design if permission to turn inside the Cherry Point airspace is granted. If permission is denied, an alternative strategy has been designed whereby an abbreviated sawtooth design is achieved with transects perpendicular to the coast and oceanographic gradients, but the design also contains a transect parallel to the coast that allows for the sawtooth transect turns to be achieved greater than 5 NM offshore of the Cherry Point airspace. Figure 2 represents the preferred option, and Figure 3 represents the survey design if work around the Cherry Point airspace is necessary and the amount of access required into the airspace is limited. The decision on which survey strategy to fly will be made survey by survey. Contact will be made with FWS contacts Jim Wortham (Jim_Wortham@fws.gov) and Steve Earsom (stephen_earsom@fws.gov) to ensure that all possible effort is made to conduct surveys according to the preferred Figure 2 survey design. Both contacts have experience surveying in the vicinity of Cherry Point. Figure 4 shows the transect lines that will pass through the Charleston Call Area and Spawning SMZ Areas 51 and 53. Ideally the survey will progress continuously along the coast. If there are problems with airspace in any area (e.g., localized weather conditions, presence of lower altitude survey planes, or FAA or military restrictions), however, the field team will relocate to other parts of the survey area and return to the affected section later.

For each WEA, the grid imagery footprint will be a minimum of 524 m × 219 m (0.114 km^2). A minimum of 20% of the WEA plus the 1-nautical–mile buffer will be collected; however, only half of the images (representing 10% of the WEA area) will be analyzed (Figure 5). The remaining unanalyzed data can be used if needed; although, this will revert the survey design from a 10% grid design to a 20% transect design.

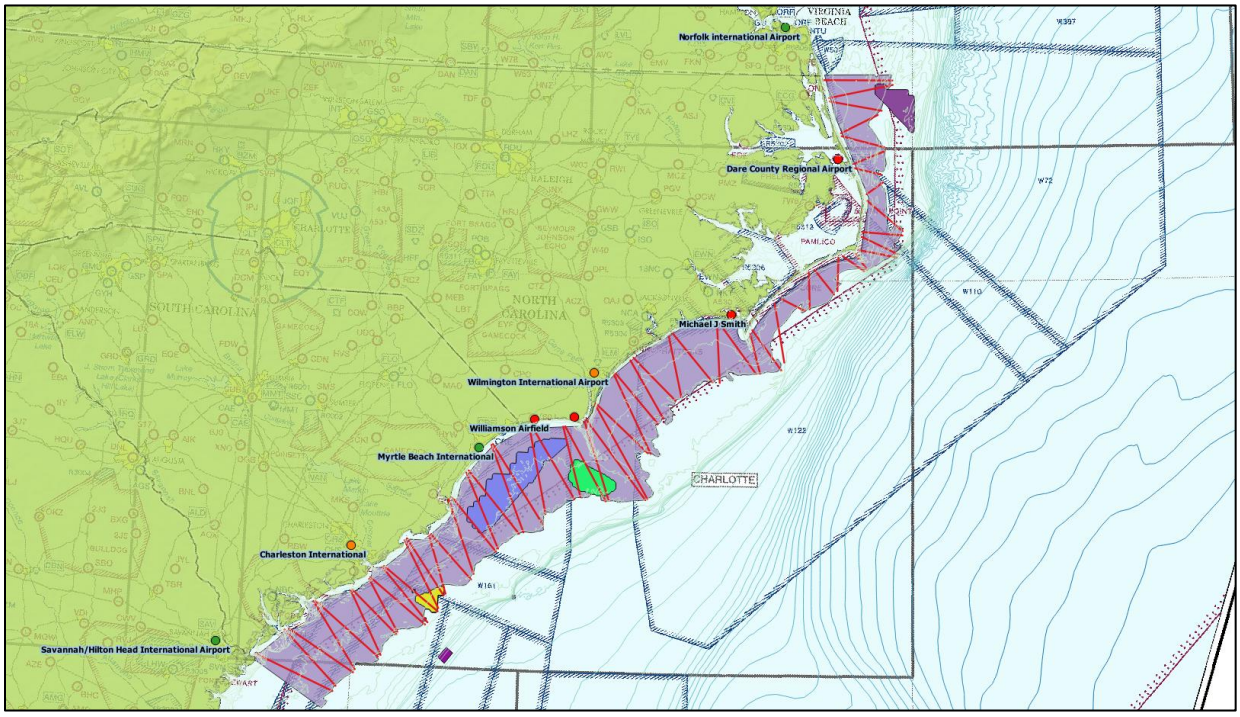

Figure 2. **South Atlantic Survey Area (SASA) showing transect survey protocol to achieve 5% coverage with Shearwater III.**

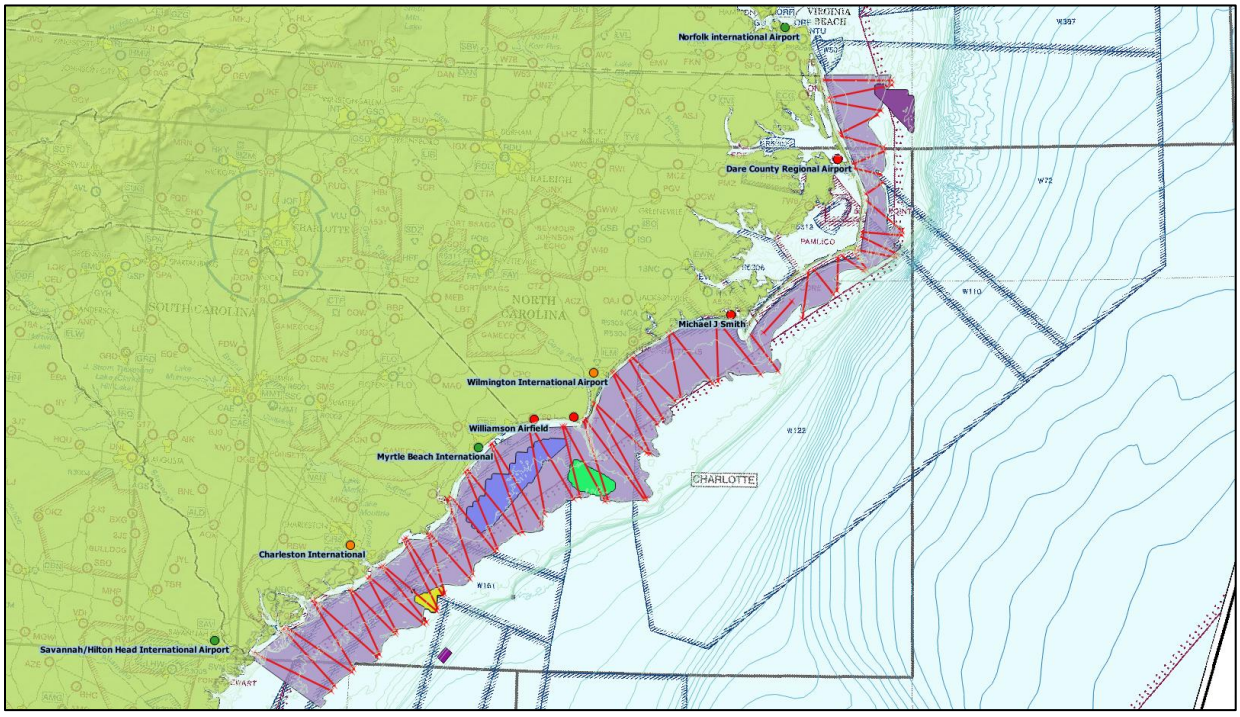

Figure 3. **South Atlantic Survey Area (SASA) showing transect survey protocol to achieve 5% coverage with Shearwater III, taking into account possible access issues into MCAS Cherry Point.**

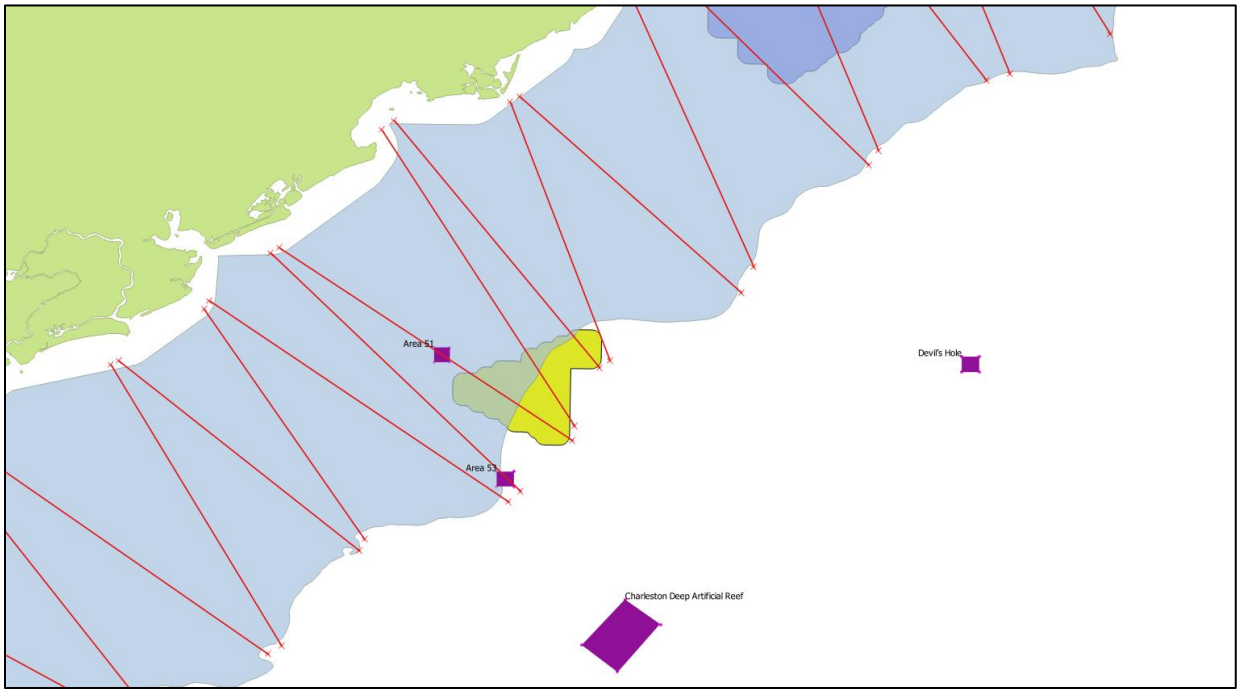

Figure 4. **Transect lines that pass through the Charleston Call Area and Spawning SMZ Areas 51 and 53.**



Figure 5. **Areas where survey will provide 10% grid coverage.**
Clockwise from top left: Kitty Hawk (NC) WEA, Wilmington (NC) East WEA, and Grand Strand (SC) Call Area/Wilmington (NC) West WEA.

The primary goal of the project is to create baseline seasonal information on the distribution of birds, mammals, turtles, rays, sharks, and other wildlife targets found in the digital imagery. The *a priori* assumption for this study is that aerial digital survey results will reveal new information about the hotspots, distribution, and population estimates for the SASA. To achieve this necessitates distributing the transects equally across the survey area. There have been human observer-based surveys in the SASA conducted using different methodologies and technology (e.g., by boat and air) (Figure 6) and that information has been used to define the targeted survey periods for the quarterly surveys rather than to pre-determine potential hotspots. BOEM acknowledges that the digital survey method could reveal similar spatial patterns found in earlier studies, although patterns could certainly differ. Changes to the survey plan would only be done if it furthered the confidence in the baseline survey results.

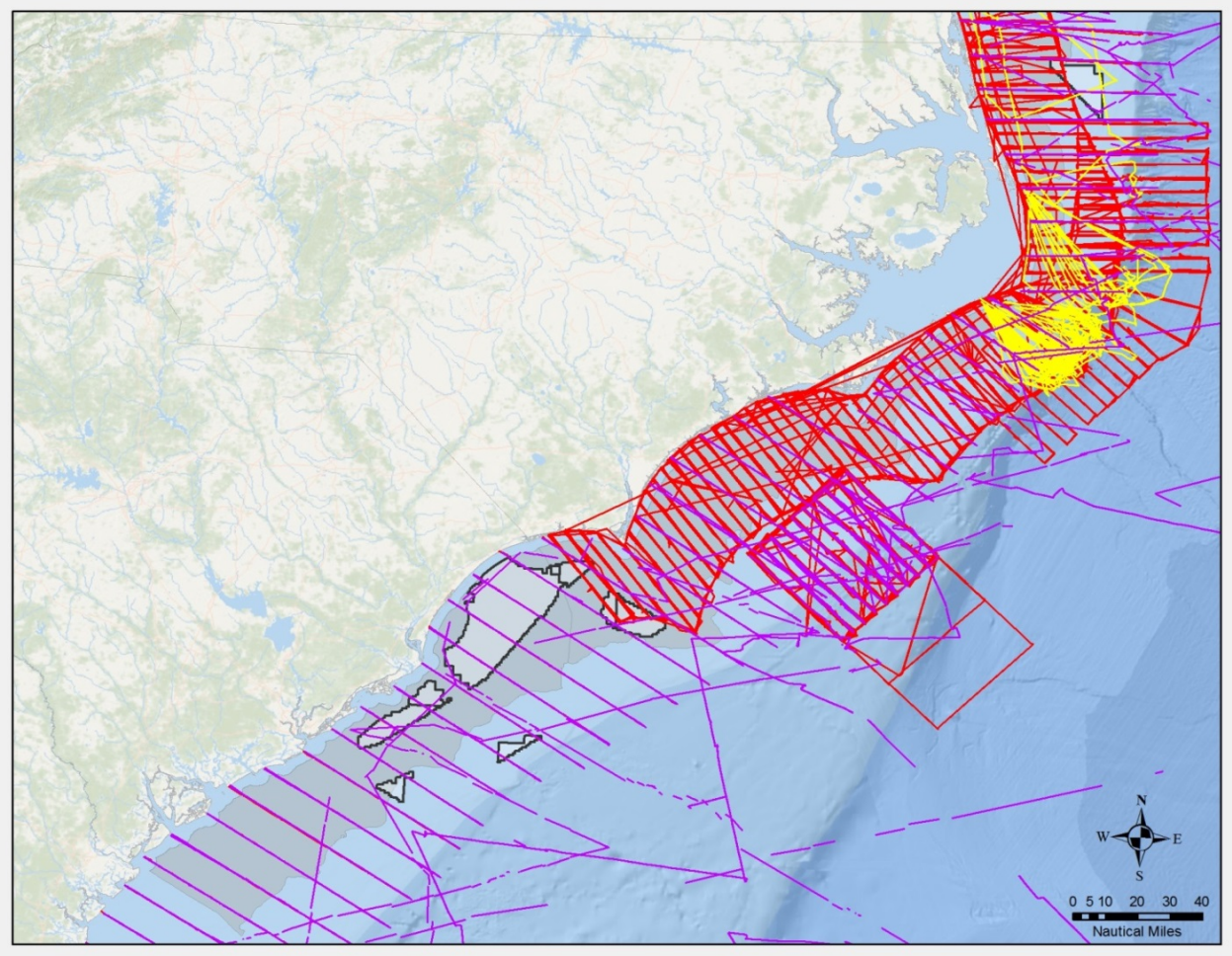

Figure 6. Map showing historic survey lines in the SASA.
All illustrated transects collected data for birds (yellow), turtles and marine mammals (red), or all three species groups (purple).

2.2 Survey Schedule

Starting in February 2018, 4 aerial ultrahigh resolution digital still surveys of the SASA, 3 WEA, and 2 Call Areas (Figure 2 and Figure 3) will be carried out, with one survey delivered per season (spring,

summer, fall, and winter). Surveys will aim to coincide with peak biological activity and associated weather patterns affecting seasonal movements of birds to maximize hotspot identification.

Each seasonal survey will require an estimated 50 hours of combined aerial survey time spread over 15–17 days. For planning purposes, on average per survey basis, there will be about 4–5 hours per day of actual data collection including daily transit to/from the airport and refueling. The survey will be flown with consideration to the migratory path of the target species. However, the number of hours of actual data collection will vary depending on season and weather. Each seasonal survey will have a 1–2-month window based on patterns observed in historical data. Based on a review of existing data sets such as the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) and the USGS Atlantic Offshore Seabird Dataset Catalog (USGS Seabird Compendium), some targeted periods and expected taxa of interest have been identified.

2.2.1 Winter (February)

Fin and humpback whales peak north of Cape Hatteras between December and April (Figure 7), while north Atlantic right whales peak in South Carolina and bottlenose dolphins are generally more abundant (Figure 8). Loons, some auk species, and northern gannet also peak between November and March (Figure 9). Many gulls and sea-duck also peak between November and March (Figure 10).

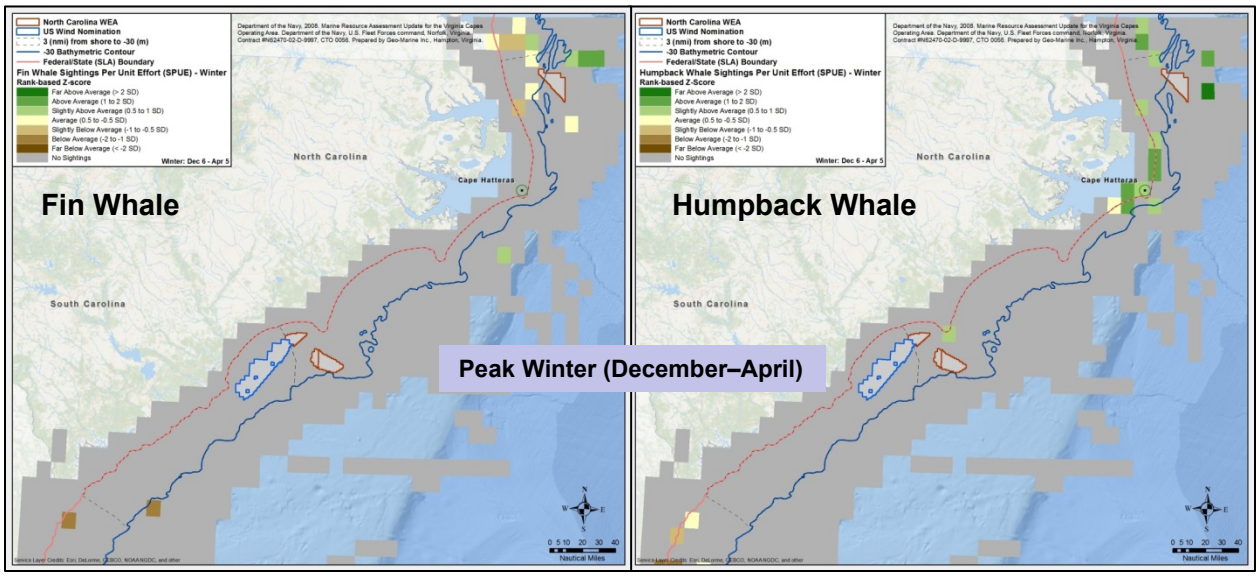

Figure 7. Peak seasonal timings and locations for fin and humpback whales.

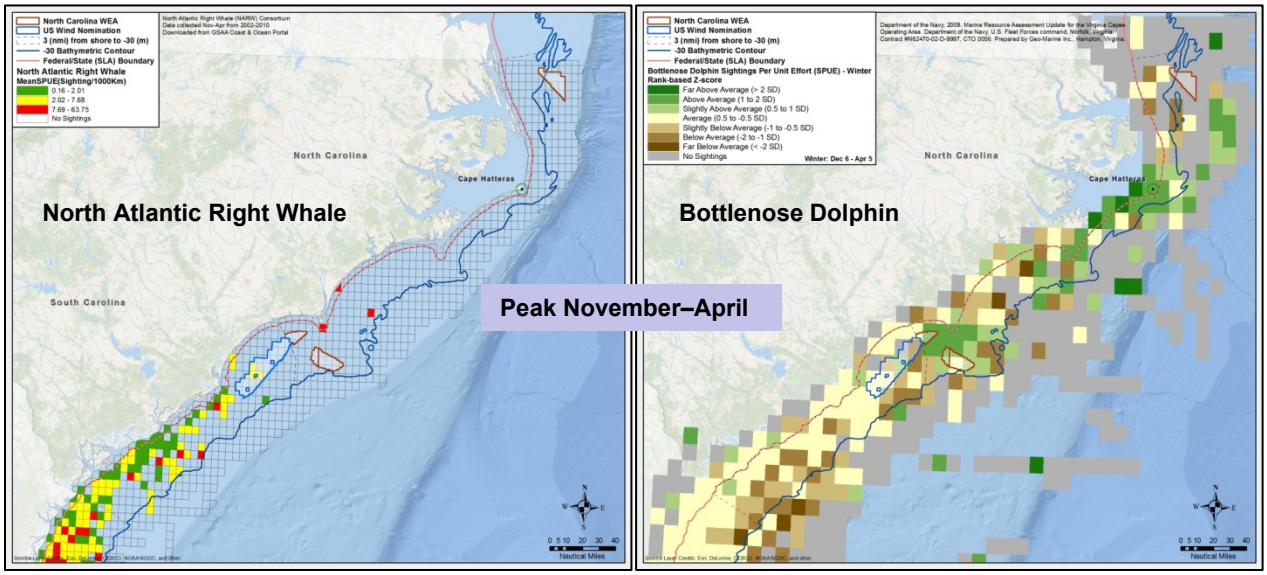

Figure 8. **Peak seasonal timings and locations for north Atlantic right whales and bottlenose dolphins.**

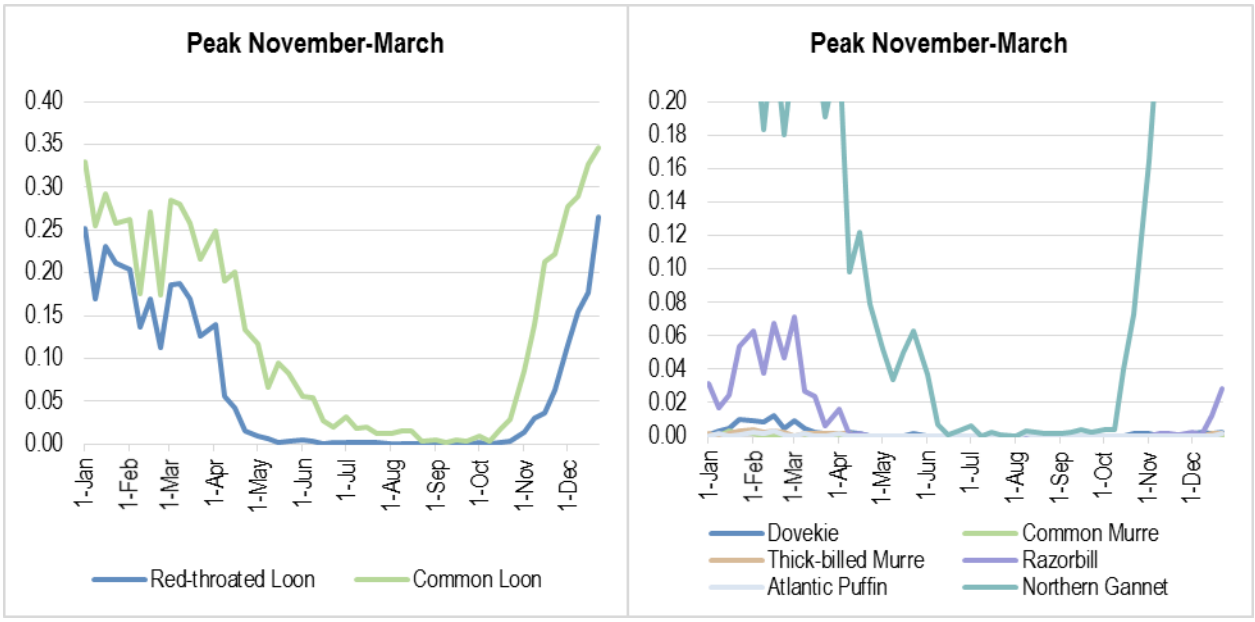

Figure 9. **Seasonality of loons, some auks, and northern gannet.**

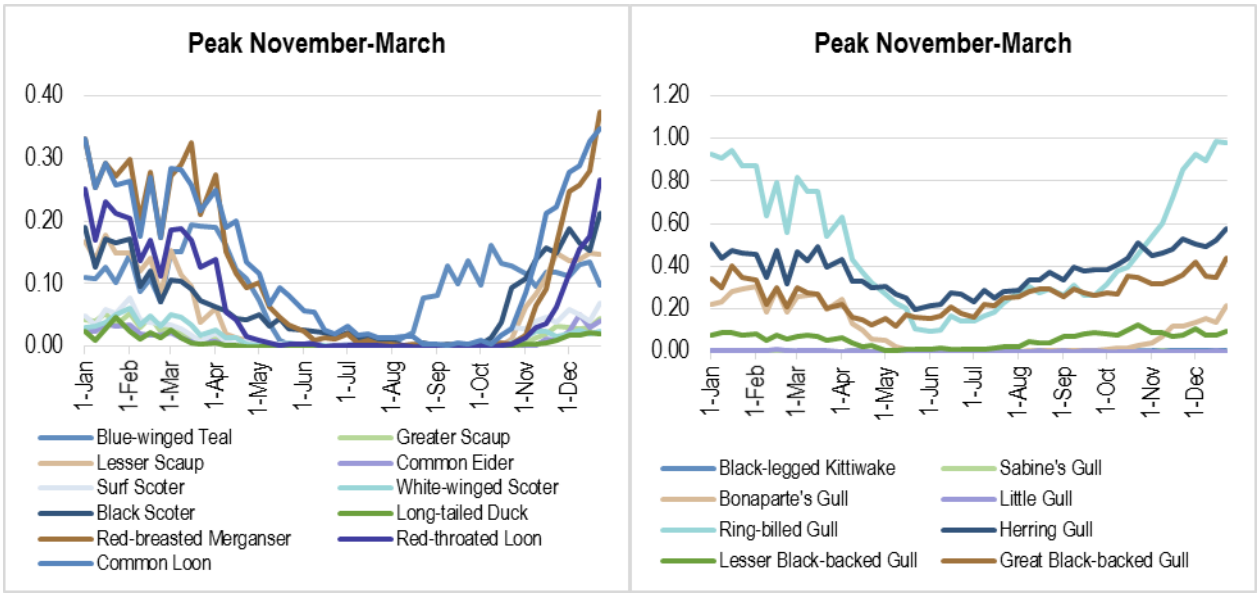

Figure 10. Seasonality of sea-ducks and gulls.

2.2.2 Spring (May/June)

Roseate tern, a target species, is likely to be migrating through the area in early May and active offshore; storm-petrels are likely to occur throughout May (Figure 11). Late May and June are anticipated to correspond with peak shearwater, northern fulmar, Bermuda and black-capped petrel activity (Figure 12). Weather conditions permitting, survey start date will target the first half of May and continue into later May.

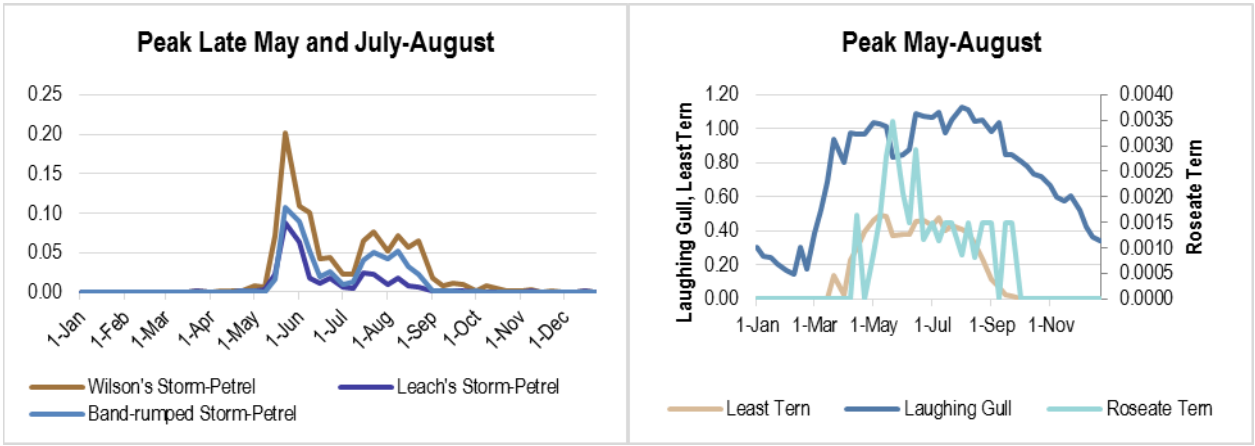

Figure 11. Seasonality of storm-petrels, least and roseate tern, and laughing gull.

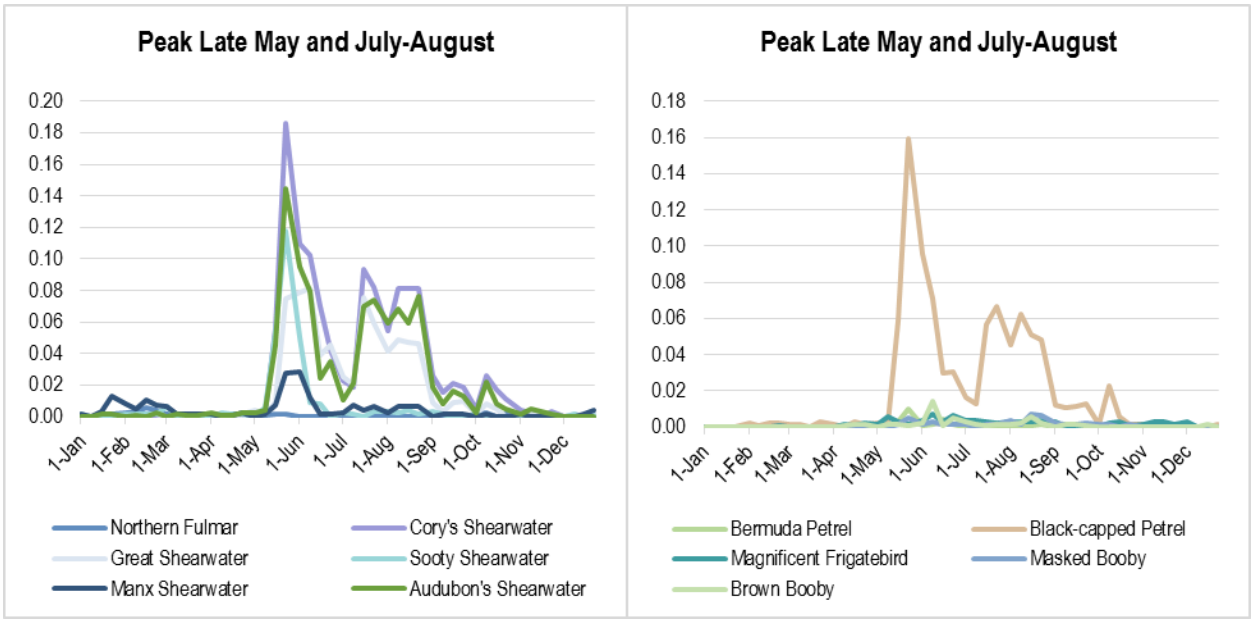

Figure 12. Seasonality of shearwaters, northern fulmars, Bermuda and black-capped petrels.

2.2.3 Summer (September)

Although August is also a good time to collect information on distributions of those species targeted in the spring survey (see Figure 11 and Figure 12), there is also the possibility that other aerial surveys will be occurring in the area in August at lower altitudes. The Team will survey in August if information provided in May or June that suggests other anticipated surveys in the area will not take place. Alternatively, if other survey crews are in the area and to avoid duplication of effort and maximize temporal coverage of the area, we anticipate collecting data in September. September coincides with peak Arctic, royal and Caspian terns, and cormorants and pelicans (Figure 13).

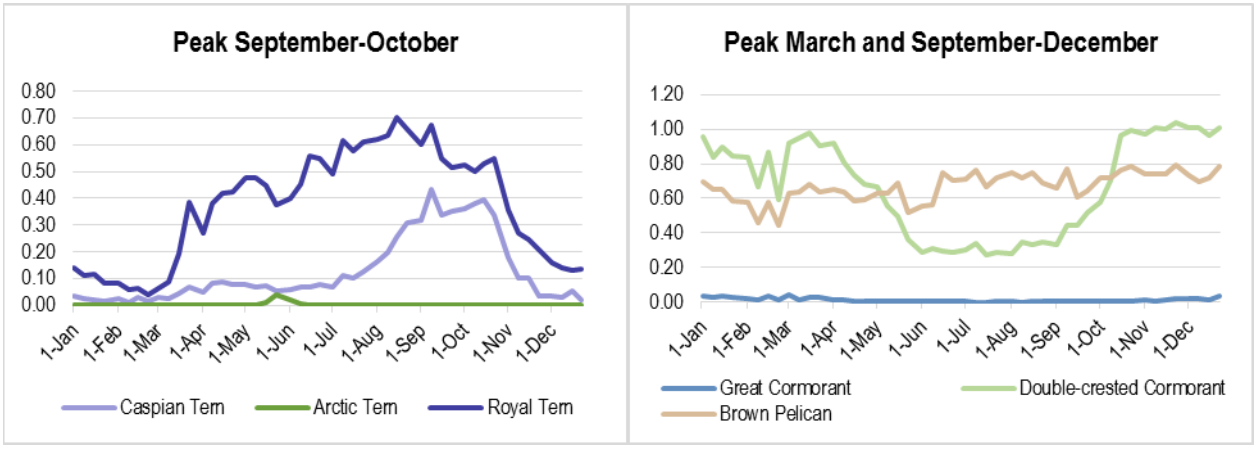

Figure 13. Seasonality of Arctic, royal, and Caspian terns, and cormorants and pelicans.

2.2.4 Fall (November/December)

Timing surveys for November or December will allow us to encounter some of those species anticipated in February (see Figure 9 and Figure 10) that span a broad winter occupancy, while also sampling across two winter season annual cycles should the first survey take place in February 2018. February 2018 is effectively the winter of 2017/2018 and November or December 2018 is effectively the start of the winter of 2018/2019. To maximize encounter rates of sub-arctic birds, e.g., sea-ducks and loons, a late November or December survey will be targeted depending on weather restrictions.

Carrying out four seasonal surveys should allow us to see seasonal distributional patterns. We anticipate encountering hardshell turtles during all seasons with differing densities by season and region (Figure 14). Similarly, we anticipate seasonal distribution observations of leatherback turtles (Figure 15).

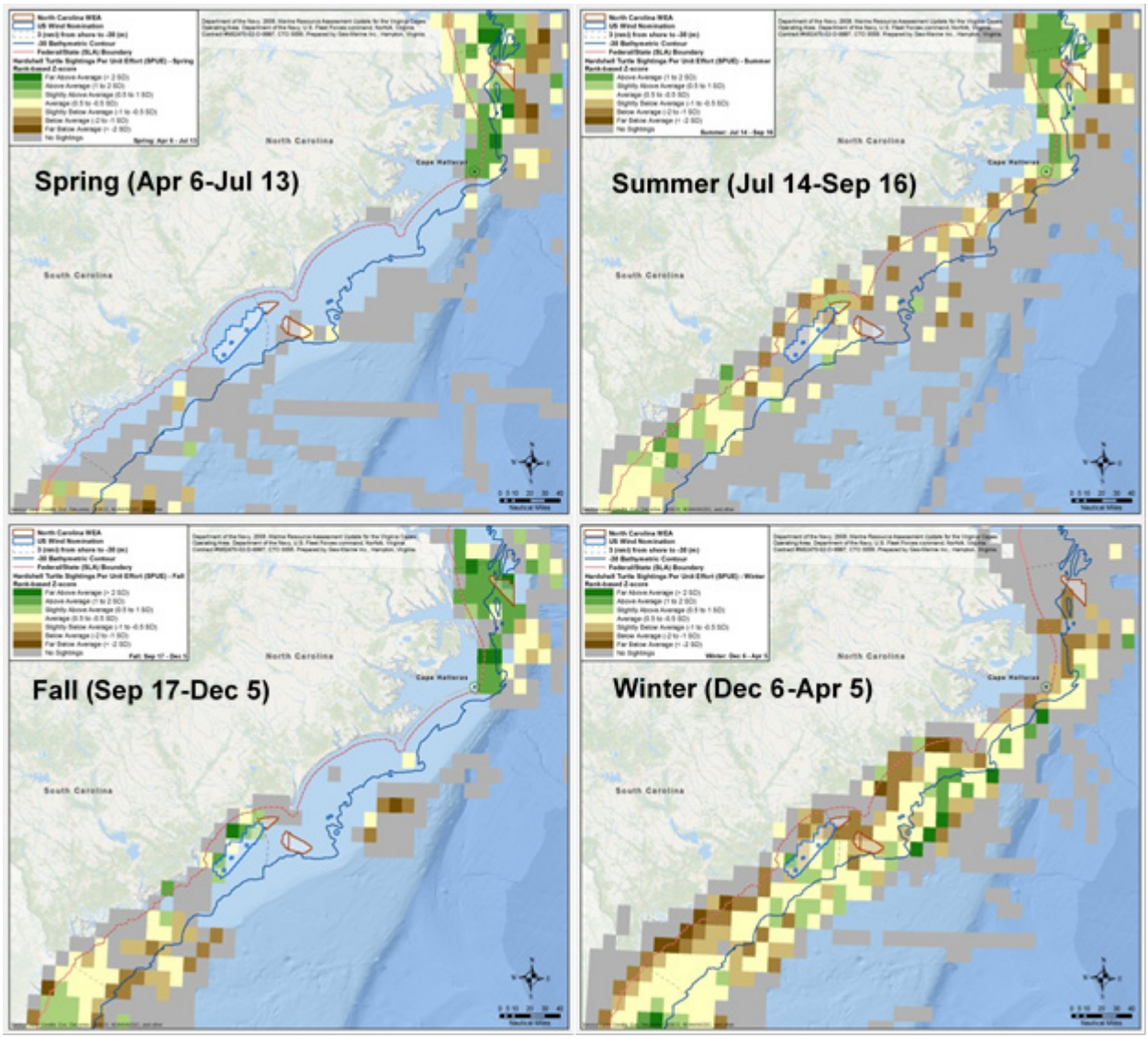

Figure 14. Seasonality of hardshell turtle distribution.

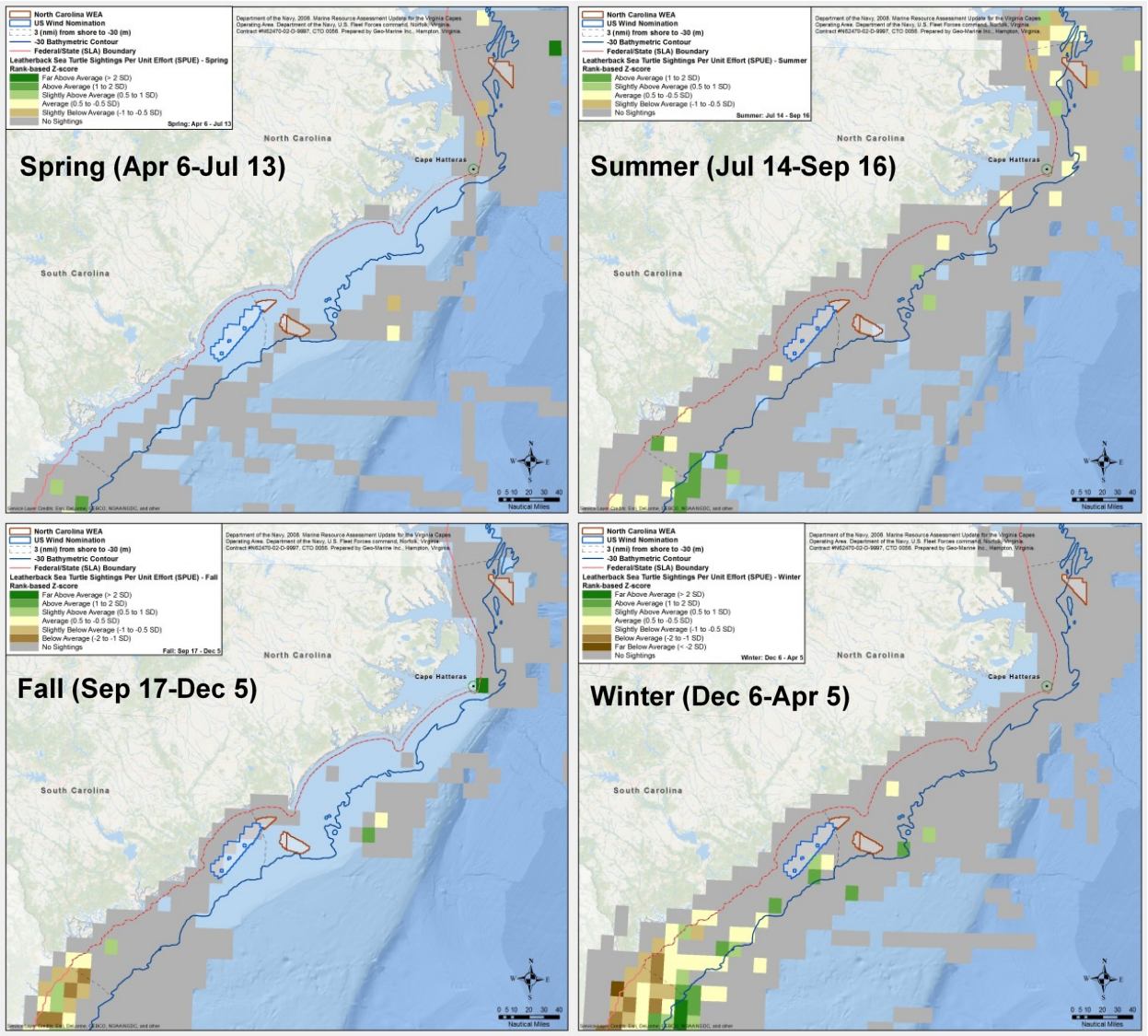

Figure 15. Seasonality of leatherback turtle distribution.

2.3 Flight Planning

2.3.1 Planning

The Shearwater III camera system is integrated with custom flight planning software that allows each survey transect to be accurately mapped out before the aircraft leaves the ground. Each image capture node for both transects and grid surveys are precisely defined, allowing the system to fire the camera exposures at exactly the right location. The planning systems also enable tolerances on flight path along survey lines to be set, automatically aborting survey lines that drift away from the aircraft's planned flight line.

2.3.2 Survey Aircraft

Each survey-specific flight plan will specify the aircraft that will be deployed but the following are requirements for all the aircraft that will be used:

- **Twin engines**: this is essential from a health and safety perspective when flying over sea
- **Survey modified**: a survey hatch through the floor of the aircraft to position the camera systems, so they can look vertically downwards, and an available power supply
- **Slow flying**: aircraft capable of relatively slow flight speed (less than 140 knots) improve image quality due to reduced motion blur
- **Long endurance**: aircraft capable of flying for several hours between refueling stops for survey efficiency
- **Reliable**: aircraft are well maintained from both a health and safety and survey efficiency point of view

The aircraft will be equipped with all necessary safety equipment, which will include but not be limited to

- life raft
- crew located personal location beacons
- life jacket
- aviation offshore immersion suits

We will be using Williams Aviation as our core aircraft provider on this contract. APEM has a long-standing working relationship with Williams that stretches many years. This allows Williams Aviation to have a full understanding of the survey goals and they strive to achieve them. Due to the scale of the project, however, other operators have been identified who meet the above requirements should they be required. Having multiple providers, rather than one company, ensures aircraft availability should one company's aircraft become unavailable.

2.3.3 Weather, Altitude, and Deployment

For the period of each survey, the aircraft will transit and be based out of local airfields close to the survey area, moving up or down the coast on a regular basis to maximize the productive flight time. The most likely airfields used for this will be Elizabeth City (KECG), Coast Carolina (KEWN), Wilmington International (KILM), Myrtle Beach International (KMYR), Charleston International (KCHS) and Beaufort (KNBC), all of which are in close proximity to the coastline.

The survey altitude will be 1,360 ft, selected to optimize areal coverage and minimize interference from cloud cover. However, if required for any reason, the altitude could be increased or decreased slightly with minimal impact to image quality, but the coverage would need to be adjusted. Flying at a higher altitude would likely increase the number of days lost to low cloud cover, however.

Aircraft will fly at a target ground speed of approximately 120 knots to reduce motion blur and ensure a high image quality. The execution (i.e., the order in which the transect lines and grids will be flown) of each flight will take into consideration weather conditions and migratory pathways and may therefore vary for each survey. In addition, the execution may also be affected by other aerial and boat-based surveys being done in the area by AMAPPS as well as by air traffic control restrictions. The survey Team will regularly communicate with other potential survey aircraft/air traffic in the vicinity of the survey area and will inform the appropriate personnel of their plans to be on task.

Surveys will be undertaken in weather conditions that do not limit the ability to identify marine fauna at or near the water surface and following protocols identified in Camphuysen et al. (2004). These target

conditions are cloud base >1,400 ft, visibility >5 km, wind speed <20 knots, and sea state Beaufort 3 (small waves with few whitecaps) or less, aiming for 2 (small waves with no whitecaps) or less to maximize turtle encounters.

In addition, on days with little cloud cover, surveys will avoid mid-day to minimize the risk of collecting images with glint (strong reflected light off the sea) that makes finding and subsequently identifying the marine fauna recorded in the images more difficult. The onboard camera technician will continuously monitor the images collected and if they cease to be of sufficient quality, image acquisition will cease until suitable conditions return. In addition, extra imagery will be collected to replace potentially glint-affected images.

2.4 Contingency Planning and Coordination with Other Survey Teams

Weather windows can be short-lived in south Atlantic waters. The Team has analyzed the weather data in the SASA to determine approximately how many days may have to be cut short or cancelled due to weather and added this to our project planning. The survey window of 17–23 days per survey includes an average of 6 days of delays and/or standby due to weather and other environmental factors that affect image quality and staff safety, such as glare.

Adjustments to survey design for accommodation of weather patterns is to be expected. The team will move to an area with more favorable weather should that be an option. There will always be a preference for surveying contrary to migratory movement patterns, but it is accepted that this might not always be possible.

During the year's survey there will be other observer-based surveys being conducted in the SASA region. These include surveys being done for AMAPPS program. Timothy White from BOEM will provide the Team with intelligence on surveys likely happening in the survey area and the Team's survey timing will be adjusted. It is expected that information pertaining to planned scope and timing of other surveys will be received at least two months ahead of the planned survey. As part of the planning process for each survey, the survey team will be proactively coordinating with key representatives from these groups prior to and during survey times when multiple groups will be in the region. This will be done to ensure safety of all parties but also to ensure that data being collected by each group is not affected by the activities of the other groups.

3 Camera and GPS/GNS Systems

The surveys will be completed using APEM flagship camera system Shearwater III. It has an array of high specification sensors, which can be mounted in a variety of configurations to provide flexible surveying adapted for the needs and conditions of each study. Although the Shearwater III is capable of capturing imagery at 1 cm GSD, operating it at this resolution would significantly reduce the survey footprint without increasing the data quality (i.e., the ability to identify small individuals to species such as piping plover). We have designed the system (including flight altitude) to obtain optimum resolution for species identification while providing cost-effective large image footprints.

Shearwater III will collect an array of still images from vertical (rather than angled) cameras. The imagery will be captured in raw format producing sharper images and allows greater control when applying image corrections such as color and contrast. This ensures that the highest quality images are captured to enable a high rate of species identification. Further to this the shutter speed, aperture, and ISO

are motored in flight by one of APEM's highly experienced technicians to ensure the correct setting is selected for the conditions on the day.

Custom survey planning and management software preprograms the survey transects and grids, an integrated Applanix GNSS and inertial system ensure that surveys are flown as accurately as possible. APEM's GNSS system has a manufacturer quoted unprocessed SPS (Standard Positioning Service) RMS error of 1.5–3.0 meter. The navigational system is calibrated with aircraft control systems and continuously monitored. Image acquisition is automatic, removing human error and ensuring data capture occurs over specified locations. As data capture occurs, GPS data are automatically logged with each exposure including the xyz coordinate and heading of the camera at the point of capture along with line information. It is impossible to fly in a perfect line at constant altitude due to effects of weather and atmospheric pressure on aircraft during flight. Commonly, an aircraft moves up and down 10 to 30 m during surveys of long lines and consequently each captured image is likely to have some deviation from the planned vertical position. Spatial information collected automatically in real time, in particular the z coordinate (camera sensor height), is crucial to aid in species identification which relies partially on organism size and to allow determination of avian flight heights.

4 Survey Staff and Data Management

4.1 Staff

For each survey's flight plan, the staff and aircraft providers will be detailed with applicable contact details of the parties involved. The following are the key staff involved with the planning of the surveys.

- **Ann Pembroke**: Normandeau Project Manager. Overall management of the project and coordination with BOEM and APEM [apembroke@normandeau.com, (603) 637-1169]
- **Julia Robinson Willmott**: Normandeau Task Order Project Manager and overall project co-manager. Supervision of APEM and Normandeau implementation of the Task Order. Oversight of Normandeau image analysis, species identification, project QA/QC and reporting [jwillmott@normandeau.com, (352) 327-3262]
- **Stuart Clough**: APEM Inc. President. Responsible for overseeing the development of the technical survey methodology. Will be available as needed for technical discussions with BOEM and Team [s.clough@apemltd.co.uk, (352) 559-9155, ext. 1351]
- **Stephanie McGovern**: APEM Task Order Project Manager. Day to day management of APEM staff responsible for acquisition, processing, and analysis of the data. Will be responsible for tracking progress of surveys and communicating with BOEM and Team [S.McGovern@apemltd.co.uk, 011 44 1244 520 460]
- **John McCarthy**: APEM Camera and Aviation Task Manager. Responsible for overseeing camera technicians using camera systems, interacting with the aviation provider to oversee ensure that the flight surveys are occurring safely and on time. Also, responsible for providing Flight and Healthy Safety Plan [j.mccarthy@apemltd.co.uk, 011 44 1244 520 460]

4.2 Data Management

When on task each aerial survey will be managed by the APEM camera technician. The camera technician will upload flight plans to the camera system, select which line to capture, adjust the camera exposure settings accordingly and be responsible for in flight Quality Assurance of the captured imagery.

The camera technician will record the progress of the mission using APEM's purpose designed Field Data Sheets (see Appendix C).

Upon completion of each flight, all images acquired will be securely saved and backed up on a local data processing computer at APEM's mobile field office. At this point multiple copies of the data will be created and cross checked. Once relevant checks are completed, one copy of the data will be shipped from the US and downloaded to secure storage servers at APEM's Headquarters in the United Kingdom. A second copy and the survey disks will remain at the mobile field office to ensure data redundancy in the unlikely event of loss of data in transit. On completion of the survey, the data will be backed up to APEM's archiving infrastructure split over two sites.

Management of the data will be overseen by a primary data manager in the US and a secondary data manager in the UK. Appropriate workflows are in place to ensure the rapid transportation and processing of data. Once those data have been processed and screened for potential targets, data will be transferred via FTP to Normandeau. Taxonomic experts at APEM and Normandeau will complete species identification and associated QA/QC of the data.

By the end of the project, the entire library of georectified target images and associated data (both the shapefile showing effort and the associated tabular data) and analyses including all approved reports will be available for download on a dedicated web portal. All data will be added to these databases:

- Northwest Atlantic Seabird Catalog, a publicly held database housed by the USFWS that is the main repository for observations and survey data collected in Atlantic waters from Florida to Maine since 1906
- North Atlantic Right Whale database
- NOAA AMAPPS
- Mid-Atlantic Regional Council on the Ocean (MARCO) Mid-Atlantic Ocean Data Portal

5 References

Camphuysen KJ, Fox AD, Leopold MF, Petersen IK. 2004. Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K.: A comparison of ship and aerial sampling methods for marine birds and their applicability to offshore wind farm assessments. NIOZ report to COWRIE (BAM–02-2002). Texel.

Appendix A: Sample Flight Plan

Sample Flight Plan

Project Number/Name

Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Signature

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Revision and Amendment Register 1
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Aerial Map 5
Google Earth Map 5
Individual Survey Maps 5
Timings 5
Comments and Specific Requirements 5
Survey Window(s) 5
Weather 5

Project Details

Project Name:

Project Code:

Project Survey Areas:

Project Type:

Client:

Project Manager:

Project Description

About Location

Camera Information

The table below details the requirements for completing the Survey when using the _____ camera system.

Transect Survey

Flight Plan Title	
Required mount	
Direction of mount	
Len(s) required	
GSD	
Height ft (AGL)	
Altitude ft (AMSL)	
Transects	
Total number of image points	
Total km	
Total transect time / decimal hours	
Total turn time / decimal hours	
Total task time / decimal hours	

Grid Survey

Flight Plan Title	
Required mount	
Direction of mount	
Len(s) required	
GSD	
Height ft (AGL)	
Altitude ft (AMSL)	
Transects	
Total number of image points	
Total km	
Total transect time / decimal hours	
Total turn time / decimal hours	
Total task time / decimal hours	

Aerial Map

Figure 1 - Survey Area

Google Earth Map

Figure 2 - Survey Area

Individual Survey Maps

Figure 3-

Figure 4-

Timings

Please note all survey timings are in decimal hours. Calculations are worked out assuming the aircraft is flying at ____knots and require ___minutes per turn. This is to ensure a worst case scenario.

Total transect time / decimal hours	
Total turn time / decimal hours	
Total task time / decimal hours	

Table 1 - Total time on survey

Comments and Specific Requirements

If you're likely / required to deviate from the intended survey plan (i.e. it will take longer than instructed), then permission from the project manager must be sought before continuing with survey.

All shipping/boating observations must be completed.

Survey Window(s)

Survey	Dates

Weather

Absolute criteria	Preferred criteria
Visibility:	Visibility:
Cloud Cover:	Cloud Cover:
Wind:	Wind:
Other:	Other:

Note: If unsure please speak to the project manager. The pilot at any time can make the decision to cancel the survey if the weather conditions become dangerous to fly.

Appendix B: Survey Transect Endpoints

Option 1—SASA transects: Complete Saw tooth

Strip number	WGS84 Start	WGS84 End
1	32 03 09.5 / -080 51 20.9	31 47 17.6 / -080 07 20.6
2	32 15 22.6 / -080 36 24.4	31 49 00.9 / -080 06 34.6
3	32 16 13.5 / -080 35 37.8	31 56 14.7 / -079 57 40.5
4	32 28 20.3 / -080 21 20.5	31 57 34.9 / -079 57 12.9
5	32 28 48.4 / -080 20 38.6	32 04 02.0 / -079 44 55.2
6	32 34 27.5 / -080 01 36.0	32 05 03.4 / -079 44 02.6
7	32 34 41.5 / -080 01 14.9	32 14 45.7 / -079 35 47.8
8	32 40 06.9 / -079 52 25.3	32 15 53.0 / -079 35 26.4
9	32 40 44.5 / -079 51 42.3	32 19 56.9 / -079 20 48.1
10	32 44 54.1 / -079 44 39.6	32 21 05.7 / -079 19 43.1
11	32 45 44.1 / -079 43 58.2	32 26 10.6 / -079 14 18.6
12	32 57 17.6 / -079 33 44.4	32 27 25.3 / -079 13 52.1
13	32 58 13.5 / -079 32 48.9	32 33 26.9 / -079 11 23.0
14	33 00 08.1 / -079 20 37.0	32 33 56.1 / -079 10 22.7
15	33 00 50.0 / -079 19 54.2	32 41 27.1 / -078 57 03.0
16	33 17 05.4 / -079 11 06.4	32 43 02.1 / -078 55 46.3
17	33 17 56.9 / -079 09 20.1	32 53 05.5 / -078 43 57.5
18	33 29 40.5 / -079 01 46.4	32 54 46.9 / -078 43 04.2
19	33 30 47.1 / -079 01 06.9	33 02 02.4 / -078 32 01.8
20	33 43 44.0 / -078 49 19.7	33 02 45.7 / -078 29 38.2
21	33 43 41.7 / -078 48 23.9	33 06 40.2 / -078 19 18.3
22	33 51 09.4 / -078 28 14.2	33 11 32.3 / -078 18 02.3
23	33 51 50.1 / -078 26 48.3	33 18 05.3 / -078 02 41.5
24	33 52 24.9 / -078 10 15.8	33 19 00.6 / -077 59 42.4
25	33 52 34.2 / -078 09 20.4	33 17 52.8 / -077 46 03.2
26	33 54 40.9 / -077 59 01.6	33 17 35.3 / -077 44 18.8
27	33 55 28.8 / -077 58 00.5	33 18 34.6 / -077 24 08.7
28	34 02 44.1 / -077 53 43.1	33 19 13.5 / -077 23 26.3
29	34 03 15.8 / -077 53 37.7	33 40 28.8 / -077 23 40.3
30	34 14 49.7 / -077 43 12.3	33 39 32.5 / -077 21 56.8
31	34 15 15.8 / -077 41 50.4	33 53 38.1 / -077 18 07.2
32	34 21 28.2 / -077 34 08.5	33 52 36.5 / -077 12 41.6
33	34 22 57.0 / -077 32 22.6	34 03 39.3 / -077 08 42.4
34	34 33 06.7 / -077 13 35.7	34 04 56.7 / -077 06 00.1
35	34 34 12.3 / -077 10 54.8	34 12 36.0 / -076 48 56.9
36	34 39 47.2 / -076 47 21.5	34 13 58.2 / -076 45 19.1

Strip number	WGS84 Start	WGS84 End
37	34 40 09.2 / -076 46 03.4	34 16 45.2 / -076 25 20.2
38	34 35 46.7 / -076 29 07.6	34 17 02.6 / -076 23 11.7
39	34 37 37.9 / -076 28 18.8	34 18 32.7 / -076 11 27.1
40	34 50 27.4 / -076 15 50.0	34 20 21.1 / -076 09 53.1
41	34 51 54.1 / -076 13 40.8	34 46 19.6 / -075 58 01.8
42	35 04 34.6 / -075 56 50.3	34 46 35.7 / -075 56 13.7
43	35 05 30.6 / -075 53 50.7	34 53 50.5 / -075 42 29.9
44	35 11 24.7 / -075 40 38.8	34 55 02.4 / -075 40 59.8
45	35 11 51.6 / -075 38 49.5	35 04 35.6 / -075 26 37.1
46	35 13 10.4 / -075 31 21.3	35 04 55.1 / -075 24 52.9
47	35 14 50.3 / -075 30 27.3	35 10 59.7 / -075 08 50.1
48	35 20 49.8 / -075 28 58.3	35 12 17.4 / -075 07 48.3
49	35 22 37.4 / -075 28 17.7	35 21 10.1 / -075 05 06.8
50	35 36 30.2 / -075 25 32.1	35 22 27.6 / -075 05 05.4
51	35 39 06.2 / -075 25 59.1	35 45 06.6 / -075 16 06.7
52	35 51 18.1 / -075 32 51.9	35 48 04.4 / -075 16 40.7
53	35 53 00.3 / -075 32 49.2	35 59 23.8 / -075 14 47.5
54	36 05 47.0 / -075 39 30.6	36 00 49.7 / -075 15 11.6
55	36 06 59.5 / -075 40 20.1	36 15 59.3 / -075 18 54.4
56	36 21 48.5 / -075 46 42.4	36 17 25.9 / -075 16 48.5
57	36 23 14.0 / -075 47 05.1	36 29 25.6 / -075 10 40.9
58	36 31 26.8 / -075 50 34.7	36 31 25.4 / -075 10 36.3

Option 2—SASA transects: Cherry Point alternative

Strip number	WGS84 Start	WGS84 End
1	32 03 12.7 / -080 50 43.6	31 46 52.0 / -080 07 11.8
2	32 14 44.2 / -080 36 08.7	31 48 53.8 / -080 06 05.6
3	32 15 28.6 / -080 33 59.9	31 56 16.7 / -079 57 52.3
4	32 25 49.3 / -080 19 12.0	31 57 37.1 / -079 57 17.2
5	32 26 29.3 / -080 17 12.2	32 03 21.9 / -079 44 15.6
6	32 34 20.2 / -080 01 38.3	32 04 23.4 / -079 43 47.4
7	32 34 57.9 / -080 01 05.2	32 14 25.6 / -079 35 26.3
8	32 39 41.8 / -079 51 55.9	32 14 50.4 / -079 34 49.0
9	32 40 13.0 / -079 50 43.3	32 19 45.1 / -079 20 35.5
10	32 45 13.3 / -079 44 53.2	32 21 49.8 / -079 20 27.1
11	32 45 33.2 / -079 43 27.1	32 26 12.5 / -079 14 18.9
12	32 57 07.6 / -079 33 53.6	32 27 33.3 / -079 13 58.1
13	32 57 52.5 / -079 32 46.3	32 33 28.1 / -079 11 13.4
14	33 00 00.1 / -079 20 41.8	32 34 11.7 / -079 10 24.3
15	33 00 41.2 / -079 19 48.6	32 40 47.4 / -078 56 16.2
16	33 17 02.9 / -079 11 22.0	32 43 42.1 / -078 55 49.2
17	33 18 35.3 / -079 09 39.0	32 53 13.1 / -078 43 53.7
18	33 30 01.8 / -079 01 59.3	32 54 29.6 / -078 42 54.6
19	33 30 53.5 / -079 01 04.8	33 01 46.7 / -078 31 25.0
20	33 42 50.8 / -078 48 45.5	33 02 24.6 / -078 29 23.3
21	33 43 18.4 / -078 48 01.1	33 05 44.8 / -078 18 36.1
22	33 51 05.9 / -078 28 22.8	33 11 05.4 / -078 17 58.3
23	33 51 40.9 / -078 26 49.6	33 18 06.9 / -078 02 38.2
24	33 52 47.1 / -078 10 20.6	33 19 02.8 / -077 59 37.2
25	33 52 43.1 / -078 09 22.9	33 17 44.7 / -077 45 49.3
26	33 54 41.5 / -077 58 51.6	33 18 03.5 / -077 44 31.7
27	33 55 12.7 / -077 57 47.5	33 18 29.7 / -077 24 13.5
28	34 02 32.0 / -077 53 37.8	33 19 13.9 / -077 23 29.2
29	34 03 04.0 / -077 53 07.7	33 40 35.2 / -077 23 48.6
30	34 15 28.0 / -077 43 13.2	33 40 16.3 / -077 22 22.1
31	34 15 52.1 / -077 42 16.1	33 53 31.4 / -077 17 34.7
32	34 22 22.4 / -077 34 51.4	33 53 02.4 / -077 13 05.9
33	34 23 31.6 / -077 32 57.1	34 03 59.4 / -077 08 45.6
34	34 34 24.8 / -077 13 54.2	34 05 08.4 / -077 06 21.2
35	34 35 39.5 / -077 12 06.7	34 12 01.1 / -076 48 49.3
36	34 40 35.4 / -076 47 32.7	34 12 42.9 / -076 46 09.6
37	34 40 30.3 / -076 45 49.0	34 16 28.7 / -076 22 25.2
38	34 36 51.7 / -076 27 31.2	34 17 30.9 / -076 18 07.1
39	34 36 18.6 / -076 21 10.8	34 51 05.4 / -076 05 24.3

Strip number	WGS84 Start	WGS84 End
40	34 43 42.6 / -076 00 00.4	35 04 13.9 / -075 57 01.3
41	35 05 38.6 / -075 53 51.6	34 53 45.2 / -075 42 37.1
42	35 11 19.7 / -075 40 31.6	34 55 18.8 / -075 40 54.0
43	35 11 47.2 / -075 38 29.4	35 04 40.4 / -075 27 03.1
44	35 12 47.8 / -075 31 35.9	35 04 47.9 / -075 24 47.3
45	35 14 42.4 / -075 30 07.9	35 11 04.0 / -075 08 49.8
46	35 20 33.4 / -075 28 23.6	35 12 41.5 / -075 08 26.5
47	35 22 44.8 / -075 28 14.6	35 21 05.5 / -075 04 56.1
48	35 36 34.0 / -075 25 47.5	35 22 32.2 / -075 05 20.0
49	35 39 27.1 / -075 26 09.0	35 44 55.7 / -075 16 36.9
50	35 51 15.6 / -075 32 18.5	35 48 20.2 / -075 16 38.0
51	35 53 15.7 / -075 32 44.5	35 59 13.0 / -075 14 38.8
52	36 05 58.9 / -075 39 28.5	36 00 53.3 / -075 15 03.0
53	36 07 12.5 / -075 40 02.0	36 15 54.9 / -075 19 04.8
54	36 21 47.8 / -075 47 03.1	36 17 11.6 / -075 16 09.5
55	36 23 13.9 / -075 47 13.5	36 29 33.5 / -075 10 55.9
56	36 31 22.4 / -075 50 03.4	36 31 32.0 / -075 10 44.8

Grand Strand Call Area and Wilmington West WEA

Strip number	WGS84 Start	WGS84 End
1	33 23 53.6 / -078 51 42.3	33 29 36.9 / -078 45 38.1
2	33 21 59.0 / -078 51 47.2	33 39 44.9 / -078 32 53.0
3	33 11 07.8 / -079 01 18.8	33 39 43.7 / -078 30 57.1
4	33 09 15.8 / -079 01 20.7	33 45 24.4 / -078 22 54.5
5	33 07 31.8 / -079 01 14.2	33 45 59.8 / -078 20 19.0
6	33 06 40.8 / -079 00 12.0	33 45 58.4 / -078 18 23.1
7	33 06 10.9 / -078 58 47.5	33 46 33.7 / -078 15 47.6
8	33 04 53.3 / -078 58 13.2	33 46 29.5 / -078 13 54.5
9	33 04 02.2 / -078 57 11.1	33 46 27.9 / -078 11 58.6
10	33 03 32.3 / -078 55 46.7	33 46 26.3 / -078 10 02.7
11	33 02 33.3 / -078 54 53.0	33 45 58.4 / -078 08 35.1
12	33 01 47.4 / -078 53 45.4	33 45 06.9 / -078 07 33.0
13	33 01 33.3 / -078 52 04.3	33 28 42.8 / -078 23 13.5

Wilmington East WEA

Strip number	WGS84 Start	WGS84 End
1	33 37 13.9 / -078 03 02.5	33 25 59.6 / -077 40 25.9
2	33 36 18.2 / -078 04 01.4	33 24 35.2 / -077 40 27.0
3	33 35 17.2 / -078 04 49.4	33 23 30.7 / -077 41 08.0
4	33 34 17.9 / -078 05 41.0	33 22 33.4 / -077 42 03.3
5	33 33 06.1 / -078 06 07.1	33 21 54.2 / -077 43 34.9
6	33 31 43.5 / -078 06 11.5	33 21 00.5 / -077 44 37.5
7	33 30 29.9 / -078 06 34.0	33 20 19.4 / -077 46 05.4
8	33 29 19.9 / -078 07 03.8	33 20 05.4 / -077 48 27.5
9	33 27 55.4 / -078 07 04.5	33 20 02.2 / -077 51 11.4
10	33 25 24.6 / -078 04 51.0	33 21 12.8 / -077 56 23.6

Kitty Hawk WEA

Strip number	WGS84 Start	WGS84 End
1	36 26 23.9 / -075 21 40.9	36 07 34.2 / -074 59 28.4
2	36 28 10.6 / -075 21 42.2	36 08 29.6 / -074 58 29.2
3	36 29 16.4 / -075 20 55.1	36 10 11.1 / -074 58 24.0
4	36 30 01.8 / -075 19 43.7	36 11 57.8 / -074 58 24.8
5	36 30 01.3 / -075 17 37.9	36 13 44.5 / -074 58 25.6
6	36 27 27.4 / -075 12 30.5	36 15 28.6 / -074 58 23.4
7	36 27 26.7 / -075 10 24.7	36 17 15.2 / -074 58 24.2
8	36 27 26.0 / -075 08 19.0	36 19 01.9 / -074 58 25.0
9	36 27 27.8 / -075 06 16.1	36 20 48.6 / -074 58 25.8
10	36 27 27.1 / -075 04 10.4	36 22 32.7 / -074 58 23.7

Appendix C: Sample Field Data Sheets

Project Name	
Project Number	
Project Manager	

Dates	
Page 1 of	

Aircraft	
Survey team	
Camera	
Lenses	
Altitude	
Required GSD	

Survey checks	
Confirm current flightplan	
Confirm survey altitude	
Correct Lenses fitted	
Confirm lens focus	
Clean lenses before take off	

Survey comments and issues

End of Day Line Check	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		

Quality control and survey feedback (Office use only)

Image Check		Flight Plan Check		Line Check		Glint Check		

Please scan to file once survey is complete: Y:\Admin\Aircraft Admin\Survey Records\Survey Tech Records

A.S.T. signature and date		Q.C. Signature and date	

Project Name	
Project Number	
Media number	

Dates

Page
of

Run	Line	Bearing	GS (kts)	Time on Line	Time off Line	Sun Angle	GPS	Image Quality	Missing Images	Ship	Notes	Line complete
1		°	kt	:	:	°						
2		°	kt	:	:	°						
3		°	kt	:	:	°						
4		°	kt	:	:	°						
5		°	kt	:	:	°						
6		°	kt	:	:	°						
7		°	kt	:	:	°						
8		°	kt	:	:	°						
9		°	kt	:	:	°						
10		°	kt	:	:	°						
11		°	kt	:	:	°						
12		°	kt	:	:	°						
13		°	kt	:	:	°						
14		°	kt	:	:	°						
15		°	kt	:	:	°						
16		°	kt	:	:	°						
17		°	kt	:	:	°						
18		°	kt	:	:	°						
19		°	kt	:	:	°						
20		°	kt	:	:	°						
21		°	kt	:	:	°						
22		°	kt	:	:	°						
23		°	kt	:	:	°						
24		°	kt	:	:	°						
25		°	kt	:	:	°						

Comments/Issues

Project Name:
Project Number:

Date:

Time Local	Boat Type	Degree, Decimal Minute	Degree, Decimal Minute	Bearing

OFFSHORE WEATHER REPORT

TIME	CLOUD COVER (%)			VISABILITY (KM)			OUTSIDE AIR TEMP (^{O}C)			PRESSURE (QNH)			WIND SPEED AND DIRECTION (KTS + ^{O})			SEA STATE (0 - 4)		
	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE
0600-0800																		
0800-1000																		
1000-1200																		
1200-1400																		
1400-1600																		
1600-1800																		
1800-2000																		
2000-2200																		

CLOUD COVER	
0-10%	CLEAR
11-50%	SCATTERED
51-94%	BROKEN
95%-100%	OVERCAST

SEA STATE	
0	CALM (GLASS)
1	CALM (RIPPLED)
2	SMOOTH
3	SLIGHT
4	MODERATE

COMMENTS OR SUGGESTED IMPROVEMENTS



Department of the Interior (DOI)

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

BOEM
Bureau of Ocean Energy Management

Bureau of Ocean Energy Management (BOEM)

The mission of the Bureau of Ocean Energy Management is to manage development of US Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

BOEM Environmental Studies Program

The mission of the Environmental Studies Program is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments. The proposal, selection, research, review, collaboration, production, and dissemination of each of BOEM's Environmental Studies follows the DOI Code of Scientific and Scholarly Conduct, in support of a culture of scientific and professional integrity, as set out in the DOI Departmental Manual (305 DM 3).

Department of the Interior (DOI)

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