CHAPTER

4

MARINE MAMMALS AND SEA TURTLES

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Introduction

Marine mammals and sea turtles serve a number of important functions in the South Atlantic Bight ecosystem. They are pelagic and, in many cases, are highly migratory or wide-ranging. They serve as vital components of marine food webs as predators, planktivores, or herbivores, and are important conduits for the movement of carbon and nutrients between coastal habitats and the open ocean. These "charismatic megafauna" draw public attention, helping to educate people about the importance of our oceans to life on earth. In many cases, the marine mammal and sea turtle species occurring in the SAB region are endangered, threatened or vulnerable and require a concerted effort by humans to ensure their persistence into the future. A consequence of the large geographic ranges of many of these species is frequent opportunity to interact with humans. These interactions can include exposure to ship and boat traffic, fishing gear (active and derelict) and pollution (including marine debris), underwater noise, and the effects of climate change, which all may pose serious threats to these sensitive populations.

Three sub-groups of marine mammals are found in the South Atlantic Bight study area: cetaceans, sirenians and pinnipeds. Cetaceans are the sub-group of marine mammals that includes whales, dolphins, and porpoises. Many species of cetaceans undertake extensive migrations and exhibit very large geographic ranges, often encompassing one hundred thousand square miles or more in an individual's lifetime. Smaller cetacean species found in the study area, including dolphins and porpoises, generally have smaller ranges. Only one sirenian (the group that includes manatees and dugongs) inhabits the study area: the Florida manatee (*Trichechus manatus latirostris*), a sub-species of the West Indian manatee. Although manatees' ranges are generally not as extensive as other marine mammal species in the study area, they can travel

hundreds of miles in search of warm water habitat and food resources. Four species of pinnipeds (seals and sea lions) are also known to occur in the SAB region.
Sea turtles are also an important component of north Atlantic coastal and ocean ecosystems because they are highly migratory, long-lived, slow growing, and utilize a diverse array of oceanic, neritic, and terrestrial environments. For these reasons, sea turtles present a unique conservation challenge. While they have been the focus of a multitude of international treaties and conventions, national laws, and regulatory protection strategies, there is still a clear need for greater understanding of their temporal and spatial distribution and migratory patterns, degree and relevance of threat sources on all life stages, and population trend analyses via international monitoring and research efforts. Five sea turtle species were chosen for inclusion in this analysis.

Distribution information on marine mammals and sea turtles is challenging to collect due to the broad geographic areas frequented by these species and the expense of data collection. In addition, these animals spend significant portions of their lives below the surface, and some of them are relatively small compared to the survey techniques used to detect them. Although the distribution information presented in this report is imperfect and likely underestimates the number of places where these species are found, it is based on the best information available. The mapped information presented in this analysis is only appropriate for decision making at the regional or state level and should not be used for making decisions at the 10-minute or 100-minute scale.

Box 4.1. Marine Mammals and Sea Turtles Technical Team Members

The Marine Mammal Technical Team was comprised of internal and external resource experts who helped identify and categorize target species, validate analyses and review the chapter.

Melissa Clark, The Nature Conservancy, Eastern Division
Mary Conley, The Nature Conservancy, South Atlantic Marine Program
Mark Dodd, Georgia Department of Natural Resources
Clay George, Georgia Department of Natural Resources
Laura Geselbracht, The Nature Conservancy, Florida Chapter
Jennifer Greene, The Nature Conservancy, North America Region
Robert Newton, The Nature Conservancy, South Atlantic Marine Program
Mark Swingle, Virginia Aquarium & Marine Science Center

Selection of Target Species

Technical team members worked together to identify the target marine mammal and sea turtle species to be included in this assessment as well as the most appropriate data sources and approaches for documentation and analysis. Several factors were considered when selecting the target species, including population status (threatened and endangered species are all included), distribution in the region, and data availability. The home ranges of the species included in this assessment extend through part or all of the region (and in many cases well beyond), from the inland to offshore waters of the South Atlantic Bight region. The list of target species is far from a comprehensive list of marine mammals and sea turtle species that occur in the region; for a complete list see Appendix 3. The target species included in this assessment are as follows:

Sea Cows

- Florida manatee *(Trichechus manatus latirostris)*

Baleen Whales

- Fin whale (*Balaenoptera physalus*)
- Humpback whale (*Megaptera novaeangliae*)
- North Atlantic right whale (*Eubalaena glacialis*)

Toothed Whales

- Beaked whales (family Ziphiidae)
- Bottlenose dolphin (*Tursiops truncatus*)
- Oceanic dolphins (genus *Stenella*)
- Common dolphin (*Delphinus delphis*)
- Pilot whales (long-finned pilot whale, *Globicephala melas* and short-finned pilot whale, *Globicephala macrorhynchus*)
- Risso's dolphin (*Grampus griseus*)
- Sperm Whale (*Physeter macrocephalus*)

Sea Turtles

- Loggerhead turtle (*Caretta caretta*)
- Green turtle (*Chelonia mydas*)
- Leatherback turtle (*Dermochelys coriacea*)
- Hawksbill turtle (*Eretmochelys imbricata)*
- Kemp's ridley turtle (*Lepidochelys kempii*)

Appendix 4 summarizes the current understanding of the biology of each of the target species and groups listed above.

Population Status of Target Species

Populations of the target mammal and turtle species addressed in this chapter are threatened in some way; for many, their populations are protected by federal and even international recognition of their status. The fin, humpback, North Atlantic right, sei, and sperm whales and the Florida manatee are listed as endangered by the U.S. Endangered Species Act. The IUCN Red List documents the fin and North Atlantic right whales and the Florida manatee as endangered, the sperm whale as vulnerable, and the humpback whale and common, bottlenose, Risso's, and oceanic dolphins as species of least concern (IUCN 2014). Due to limited data, a determination of the population status of many target species is not yet available. The majority of existing data are derived from marine mammal aerial and ship surveys, with a large portion of the data consisting of a low abundance or single occurrence sightings.

The North Atlantic right whale is a species of particular concern in this region. It is considered to be one of the most critically endangered large whales in the world and could be facing extinction (Clapham and Mead 1999; Kenney 2002). Recent observations offer some encouragement. Based on 2010 observations, the western North Atlantic right whale stock was estimated to be at a minimum 455 individuals and an examination of the minimum number alive population index over the previous 10-year period revealed an increasing population trend of 2.8% (geometric mean growth rate; Waring et al. 2014).

In the United States, all five sea turtle target species are federally listed as endangered or threatened. Leatherback, hawksbill and Kemp's ridley sea turtles are considered endangered throughout their ranges; the loggerhead is considered threatened in the SAB region and either threatened or endangered in other parts of the world; green sea turtles are considered threatened except for breeding populations in Florida and on the Pacific coast of Mexico which are considered endangered. According to the International Union for Conservation of Nature (IUCN) Red List (IUCN 2014), both the loggerhead and green turtles are categorized as endangered while the leatherback turtle is considered vulnerable (Wallace et al. 2013; Seminoff 2004). The hawksbill sea turtle is categorized as critically endangered as a result of declines at index monitoring sites in all major ocean basins. All of these species are protected against international trade (CITES 1973).

Importance of U.S. South Atlantic Bight Waters to Target Species

Marine mammals targeted by this assessment use the waters of the U.S. South Atlantic for a variety of purposes including feeding, breeding, nursing and migration. Most of the baleen species found in the region breed either outside of the area or their breeding location is unknown (Jonsgård 1966). The North Atlantic right whale uses the area offshore of Georgia and North Florida as calving grounds (NMFS 2006a). Some of the small toothed whales and the Florida manatee are known to use the region for breeding, calving, nursing and feeding (Haubold et al. 2006; Sargent et al. 1995; Waring et al. 2003). Dolphins (*Stenella* spp. and *Tursiops truncatus*) are by far the most numerous marine mammals found in the study area (Department of Navy 2008). Unlike the other species of marine mammals found in the region, the primary range of the Florida manatee is Florida coastal waters with some migration north of the state in the summer months (Fertl et al. 2005; Powell and Rathbun 1984; Rathbun et al. 1982).

Sea turtle species also use the SAB region at a variety of ecological stages; for some species, the SAB population represents a significant proportion of the species' overall population. One of the two primary global loggerhead nesting aggregations with greater than 10,000 nesting females per year is in South Florida (the other is in Masirah, Oman, on the Arabian Sea; Baldwin et al. 2003; NMFS USFWS 2008). A comprehensive three-year study of the distribution of loggerheads in the Northwest Atlantic estimated that the total summer loggerhead population was between 2,200 and 11,000 individuals (Shoop and Kenney 1992). More recent studies in Virginia coastal waters documented up to 10,000 loggerheads in Chesapeake Bay and tens of thousands in ocean waters (spring estimate > 60,000; Swingle 2014). In the SAB region, the most loggerhead nesting is concentrated along the coast from southern Virginia to Florida (Conant et al. 2009). Over the past decade, estimates for U.S. nesting aggregations have fluctuated between 47,000 and 90,000 nests per year, with 80% of nesting occurring in eastern Florida (NMFS USFWS 2008). While loggerhead nesting in Florida has been cyclical over the 25-year observation period, over the most recent 15-year period (1998 to 2013) no demonstrable trend has been observed (FWC, FWRI 2014c).

Despite the global decline of green turtles over the past 150 years, in the IUCN's Western Atlantic Ocean and Caribbean Region, representing approximately 30% of the overall global population of nesting females, all but one of the subpopulation index sites (Venezuela, Aves Island) witnessed increases including the United States (Florida). In the SAB region nesting primarily occurs in Florida, where green turtle nest counts have increased approximately one hundredfold since counts began in 1989 (n = 267). The most dramatic growth occurred in 2013 (n=25,553) when the nest count was more than twice that of the next highest year (FWC, FWRI 2014b).

Leatherback population decreases and collapse have been documented in major nesting areas in the Pacific region. The most recent global assessment of leatherback turtle nests estimated a 40% decline over the past three generations (approximately 90 years) from 90,560 to 54,260 nests in 2010. However, the assessment also predicts that global population will increase in the future (3% by 2030 and 104% by 2040), primarily because of increasing populations in the Northwest Atlantic region. Shoop and Kenney (1992) estimated that the total summer population of leatherbacks in the Northwest Atlantic was between 100 and 900 individuals. A more recent study of nesting leatherbacks conducted in 2004 - 2005 estimated the Florida stock (nesting stock in the SAB area) of adult leatherbacks to be between 320 and 920 individuals (5^{th} to 95^{th} percentile; TEWG 2007). In the SAB region, nesting is limited to Florida where standardized counts suggest that the population has been increasing between 1989, when the nest count was 27, and 2013, when 896 nests were counted (FWC, FWRI 2014b).

Globally, the hawksbill turtle has experienced an extensive population decline, estimated at 80% over the past three generations (approximately 105 to 135 years). Declines have been observed for all subpopulations in all major ocean basins. Numerous populations, especially some of the larger ones, have continued to decline since the last assessment of the species (Meylan and Donnelly 1999), however, some protected populations are stable or increasing. In the SAB region, the hawksbill turtle nests only rarely. During the period 1979 to 1992, 0 to 2 hawksbill nests were recorded annually (Meylan et al. 1995). More recently, 4 nests were observed during the years 2009 to 2013 on one Florida Keys beach (FWC, FWRI 2014b). These observations are likely an underestimate because females in the process of laying eggs have rarely been encountered and tracks left in the sand resemble loggerhead tracks, hatchlings are difficult to distinguish from loggerhead hatchlings, and some nesting takes place beyond the standard monitoring period.

Kemp's ridley turtles are distributed throughout the Gulf of Mexico and along the U.S. Atlantic coast from Florida to New England (NOAA 2014a). This species is highly vulnerable due to the manner in which it nests and the very limited geographic range of its primary nesting population. The Kemp’s ridley nests in arribadas, or large nesting aggregations, the main locations of which are three beaches in the Tamaulipas state of Mexico. Since the 1940s, the Kemp's ridley has experienced a dramatic population decline. At an arribada video-taped in 1947, turtles created an estimated 42,000 nests in a single day. Between 1978 and 1991, only about 200 Kemp's ridleys nested annually. In recent years, the Kemp’s ridley has seemed to be in the early stages of recovery. In the SAB region, the Kemp’s ridley turtle only rarely nests. During the period 2009 to 2013, one to three Kemp’s ridley nests were observed on 22 Florida index beaches, five of which were on the Atlantic Coast (FWC, FWRI 2014b). Rare nesting has also been documented in Virginia, North Carolina, South Carolina and Georgia (Georgia Conservancy 2012; Hampton Roads 2012; NOAA 2014a).

Ecosystem Interactions and Ecological Dependencies

Relationships between marine mammals and sea turtles and their environment are complex and can vary by ecosystem. The sections below review the current state of our knowledge of these complex interactions.

Marine Mammals

While the exact ecological function of marine mammals is not fully known, insights into their role in the marine ecosystem have emerged through large-scale studies of species-ecosystem interactions and community structure (Bowen 1997; Haubold et al. 2006). Katona and Whitehead (1988) hypothesized that marine mammals could play a major role in determining the behavior and life history traits of their prey species, affecting nutrient storage and cycling and altering benthic habitats. Further information about the ecological role of each group of marine mammals is provided below.

CETACEANS

As predators, cetaceans are major consumers at most trophic levels, specifically feeding on zooplankton, invertebrates, and forage fish in the region. Mysticetes (baleen whales), including fin, humpback, minke, right, and sei whales, are migrating animals that move (in the case of the Northwest Atlantic stocks) from northern feeding grounds in the summer to warmer waters in the fall and winter to breed and reproduce (Jonsgård 1966; Garrison 2007). They typically forage for pelagic prey, consuming large quantities at one time, including zooplankton (e.g., copepods), euphausiids (e.g., krill), and small fish (e.g., sand lance, herring, mackerel) (Nemoto 1959; Jonsgård 1966; Mitchell 1975; Kawamura 1982; Mizroch et al. 1984; Kenney et al. 1985; Haug et al. 1995; Flinn et al. 2002; Perrin and Brownell 2002). Some baleen species like sei and right whales are dependent on euphausiids and copepods when feeding in the North Atlantic, while other species are less selective in their diet (Nemoto 1959; Kraus et al. 1988).

Odontocetes (toothed whales) typically prefer larger prey than baleen whales, consuming individual organisms, and typically feed at higher trophic levels (Pauly et al. 1998). Unlike the mysticetes, not all odontocetes are migrating animals, and they feed year-round (Lockyer and Brown 1981). Primary food sources for toothed whales are cephalopods (e.g., small and large squid), small fish (e.g., smelt, herring, mackerel), and demersal fish (e.g., cod, skate) (Smith and Whitehead 2000; Archer 2002; Sergeant et al. 1980; Katona and Whitehead 1988). For members of this suborder that migrate seasonally, food availability appears to be a driver of this behavior (Irvine et al. 1981) but migrations do not exhibit a consistent pattern as seen in the mysticetes (Lockyer and Brown 1981). Some of the smaller odontocetes, in particular estuarine stocks of the bottlenose dolphin, have strong site fidelity with no observed migration (Odell and Asper 1990; Caldwell 2001; Grubbins 2002; Zolman 2002; Mazzoil et al. 2005;

Speakman et al. 2006; Mazzoil et al. 2008). The lack of migration may be because some species are able to employ a variety of feeding techniques and rely on a number of prey items (Leatherwood 1975). Within the boundaries of the study area both baleen and toothed whales have few predators, which include large sharks, killer whales, and potentially, false killer whales (Perry et al. 1999; Heithaus 2001; Perrin and Brownell 2002; Horwood 2002; Swingle 2014).

SIRENIANS, THE FLORIDA MANATEE

The only sirenian found in the SAB region is the Florida manatee, an herbivore that feeds on a variety of vegetation types including seagrass in shallow marine areas, floating and emergent vegetation, and vegetation along banks (Haubold et al. 2006). Macroherbivores can have a profound effect on the distribution and productivity of the vegetation they feed on, on other grazers and fauna associated with the plants they feed on, and on chemical and decompositional processes occurring within their feeding areas (Thayer et al. 1984). The Florida manatee is found in a variety of coastal aquatic habitats from freshwater canals in highly urbanized areas to coastal lagoons, estuaries, and shallow seagrass and coral reef areas in marine waters (Smith 1993). It migrates seasonally hundreds of kilometers between a warm-season range and a cold-season range; great variability in movement patterns has been described (Deutsch et al. 2003). A small percent (approximately 12% in one study) of Florida manatees do not migrate, but rather stay year-round in a relatively small area (< 50 km (31 miles); Deutsch et al. 2003). Manatees are sensitive to cold water (< 20°C; 68°F) and seek warm water refugia in the winter months (Haubold et al. 2006).

Sea turtles

The sea turtles occurring in the SAB region are highly migratory and use a wide range of habitats during their lifetimes (Seminoff 2004). Their diets vary by species, life stage and habitat zone (i.e., oceanic, neritic). During the loggerhead's post-hatchling transition stage, individuals hatched on U.S. beaches migrate offshore and become associated with floating *Sargassum*, driftlines, and other convergence zones (Carr 1986; Witherington 2002). During this period, they forage on organisms associated with the *Sargassum* including hydroids, copepods, coelenterates and salps (Witherington 2002; Bjorndal 1997, 2003). As juveniles transition from oceanic to neritic habitats, diets become more diverse and shift according to season and geographic position. In the North Atlantic, neritic stage adults forage primarily on mollusks and benthic crabs. The diet of oceanic stage adults is currently unknown (NMFS USFWS 2008).

Only limited information is available on green turtle ecosystem interactions during the juvenile oceanic stage. Evidence suggests that hatchlings from disparate natal sites outside of the Caribbean enter the North Atlantic gyre and form mixed stock feeding aggregations in the Eastern Caribbean before returning to feeding areas closer to their natal rookeries (Luke et al. 2004). Upon recruitment back to coastal areas, neritic juveniles subsist primarily on seagrasses and marine algae (NMFS USFWS 2007a). The availability of food items within coastal foraging areas may vary seasonally and interannually. The diet of migratory oceanic adults is currently unknown.

Leatherbacks forage primarily on pelagic gelatinous organisms including jellyfish (medusae), siphonophores, and salps in temperate and boreal latitudes (NMFS USFWS 1992, 2007b). They are also known to eat crustaceans, vertebrates, and plants (Eckert et al. 2012; Dodge et al. 2011; Jones and Seminoff 2013). Surface feeding is the most commonly observed foraging habit for leatherbacks, but dive data indicate that they may forage throughout the water column. Based on satellite telemetry and stable isotope studies, leatherbacks appear to associate with highly productive ecosystems and have been observed transiting low productivity areas at high speed until they reach more productive foraging areas (Fossette et al. 2010).

As juveniles, hawksbill turtles may forage in coral reefs or other hard bottom habitats, seagrass, algal beds, mangroves (Musick and Limpus 1997) or mud flats (R. von Brandis unpubl. data as reported in Mortimer and Donnelly 2008). These foraging habitats may be located hundreds or thousands of kilometers away from natal beaches. Hawksbills are known to be an important component of healthy coral reef ecosystems. In the Caribbean (SABMA area), they may support coral reef health by controlling sponges, their primary local food source (Hill 1998; Meylan 1988; León and Bjorndal 2002; Bjorndal and Jackson 2003).

Kemp's ridley turtles may have limited ecological significance in the SAB region due to their current population size. Adults are found in neritic habitats with muddy or sandy bottoms. Their diet consists mainly of swimming crabs, but may also include fish, jellyfish, and an array of mollusks (NOAA Fisheries 2014b). Little is known of the feeding habitats of the juvenile, oceanic stage.

U.S. South Atlantic Distribution and Important Areas

Methods

In-water Distribution – Sighting per Unit Effort (SPUE) Model

Two effort-corrected methods of observation have been used over the past several decades to estimate where cetaceans and sea turtles are distributed in offshore areas: shipboard and aerial surveys. Correcting observations for effort is essential to minimize the bias that would otherwise result for heavily surveyed areas. While opportunistic sightings of cetaceans and sea turtles in the SAB region have been recorded for over one hundred years, this information is less valuable for improving our understanding of cetacean and sea turtle distribution in the study area. Consequently, we have focused our analysis on data sets that are corrected for effort (see below for more detail about how data are corrected for effort). The most complete source for this information in the SAB region is the data collected, assembled, and processed by the U.S. Navy for the Charleston/Jacksonville Marine Resource Assessment (Department of Navy 2008). Geospatial analyses of cetacean and sea turtle sightings were obtained from the U.S. Navy (see Department of Navy 2008). These analyses were completed for the Navy's Marine Resource Assessments (MRA), a program used to develop comprehensive data and literature concerning protected and managed marine resources found in Navy operating areas for use in environmental and biological assessments prepared in accordance with various federal laws (e.g., Marine Mammal Protection Act, National Environmental Policy Act). Data were from the Navy's Charleston/Jacksonville MRA study region, which covers only the northern portion of the SABMA study area, extending south to waters just north of the Indian and Banana River Complex, Florida. Data for areas south of the Charleston/Jacksonville MRA study area were not available for this analysis.

The sightings used in the Navy's analysis were taken from National Marine Fisheries Service-Southeast Fisheries Science Center (NMFS-SEFSC) aerial surveys, NMFS-SEFSC shipboard surveys, and the North Atlantic Right Whale Consortium database (See Table 4.1 for a complete listing). The surveys used covered the years 1978 – 2005. Data used in these analyses were primarily collected via aerial and shipboard surveys during daylight hours, weather permitting. The data were provided in a seasonal format where the seasons covered the following dates: winter, December 6 – April 5; spring, April 6 – July 13; summer, July 14 – Sept 16; and fall, September 17 – December 5.

Table 4.1. Sources for marine mammal and sea turtle data (Department of Navy 2008)

Shipboard Sighting Surveys	DATA YEAR(S)
NMFS-SEFSC R/V Oregon II Cruise 92-01 (198) 1992	1992
NMFS-SEFSC R/V Relentless Cruise 98-01 (003) 1998	1998
NMFS-SEFSC R/V Oregon II Cruise 99-05 (236) 1999	1999
NMFS-SEFSC R/V Gordon Gunter Cruise GU-02-01 (021) 2002	2002
NMFS-SEFSC R/V Gordon Gunter Cruise GU-04-03 (028) 2004	2004
NMFS-SEFSC R/V Gordon Gunter Cruise GU-05-03 (062) 2005	2005
CETAP Shipboard Survey 1978-1982	1978 - 1982
Aerial Sighting Surveys	
DoN-Continental Shelf and Associates, Inc. (CSA)	1996-1999
DoN SEAWOLF Mayport Shock Trial	1995, 1997
DoN Winston S. Churchill Shock Trial	1999
NMFS-SEFSC Southeast Cetacean Aerial Surveys (SECAS)	1992, 1995
New England Aquarium (NEA) (pre-Early Warning System [EWS])	1984 - 1993
New England Aquarium (NEA) (EWS)	1993-2005
New England Aquarium (NEA) Core of Engineers (COE)	1989-1993
Georgia Department of Natural Resources (GADNR) (EWS)	1993-2002
Florida Marine Research Institute (FMRI) (EWS)	1992-2005
Associated Scientists at Woods Hole Oceanographic Institution (ASWHOI) Airship (blimp) Survey	1991-1993
CETAP Aerial Survey	1978-1982
Offshore Surveys (GADNR and FMRI)	1996-2002
University of North Carolina at Wilmington (UNCW) Aerial Survey (EWS)	2001-2002
University of Rhode Island (URI) Aerial Survey	1987
Wildlife Trust (WLT) Aerial Survey (EWS)	2002-2005

One issue with interpreting marine mammal and sea turtle data is the bias introduced by uneven survey coverage or "effort." For example, an area may have few sightings because of the absence of a given species or there just may be little survey effort in that location. Figure 4.1 illustrates the seasonal survey effort for the surveys used in this analysis (exception is the North Atlantic right whale). A standard approach to overcoming this bias is using effort-corrected sightings data (Kenney and Winn 1986; Shoop and Kenney 1992). Calculating sightings per unit effort, or SPUE, an index of relative density, allows for comparison of data spatially and temporally within a study area (Shoop and Kenney 1992). SPUE is calculated as:

SPUE = 1000*(number of animals sighted)/effort

Geospatial analysis obtained from the U.S. Navy included shapefiles of valid cetacean and sea turtle sightings and pre-calculated effort grids for each season. The validity of sightings was carefully screened and verified by Navy contractors before inclusion in the model. Invalid records were not included in the analysis. Data included in the density estimates were restricted to sightings collected during defined census tracks (i.e., “on-effort”). Sightings collected during transits to or from a survey area, on cross-legs between census tracks, or while the ship or aircraft has left a census track to investigate a sighting were considered to be “off-effort” and were not included in the density estimates. Only datasets that included the following data fields were included in the Navy SPUE analysis:

- Assessment of the sighting conditions encountered during each segment of the survey track, including visibility and sea state
- Observer watch status
- Altitude (aerial surveys only)
- Sufficient records (time and position) for the survey track, in addition to the sighting locations, to adequately reconstruct the platform track.

The Navy SPUE analysis only included track segments completed with at least one observer on watch, clear visibility of at least two nautical miles, Beaufort sea state of less than or equal to three, and an altitude of less than 366 m.

Using the formula above, SPUE was calculated for each target species/species group in each of the four seasons in all ten-minute squares (TMS) within the project area. The SPUE grid cell values were converted to rank-based z-scores representing each TMS SPUE value in relation to the mean. The rank-based z-scores are interpreted in the same manner as standard z-scores. That is, a rank-based z-score of 1 indicates that the grid cell value is 1 standard deviation greater than the mean of all the grid cells. Refer to Appendix 5 for more details about calculating z-scores. We assigned all rank-based z-scores to the following categories:

- Far Above Average: > 2 Standard Deviations (SD) above the mean
- Above Average: > 1 SD
- Slightly Above Average: 1 to 0.5 SD
- Average: 0.5 to -0.5 SD
- Slightly Below Average: -0.5 to -1 SD
- Below Average: < -1 SD
- Far Below Average: < 2 SD

The z-scores were then mapped using the same methodology for all species/species groups.

SPUE was calculated for hardshell turtles (loggerhead, green, hawksbill and Kemp's ridley) and leatherback turtles. Data for hardshell turtles was combined in recognition of the difficulty of identifying these turtles to species level from the distances associated with aerial and shipboard sightings. In addition, sea turtles are more likely to be on the surface during fall and winter when water temperatures are cool and the sun is out (behavioral thermoregulation; Dodd 2014). As a result, observed seasonal variations in abundance are more likely an artifact of this behavior than movements of animals in and out of an area seasonally. The data set precludes an assessment by turtle life stage (adult, juvenile) and does not allow examination of use of larger coastal estuaries in the SAB region.

Box 4.2. Additional Data and Information

- New shipboard and aerial survey data have been or are in the process of being collected that will improve our knowledge of cetacean and sea turtle distribution in the SAB region but were unavailable for this analysis. Some of this new data collection is being driven by pre-development environmental monitoring of identified offshore wind energy areas within and adjacent to the study area. In addition, passive acoustic monitoring of cetaceans is now taking place in some areas and when combined with the survey data may provide a more complete picture of distribution along the U.S. mid-Atlantic Coast.

- Other information will be available soon through the Cetacean Density and Distribution Mapping Working Group (CetMap). This group has been working on creating "comprehensive and easily accessible regional cetacean density and distribution maps that are time- and species-specific, ideally using survey data and models that estimate density using predictive environmental factors." For more information visit the CetMap website at: http://cetsound.noaa.gov/cda-index.

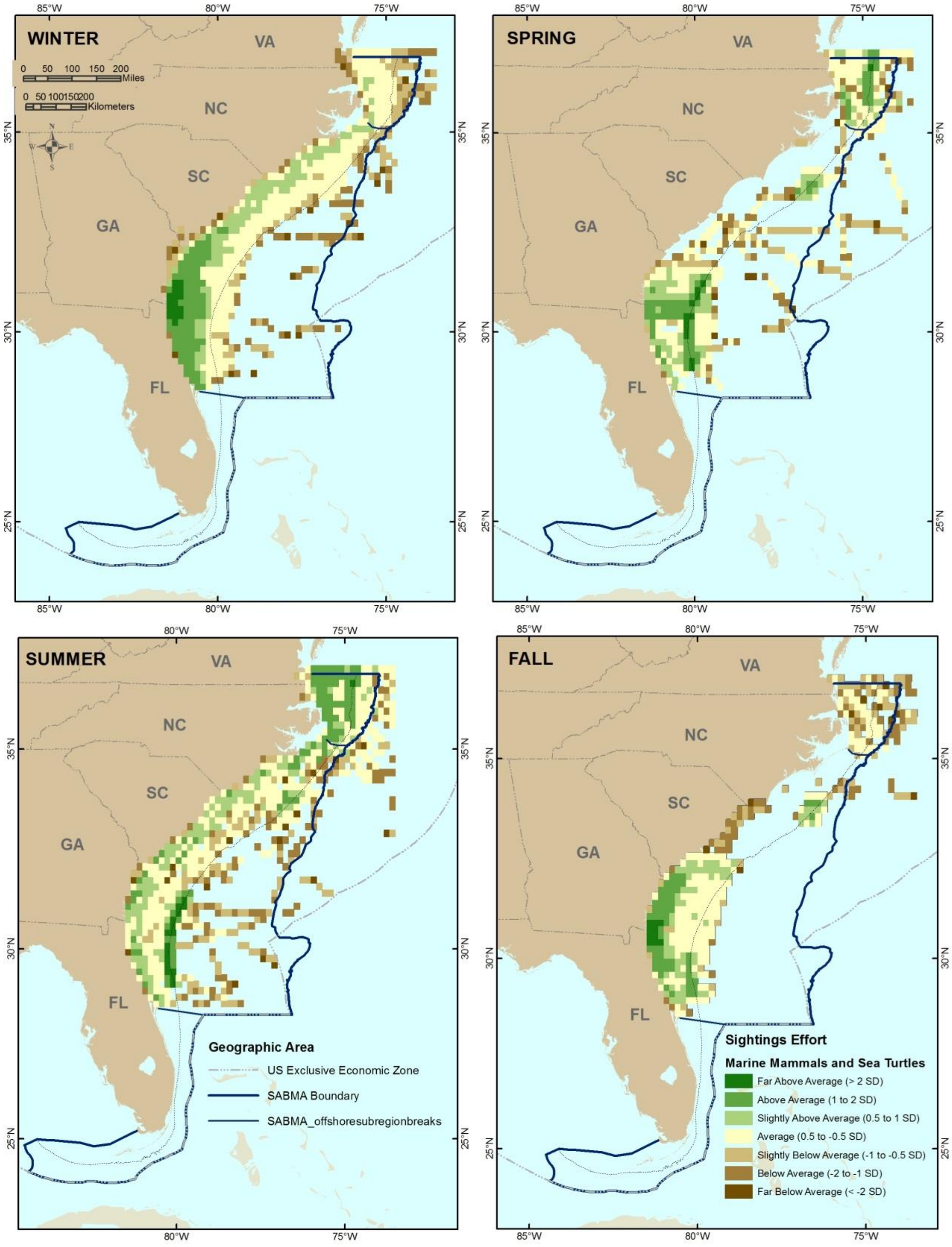

Figure 4.1. Effort grid for in-water cetacean and sea turtle observation surveys utilized in the SPUE Analysis

NORTH ATLANTIC RIGHT WHALE

A recent analysis of North Atlantic right whale (NARW) distribution (effort-corrected) in the SABMA region was obtained from the Florida Fish and Wildlife Conservation Commission (FWC). FWC compiled and analyzed NARW calving season data for the SAB region from a number of researchers made available through the North Atlantic Right Whale Consortium. The compiled data were for the 1991/1992 - 2012/2013 calving seasons (December – March) when these whales are present in the SAB region. Survey effort is presented in Figure 4.2.

FLORIDA MANATEE

Three types of Florida manatee distribution information were obtained from the Florida FWC to summarize distribution of this species in the SABMA study area: aerial distribution surveys, synoptic surveys, and mortality data. For each type, the data were spatially parsed into 1-minute squares. The 1-minute square resolution was used to accommodate the relatively fine scale of the data collected. Although no formal surveys of manatee distribution are conducted in Georgia, they are known to occur (in relatively low numbers) in all tidally connected waters. Manatees are also occasionally observed in the coastal and inshore waters of the other states in the SABMA region.

AERIAL DISTRIBUTION SURVEYS

The FWC and other agencies use aerial distribution surveys to determine the seasonal distribution and relative abundance of manatees. The surveys utilized in the SABMA analysis were typically conducted in inshore waters around the state. Flights were usually between four and six hours long and were most commonly flown every two weeks for two years (FWC, FWRI 2014a).

Most surveys were flown from small, four-seat, high-winged airplanes (Cessna 172 or 182) flying at a height of 150 m (500 ft) at a speed of 130 km/hr (80 mph). The flights were designed to maximize manatee counts by concentrating on shallow nearshore waters, where manatees and their primary food source, seagrasses, are located. Flight paths were parallel to the shoreline, and when manatees were sighted, the airplane circled until the researchers onboard were able to count the number of animals in each group. Deeper waters were usually not surveyed. In urban areas or where waters are particularly opaque, some studies were made using small helicopters. Manatee distributional survey datasets were available for 12 of Florida's 13 Atlantic Coast counties in the MRGIS database or directly from FWC. In addition, the Palm Beach County data and more recent survey data for Duval County were obtained directly from the survey contractors (Dr. James Powell of Sea to Shore Alliance and Dr. Gerry Pinto of Jacksonville University, respectively). Processing of the data for this analysis entailed summarizing the most recent 2 years of distributional survey data available for each county into 1 min grid cells.

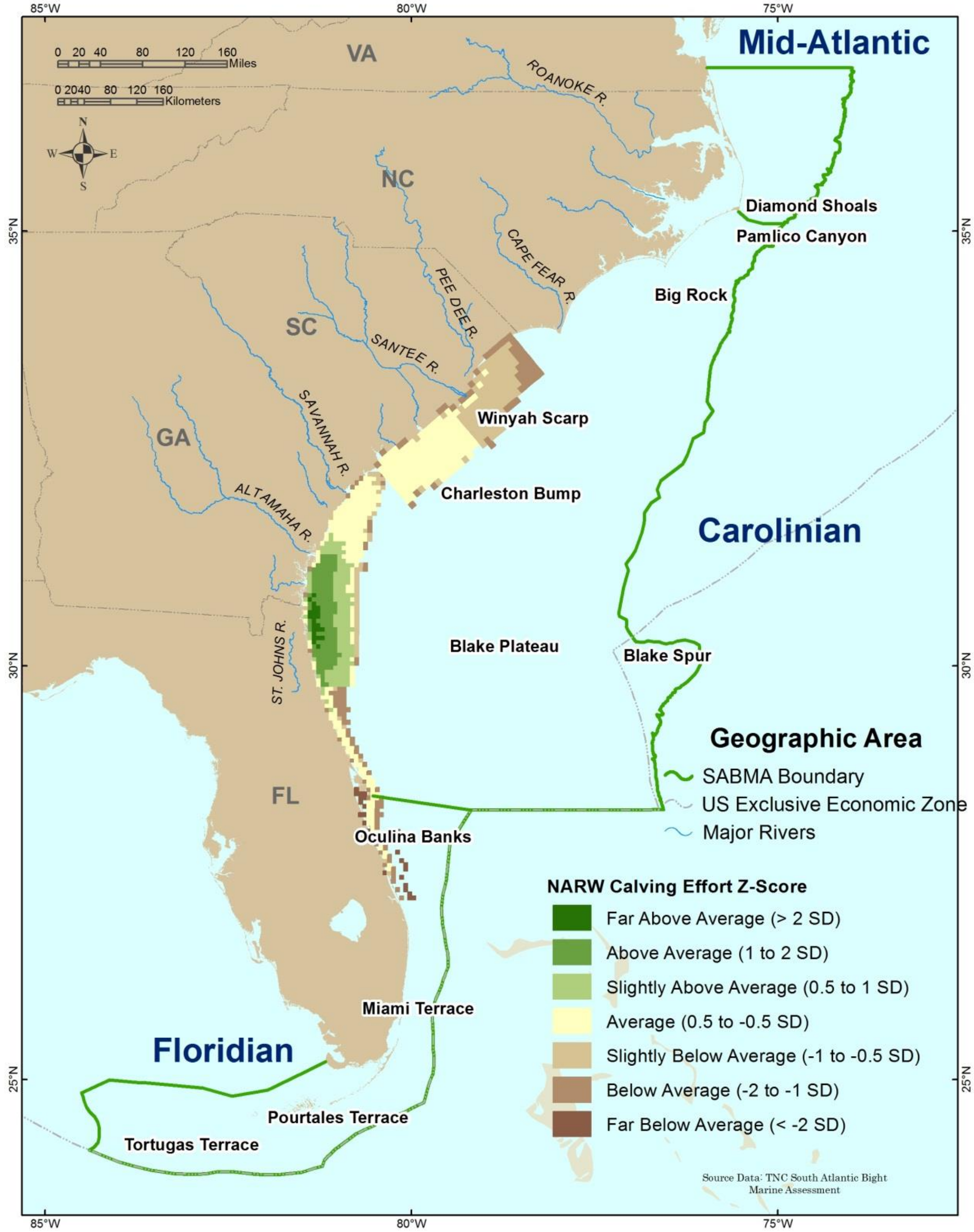

Figure 4.2. Effort map for NARWC aerial survey data from the 1991-2012/2013 calving seasons (December through March)

SYNOPTIC SURVEYS

The FWC also coordinates an interagency team that conducts aerial manatee synoptic surveys. These surveys cover a large area including all of the manatees' known wintering habitats in Florida (FWC, FWRI 2014a). These statewide interagency surveys take place during the winter months and are conducted after cold fronts pass through Florida when manatees gather at warm springs and thermal discharges from power and industrial plants. These surveys are useful in determining minimum estimates of the manatee populations.

Winter synoptic survey data were obtained from the FWC for the years 1991 - 2011. First, abundance for each 1-minute square was calculated. Abundance was measured in numbers of individuals sighted in any given 1-minute square over the years 1991-2011. Persistence is based on the consistency with which a species was observed in the same 1-minute square over time. The weighted persistence score is a variation of the persistence score in which each five-year period is weighted by the average abundance of the species over the five-year period it was present. Because the abundance data were skewed toward low abundances with a few very high abundances, values were log-transformed and mean log abundances were calculated for each five-year period within each 1-square. These five-year mean scores were averaged across all decades to obtain a grand average for each 1-minute square. The grand average was then normalized across all 1-minute squares for manatees to create a metric of abundance ranging between 0.0 and 1.00 for each 1-minute square, with low abundance defined as 0.0-0.49 and high abundance defined as 0.50 – 0.99. The weighted persistence score was calculated by adding the persistence and relative average abundance. In the resulting metric, the integer part of the score is the persistence score while the decimal part of the score is the relative grand average abundance value.

MORTALITY REPORTS

Established in 1974, a network of researchers and law enforcement agencies recover reported manatee carcasses and assist injured manatees. In 1985, field coordination of the rescue program and responsibilities for salvaging and necropsying manatee carcasses were transferred to the state of Florida by the U.S. Fish and Wildlife Service (USFWS) and now rest largely with FWC's Fish and Wildlife Research Institute (FWRI). Manatee mortality data were obtained from the FWC for this study and are current through 2012. While other states in the SAB area also monitor marine mammal mortality, the available data for manatees are not as consistent as Florida's and therefore were not included in the assessment.

SEA TURTLE NESTING

The South Carolina Department of Natural Resources assembled sea turtle nesting information as part of the Governors' South Atlantic Alliance regional geospatial database entitled "Comprehensive Spatial Data on Biological Resources and Uses in Southeastern Coastal Waters of the U.S." Annual state survey data from North Carolina, South Carolina, Georgia and Florida were compiled for 2006-2011. At surveyed beaches mean nesting density per segment of beach was calculated and mapped. We applied a similar approach to sea turtle nesting in the portion of Virginia falling within the SAB region (beaches within the boundaries of the City of Virginia Beach, Virginia). These data were obtained from the Back Bay National Wildlife Refuge. The Northwest Atlantic population of loggerhead sea turtles, which nests primarily within the SAB region, is comprised of several genetic subunits (Shamblin et al. 2011, 2012). The FWC recognizes four genetic subunits in Florida (FWC 2014b) and one in the remainder of the SAB region: Upper SAB (North Carolina to the Florida border), Northeast Florida (Florida border south to Ponce Inlet), Central East Florida (Ponce Inlet south to St. Lucie Inlet), Southeast Florida (St. Lucie Inlet south to Key West), and the Dry Tortugas unit (includes Marquesas) (Figure 4.3). From a genetic/scientific standpoint, the upper SAB subunit of loggerheads is defined as all animals nesting from Ponce Inlet to the northern extent of the range in Virginia (Shamblin et al. 2012), but for geopolitical reasons the subunit is defined as above to facilitate management. For purposes of evaluation, the density of sea turtle nesting on beach segments was compared within the defined genetic subunits (Figure 4.3).

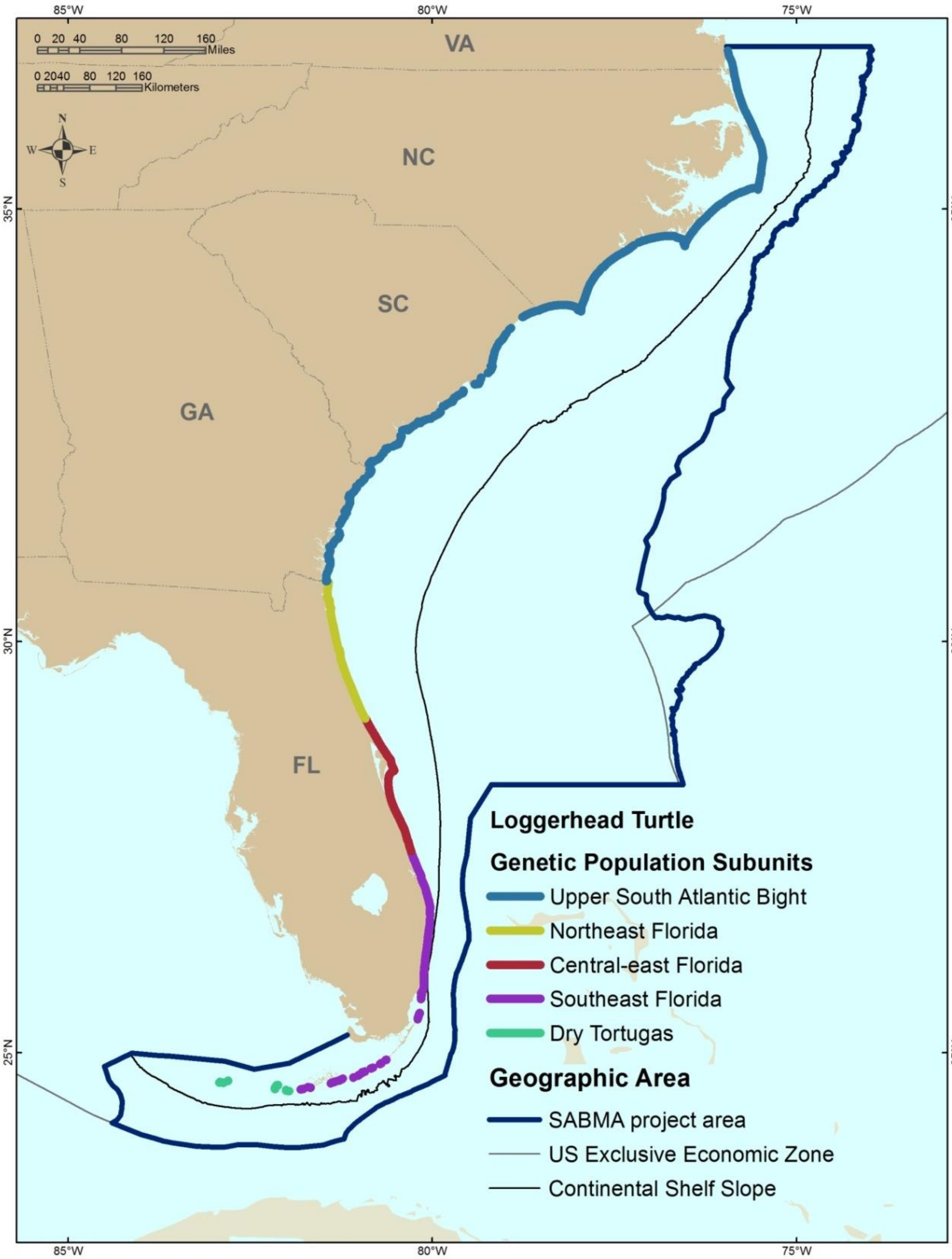

Figure 4.3. Loggerhead turtle genetic subunits within the South Atlantic Bight region

Maps, Analysis, and Areas of Importance

CETACEANS

The number of sightings varied considerably by species (Table 4.2). Due to the limited number of observations for some cetacean species in the study area, results were in some cases compiled into species groups when species shared similar or overlapping distributions (see Table 4.2). The groupings include spotted dolphins, pilot whales, and beaked whales. While long-finned and short-finned pilot whales overlap in range in the mid-Atlantic, the short-finned pilot whale's distribution is more southerly and the long-finned pilot whale's is more northerly.

Species displayed separately due to unique distribution patterns and/or listed status under the ESA includes the humpback, fin, North Atlantic right and sperm whales, and the Risso's, bottlenose and common dolphins. Distributions of species groups and individual species are described below. Cetacean distributions are mapped by season with the exception of the North Atlantic right whale which is only mapped for the season in which it appears in the study area, winter. Maps for all the in-water distributions are presented as z-scores (mean and standard deviations from the mean). The table in Appendix 6 provides a translation map between the z-scores and the sightings per unit effort. Absence of observations, especially in lightly surveyed areas, should not be interpreted to mean that the species, species group, or cetaceans in general do not occur there.

Table 4.2. Species/species groups displayed in the in-water distribution maps including number of sightings in the SAB region from the Navy Marine Resource Assessment (Department of Navy 2008)

Species/ Species Group Mapped	Sight-ings	Group Members	Scientific Name
North Atlantic Right Whale	1,299		*Eubalaena glacialis*
Fin	32		*Balaenoptera physalus*
Humpback	106		*Megaptera novaeangliae*
Spotted Dolphin/*Stenella* Group (Oceanic dolphins)			
	522	Atlantic Spotted Dolphin	*Stenella frontalis*
	7	Clymene Dolphin	*Stenella clymene*
	43	Pantropical Spotted Dolphin	*Stenella attenuata*
	5	Spinner Dolphin	*Stenella longirostris*
	92	Unidentified Spotted Dolphin	*Stenella spp.*
	19	Striped Dolphin	*Stenella coeruleoalba*
	439	Unidentified Stenella spp.	
Risso's Dolphin	113		*Grampus griseus*
Bottlenose Dolphin (Coastal & Oceanic)	55,454		*Tursiops truncatus*
Pilot Whales			
	275	Long-finned Pilot Whale	*Globicephala melas*
	76	Short-finned Pilot Whale	*Globicephala macrorhynchus*
Common Dolphin	78		*Delphinus delphis*
Sperm Whale	132		*Physeter macrocephalus*
Ziphiidae [Beaked Whales]	41	Beaked Whale grouping	family *Ziphiidae*

HUMPBACK WHALE

Humpback whales are most prevalent in the study area in winter, when they appear to be concentrated in two areas: within approximately 75 miles of shore offshore of Georgia and northern Florida to the southern limit of the available data, and offshore of northern North Carolina and southern Virginia (the northern boundary of the SABMA study area; Figure 4.4). Based on the Navy SPUE data, humpbacks were not observed in the study area during the summer and fall and only a very limited number of sightings were recorded in spring off the coast of northern North Carolina, however, documented sightings and strandings of this whale have been recorded in the study area in all seasons (Swingle, pers. comm.).

FIN WHALE

Fin whales are most prevalent in the study area in winter and spring (Figure 4.5). During these seasons, they are most concentrated off northern North Carolina and southern Virginia (to the northern boundary of the SABMA study area). In the spring, observations are most concentrated near the shelf break. During winter, fin whales are somewhat more dispersed in this same general area with another small concentration of sightings off northern North Carolina. Fin whales were not observed in the study area during fall and were only sighted a few times in the extreme north of the study area in summer.

NORTH ATLANTIC RIGHT WHALE

In the SABMA region, North Atlantic right whales are regularly found in coastal waters from South Carolina to Florida during their calving season (December to mid-March) with the highest concentrations off north Florida and southern Georgia (Figure 4.6; Winn 1984; Kraus et al. 1986; IWC 1986). In early to mid-March, North Atlantic right whales leave their calving grounds and head to feeding grounds in Cape Cod Bay and Gulf of Maine (Kenney and Winn 1986, Mitchell et al. 1986, Kenney et al. 1995). In the spring, the area between their calving grounds and southern feeding grounds around Cape Cod Bay has been identified as a primary migratory corridor for this whale (Firestone et al. 2008). While the endpoints of their migration are known, little is known about the seasonal movements of right whales within this migratory corridor (Wiley et al. 1995).

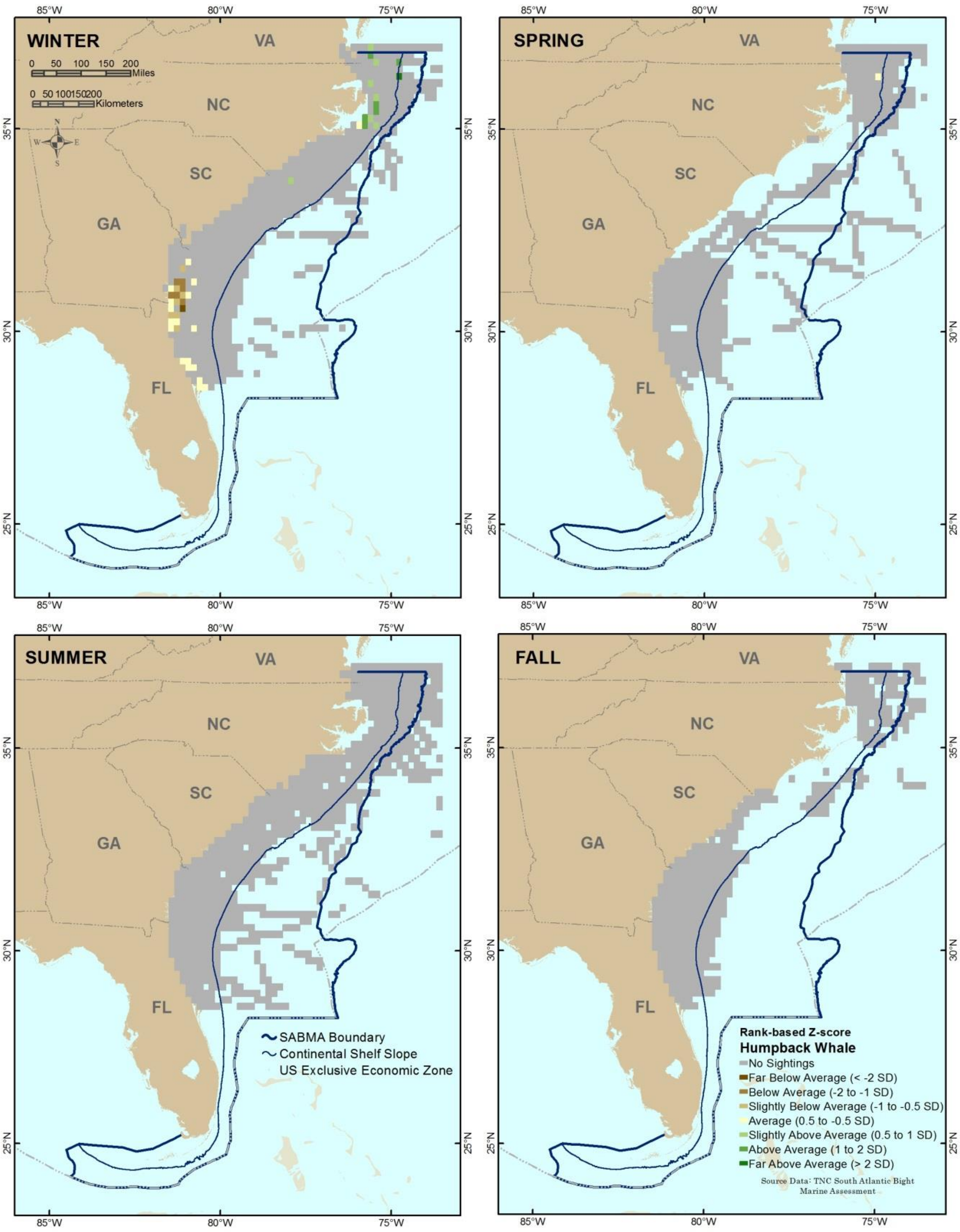

Figure 4.4. Humpback whale distribution maps by season

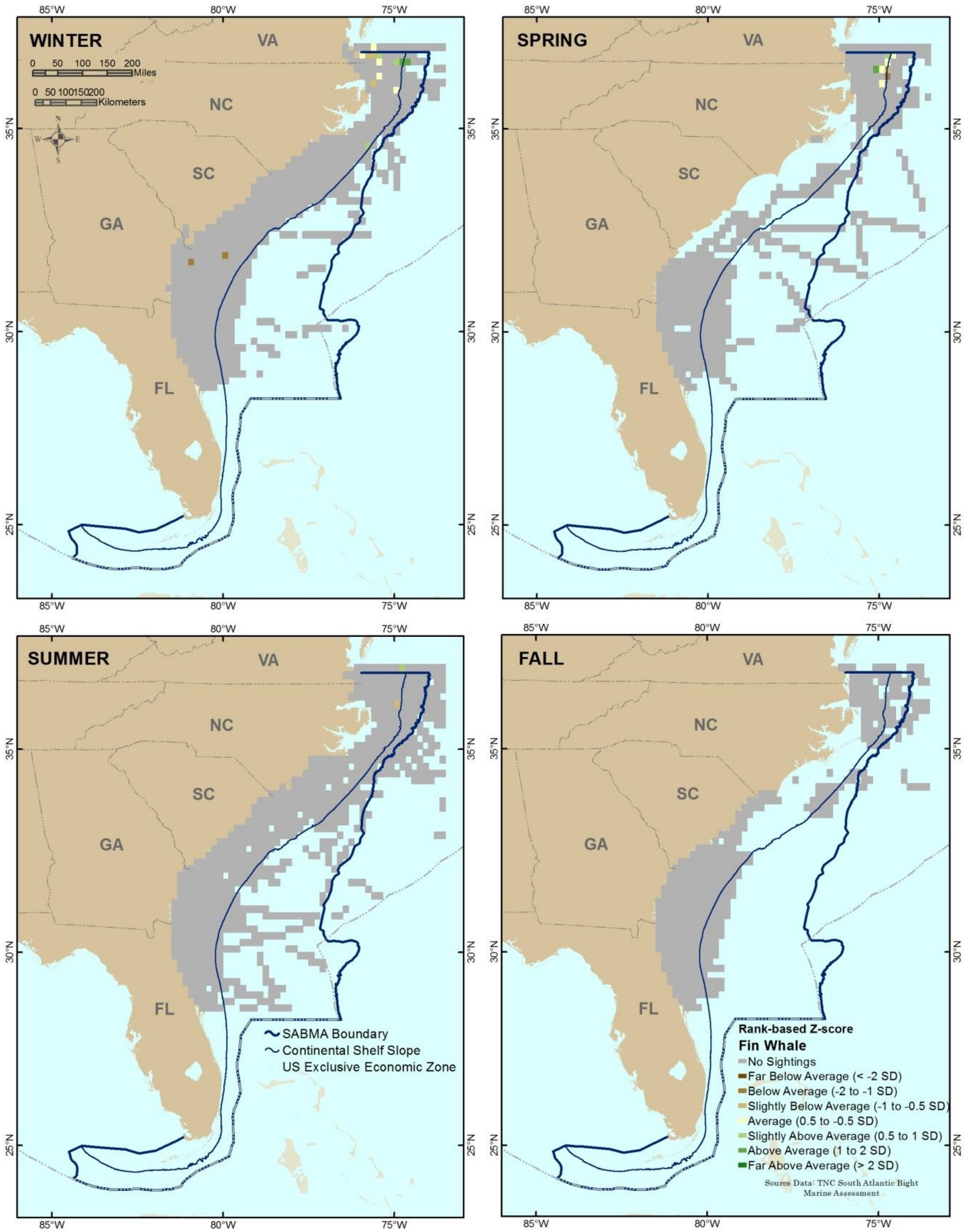

Figure 4.5. Fin whale distribution maps by season

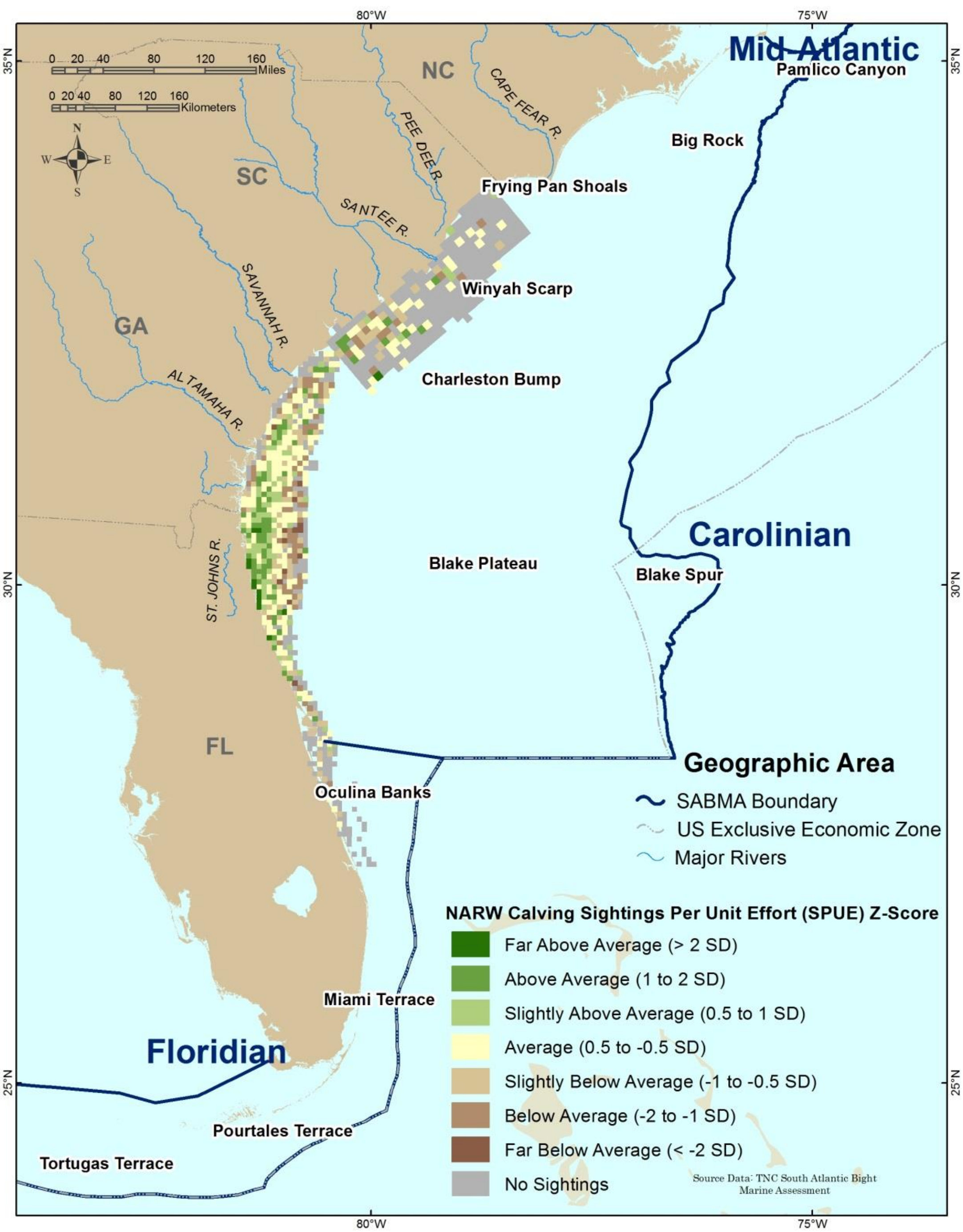

Figure 4.6. Map of North Atlantic Right Whale distribution during the 1991/1992 - 2012/2013 calving seasons (December through March)

BOTTLENOSE DOLPHIN

Two morphologically and genetically distinct bottlenose dolphin morphotypes are found in the Northwest Atlantic Ocean (Duffield et al. 1983; Duffield 1986): the coastal and offshore forms. The coastal form has been differentiated into a number of coastal populations based on genetic analyses, each of which is managed as a separate stock by NMFS. The data utilized for this study only evaluated offshore and nearshore populations of bottlenose dolphins, not those that inhabit the estuarine portion of the study area. In the winter, bottlenose dolphin sightings were the highest, with greatest concentrations of sightings in offshore areas off North Carolina and nearshore areas off northern Florida (Figure 4.7). In the summer, bottlenose dolphins were present in both nearshore and offshore areas throughout most of the study area. In fall and spring, they were mostly found off Cape Hatteras in the northern portion of the study area and off the South Carolina, Georgia and northern Florida coasts.

OCEANIC DOLPHINS

Oceanic or Atlantic and pantropical spotted dolphins (*Stenella* spp.) are found throughout the SABMA study area year-round and display movement patterns that appear to vary by season (Figure 4.8). A large number of spotted dolphin sightings were recorded in the winter and summer, a smaller number of sightings were recorded in spring, and there were relatively few sightings in fall. In winter and summer, spotted dolphins were located throughout the study area in relatively large numbers. In spring, most sightings were recorded off northern Florida, Georgia and South Carolina, northern North Carolina and southern Virginia. Survey effort off the southern portion of North Carolina was very limited. In fall, relatively fewer spotted dolphins were recorded where surveys took place. Little is known of these species' migratory patterns.

RISSO'S DOLPHIN

Risso's dolphins were present in the study area year-round, primarily in deeper waters of the Continental Slope (Figure 4.9). They were more widely distributed in spring and summer. In the fall Risso's dolphins were only documented in the northern portion of the study area in Continental Slope waters off southern Virginia and North Carolina.

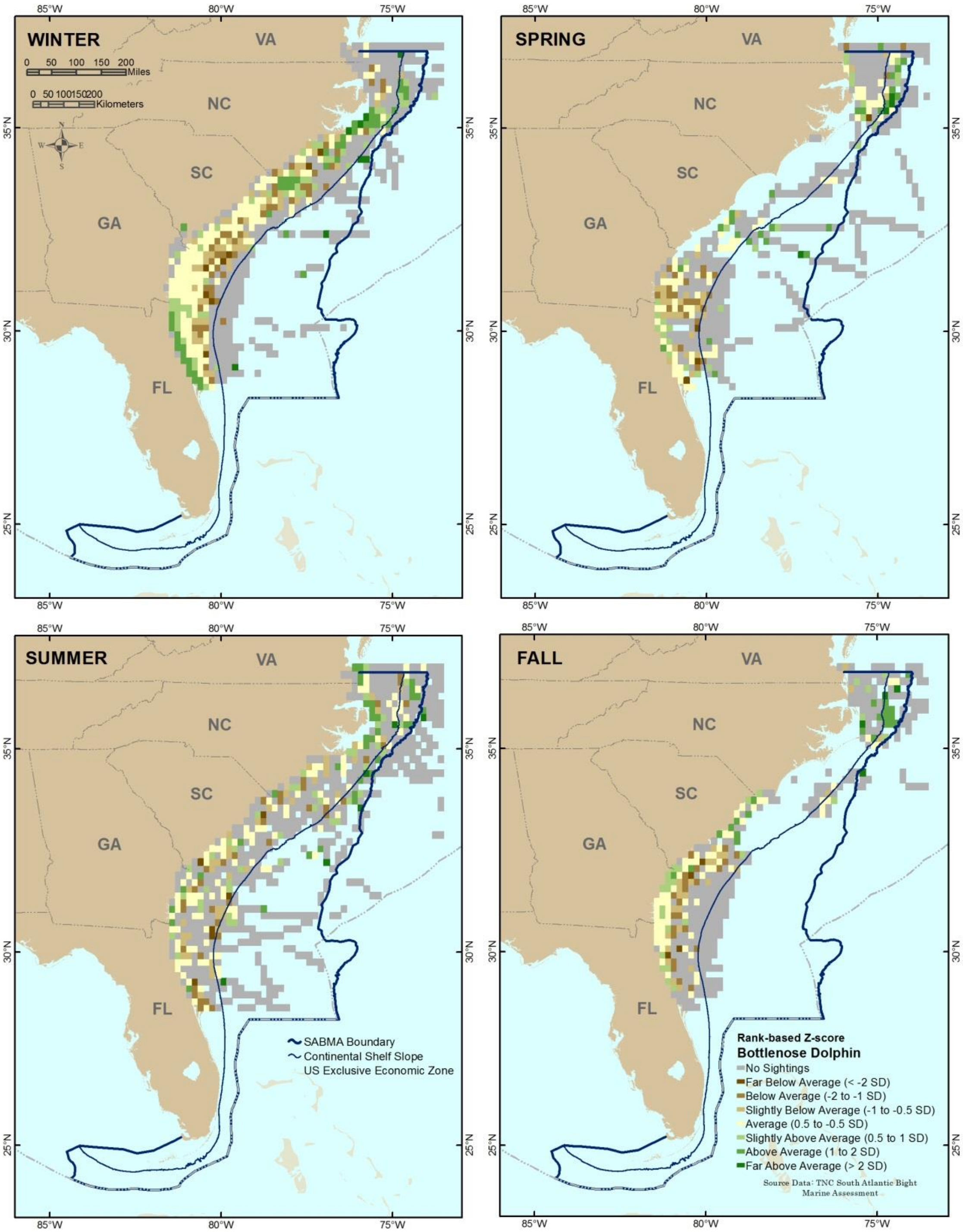

Figure 4.7. Bottlenose dolphin distribution maps by season

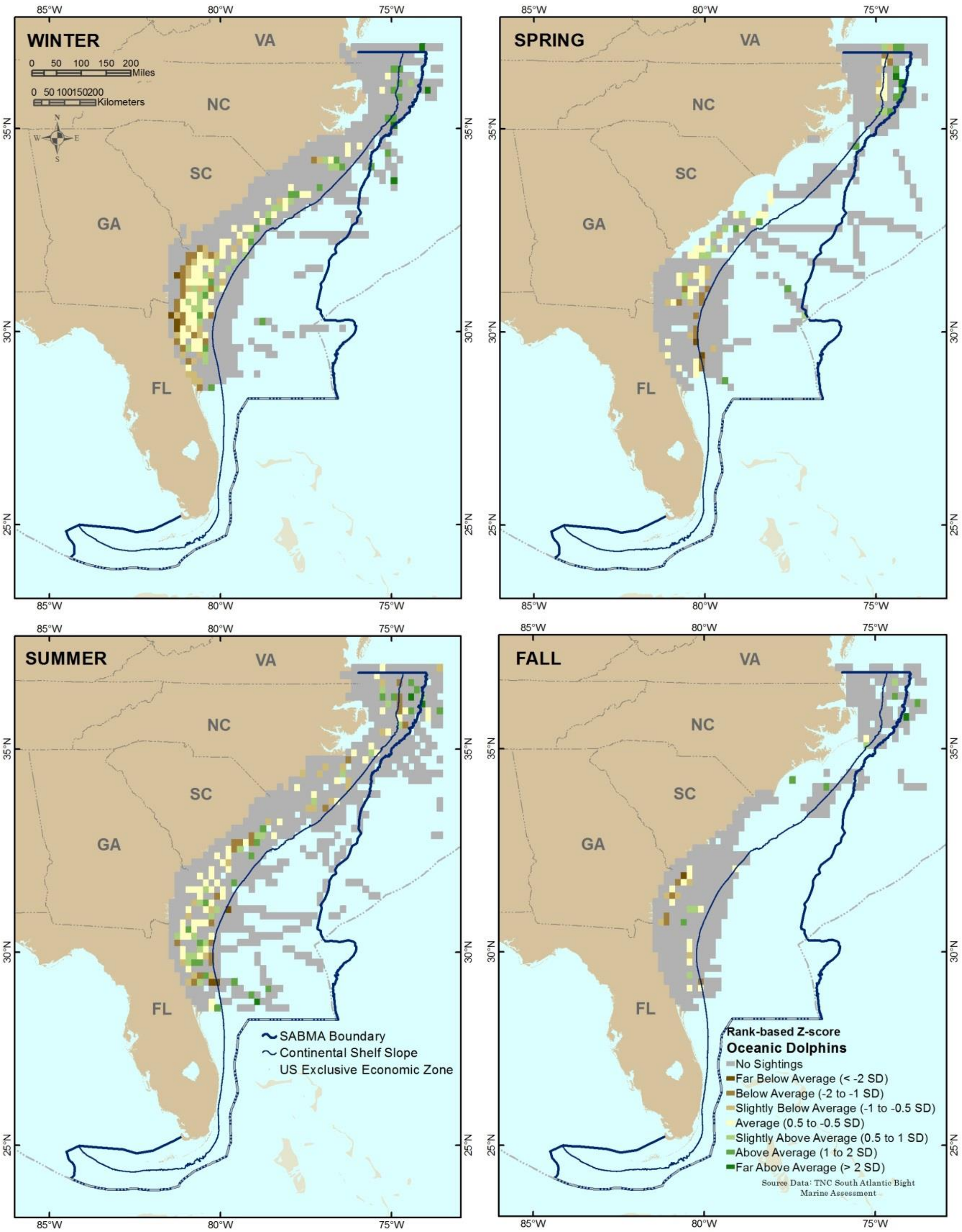

Figure 4.8. Oceanic dolphins (*Stenella* spp.) distribution maps by season

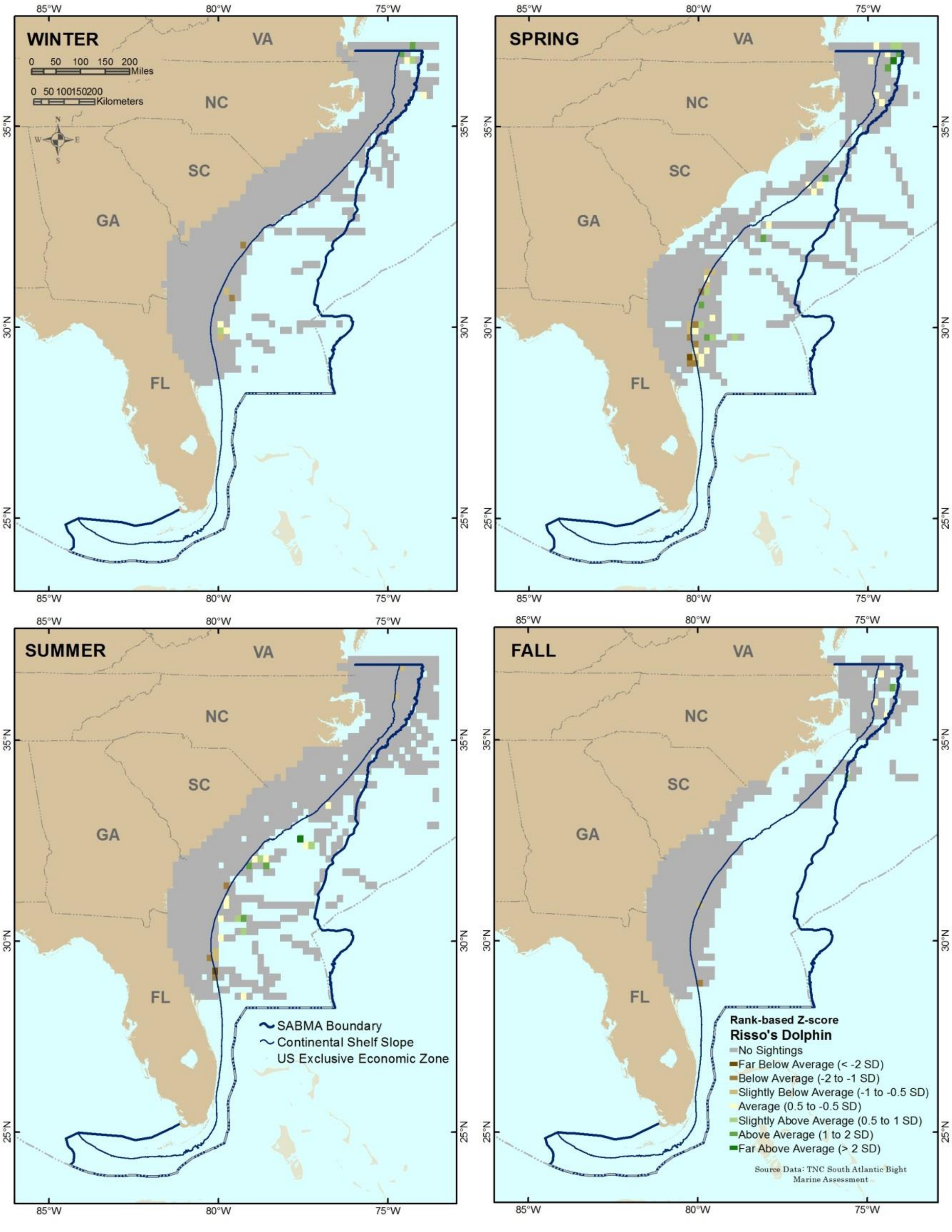

Figure 4.9. Risso's dolphin distribution maps by season

COMMON DOLPHIN

Data used in this assessment indicated that the common dolphin is primarily found in the northern portion of the study area from North Carolina north in the vicinity of shelf break waters (Figure 4.10). Prevalence was greatest in winter, particularly in shelf and shelf break waters off North Carolina and southern Virginia. Sightings declined in spring and were relatively low in summer and fall.

PILOT WHALES (LONG-FINNED AND SHORT-FINNED)

Pilot whales were prevalent in the SAB region in all seasons (Figure 4.11). A year-round concentration area for these whales appears to be shelf break and slope areas off Cape Hatteras. In the winter, pilot whales had a second concentration area off the northeast Florida coast. In all seasons, a portion of the pilot whales observed were broadly distributed in shelf slope waters off north Florida to the SABMA boundary (southern Virginia).

SPERM WHALE

Data indicated that sperm whales are present along the shelf-slope break in the northern portion of the study area, primarily between 200 and 2000 m depth off North Carolina (Figure 4.12). Other studies have indicated similar patterns in sperm whale distribution, reporting that sightings are centered along the Continental Shelf break and over the Continental Slope from 100 to 2000 m deep and in submarine canyons and edges of banks (Waring et al. 2008). In winter, North Atlantic Stock whales are concentrated east and northeast of Cape Hatteras. In spring, summer, and fall their distribution shifts northward and out of the SABMA study area (NOAA 2014b).

BEAKED WHALES (CUVIER'S, BLAINVILLE'S, GERVAIS' AND TRUE'S BEAKED WHALES)

Beaked whales were infrequently encountered in the SABMA region. The data suggest that their distribution is diffuse in Continental Shelf and Slope waters (Figure 4.13). Members of this family group were present in every season except fall. Cuvier's and Blainville's beaked whales are known to have a cosmopolitan distribution (NOAA 2014b).

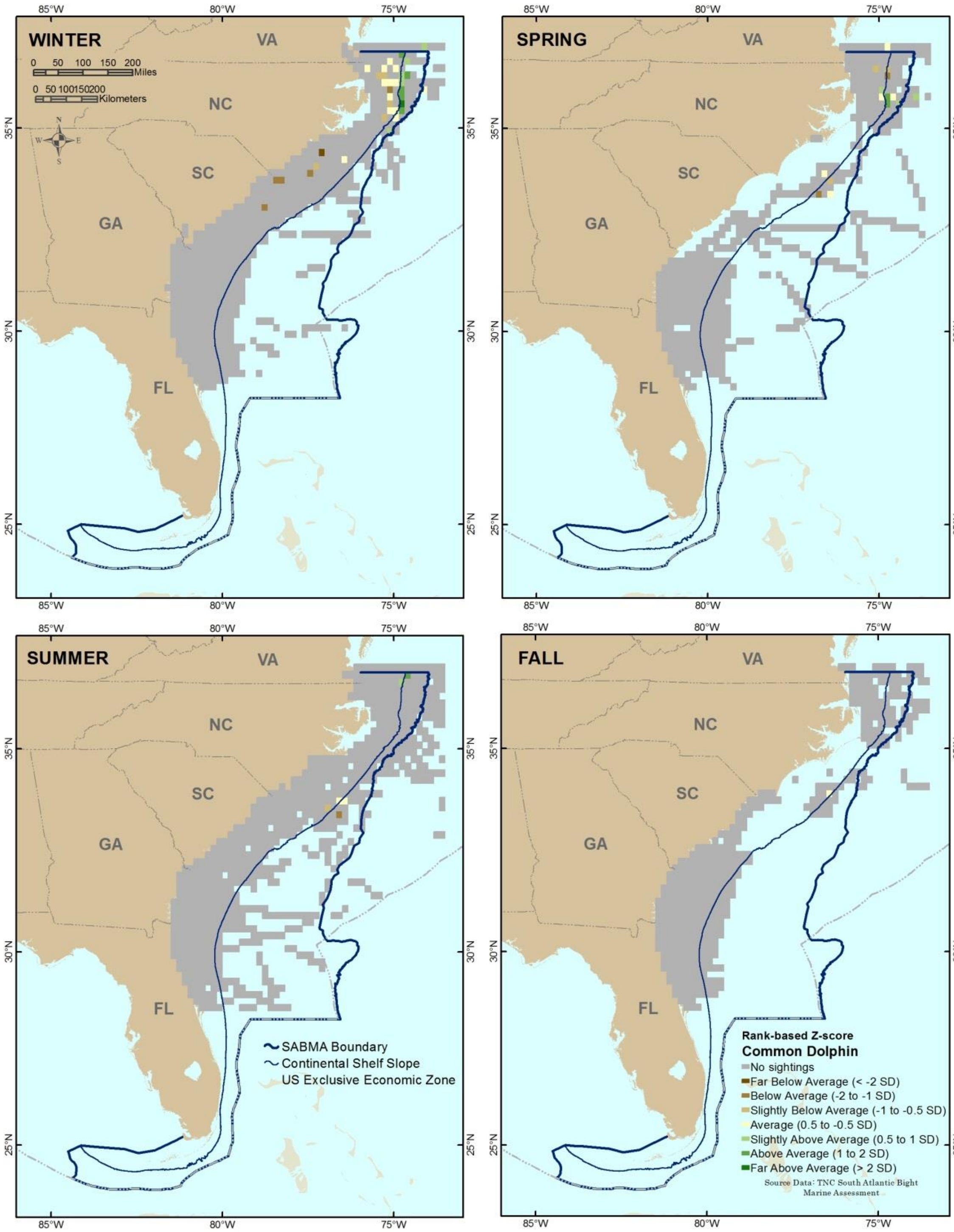

Figure 4.10. Common dolphin distribution maps by season

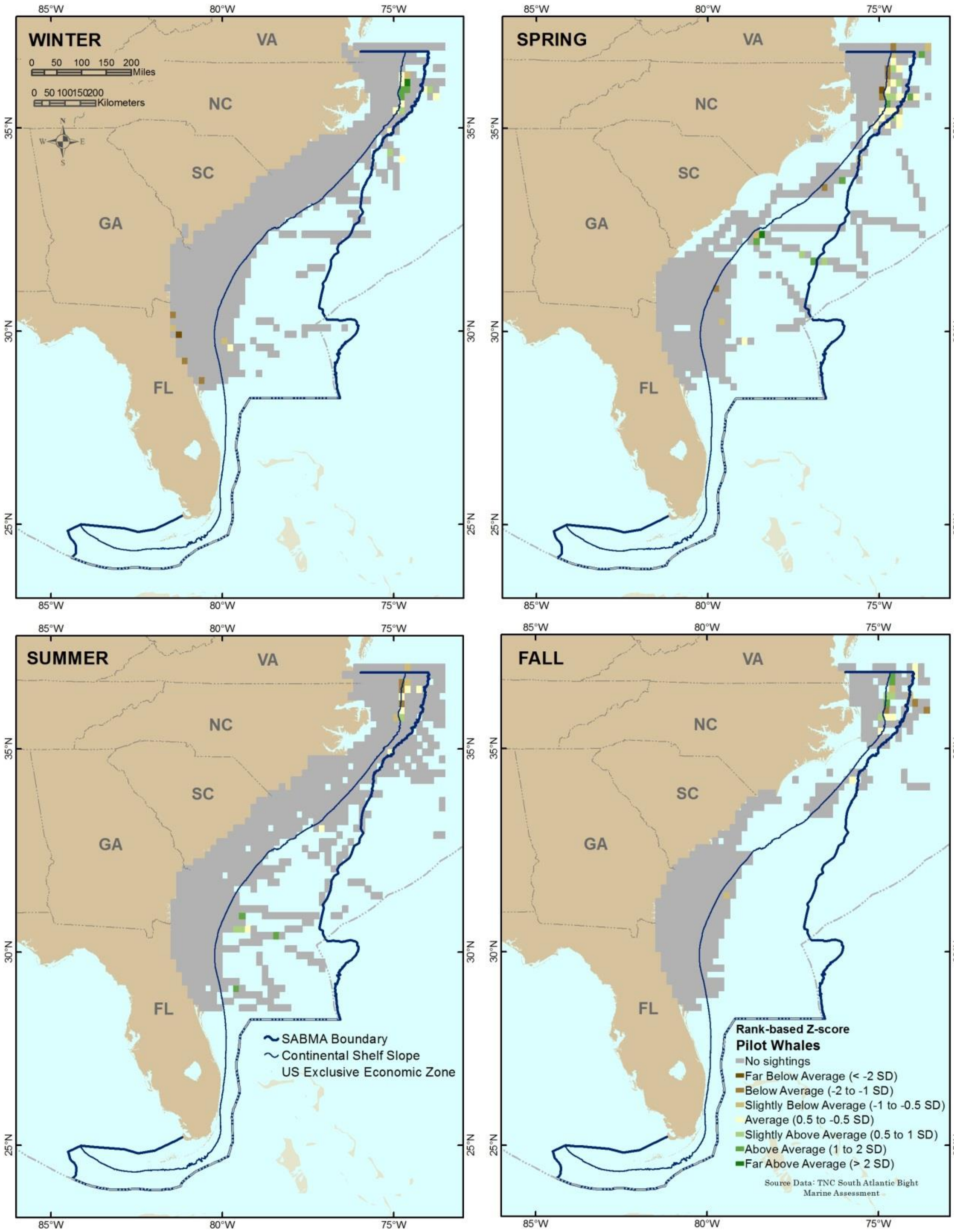

Figure 4.11. Pilot whale distribution maps by season

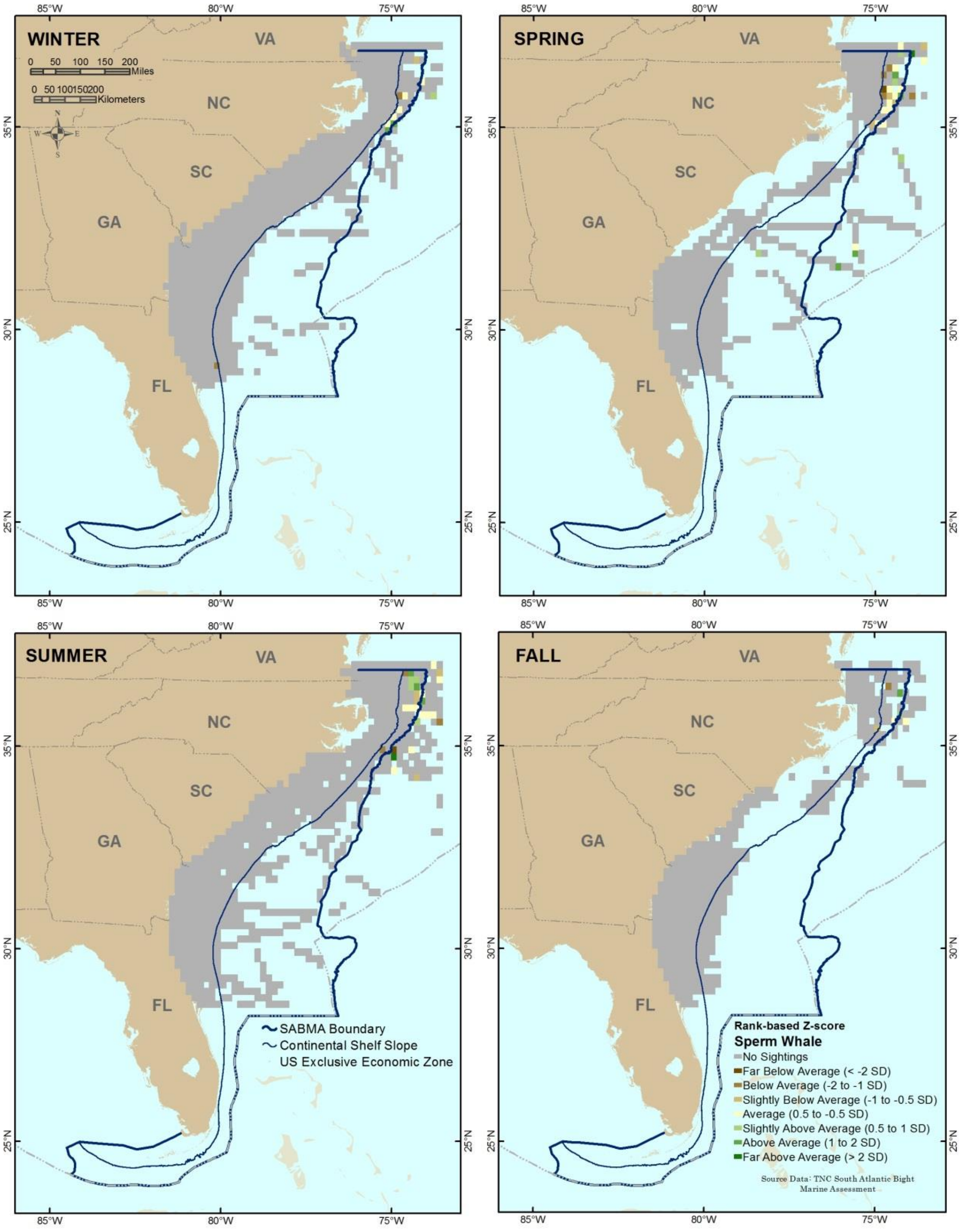

Figure 4.12. Sperm whale distribution maps by season

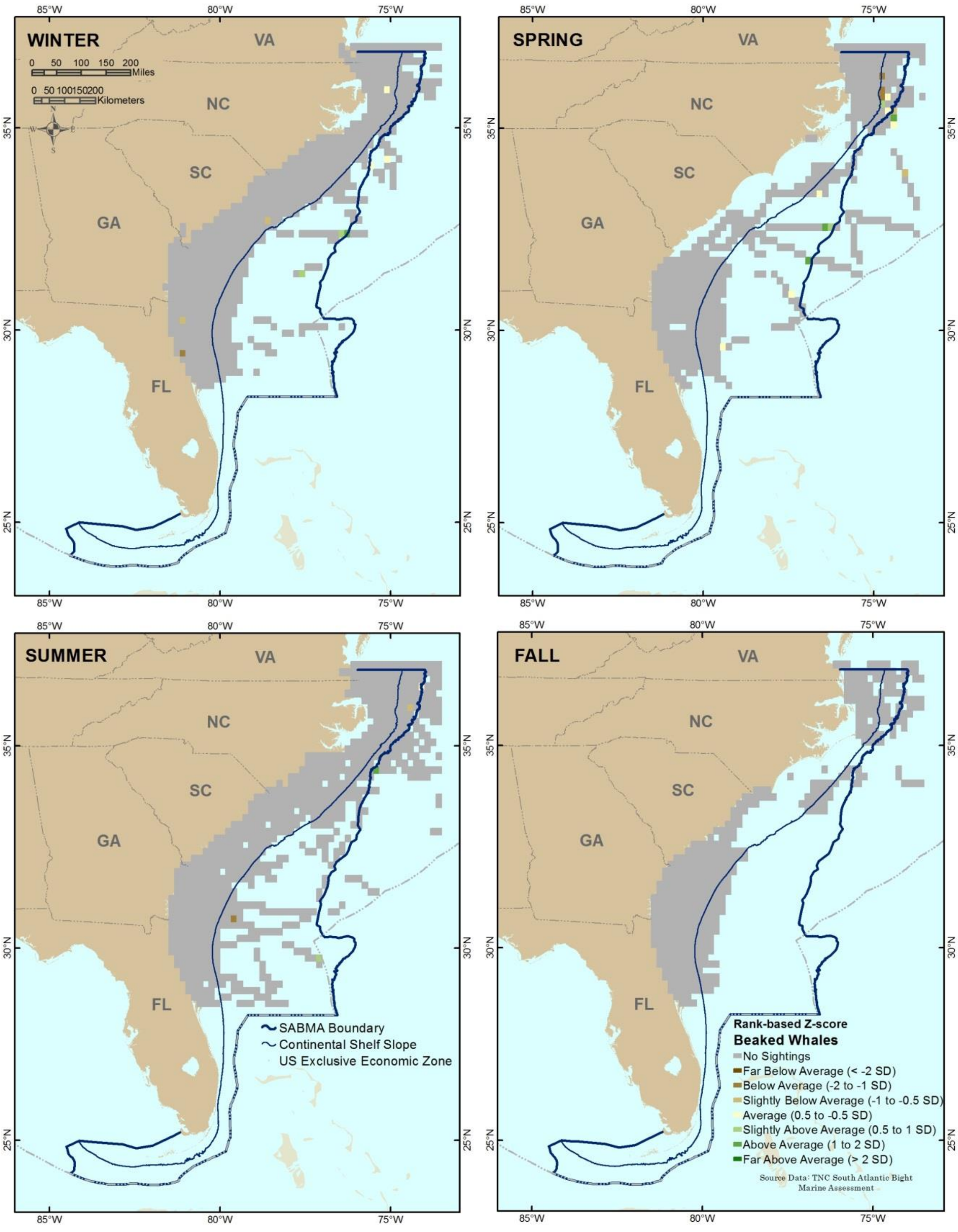

Figure 4.13. Beaked whales (family Ziphiidea) distribution maps by season

Box 4.3. Comparison to Northwest Atlantic Marine Ecoregional Assessment Results

While the cetacean species selected for analysis in the Northwest Atlantic Marine Ecoregional Assessment (NAMERA; Greene et al. 2010) and for this assessment do not completely overlap, there are several whale species whose sightings can be compared: the fin, humpback, and North Atlantic right whales and the bottlenose dolphin. In general, the large whale species were sighted more frequently in the NAMERA study area (Cape Hatteras in North Carolina to the northern limit of the Gulf of Maine in Canadian waters) whereas bottlenose dolphins were sighted more frequently in the SABMA study area. The greatest difference in effort-corrected sightings was for the humpback whale, for which average sightings across all seasons in the NAMERA study area were nearly 100 times greater than for the SABMA study area (3120 versus 32 SPUE, respectively). Effort-corrected fin whale sightings were more than 20 times greater in the NAMERA study area as compared to the SABMA study area over the same period (2707 versus 110 SPUE, respectively). North Atlantic right whale sightings were more than 15 times greater in the NAMERA study area (2065 versus 132 SPUE, respectively) and sperm whale sightings were approximately 31% greater in the NAMERA versus SABMA study area (2294 versus 2294 SPUE, respectively). Approximately 86% more bottlenose dolphin sightings were observed in the SABMA study area versus the NAMERA study area (75,774 versus 40,646 SPUE, respectively).

FLORIDA MANATEE

Analysis of the three sources of Florida distribution information used in the assessment revealed that the Florida manatee was generally present throughout tidally connected waters. The winter synoptic survey results for the years 1992 through 2011 are illustrated in a weighted persistence format. Table 4.3 below provides the abundance ranges used to categorize high and low abundance in each of the persistence categories. The weighted persistence maps (Figures 4.14-4.16) highlight that the most important overwintering areas for the Florida manatee in the SABMA region are in southern Florida from the upper Florida Keys to the St. Lucie Inlet with a few additional isolated important areas including Vaca Key in the Florida Keys, a few locations along the Indian River Lagoon, and the spring-fed Blue Springs area of the St. Johns River more than 100 miles upstream (south) of where the river meets the ocean.

The available distributional survey results (Figures 4.17 through 4.19) suggest that the upper St. Johns River (northern portion) and the east-central Florida coast from Cape Canaveral south to Palm Beach County have the greatest concentration of high abundance areas along the Florida coast.

Results of the mortality recovery locations (Figures 4.20-4.22) are more difficult to interpret as they may indicate both where manatees are concentrated as well as where manatees are most vulnerable to human impacts (e.g., boat strikes). The mortality location maps display a spatial pattern similar to the distributional survey maps, with the exception that mortality also appears to be high in Broward and Miami-Dade counties.

Table 4.3. Abundance ranges used to categorize high and low abundance categories for the Florida manatee winter synoptic survey weighted persistence maps

Persistence Category	Abundance Category	Abundance Range (animals per cell)
Occurred in All 4 Five Year Periods	High Abundance	2022 to 46.5*
Occurred in All 4 Five Year Periods	Low Abundance	77.25 to 1.75
Occurred in 3 Five Year Periods	High Abundance	172**
Occurred in 3 Five Year Periods	Low Abundance	40.7 to 88
Occurred in 2 Five Year Periods	Any Abundance	44 to 1
Occurred in 1 Five Year Period	Any Abundance	247 to 1

** Overlap in high and low abundance categories is a result of normalizing the data and the top range value in this category (77.25) is an outlier caused by a declining trend in abundance.*
***Only one cell in the high abundance category.*

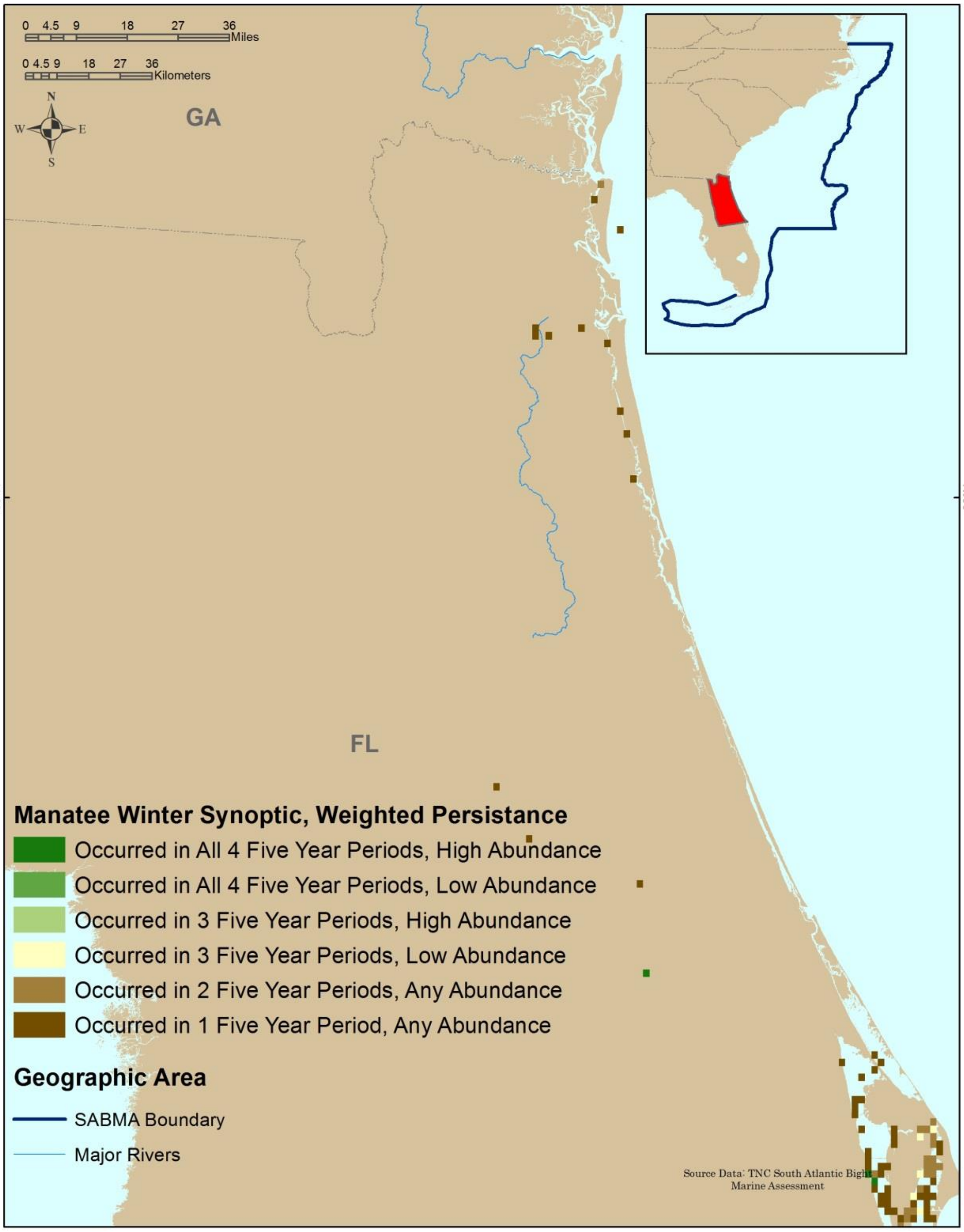

Figure 4.14. Manatee weighted persistence maps developed from winter synoptic aerial survey data, Northeast Florida. The St. Johns River extends further south than what is shown on the map.

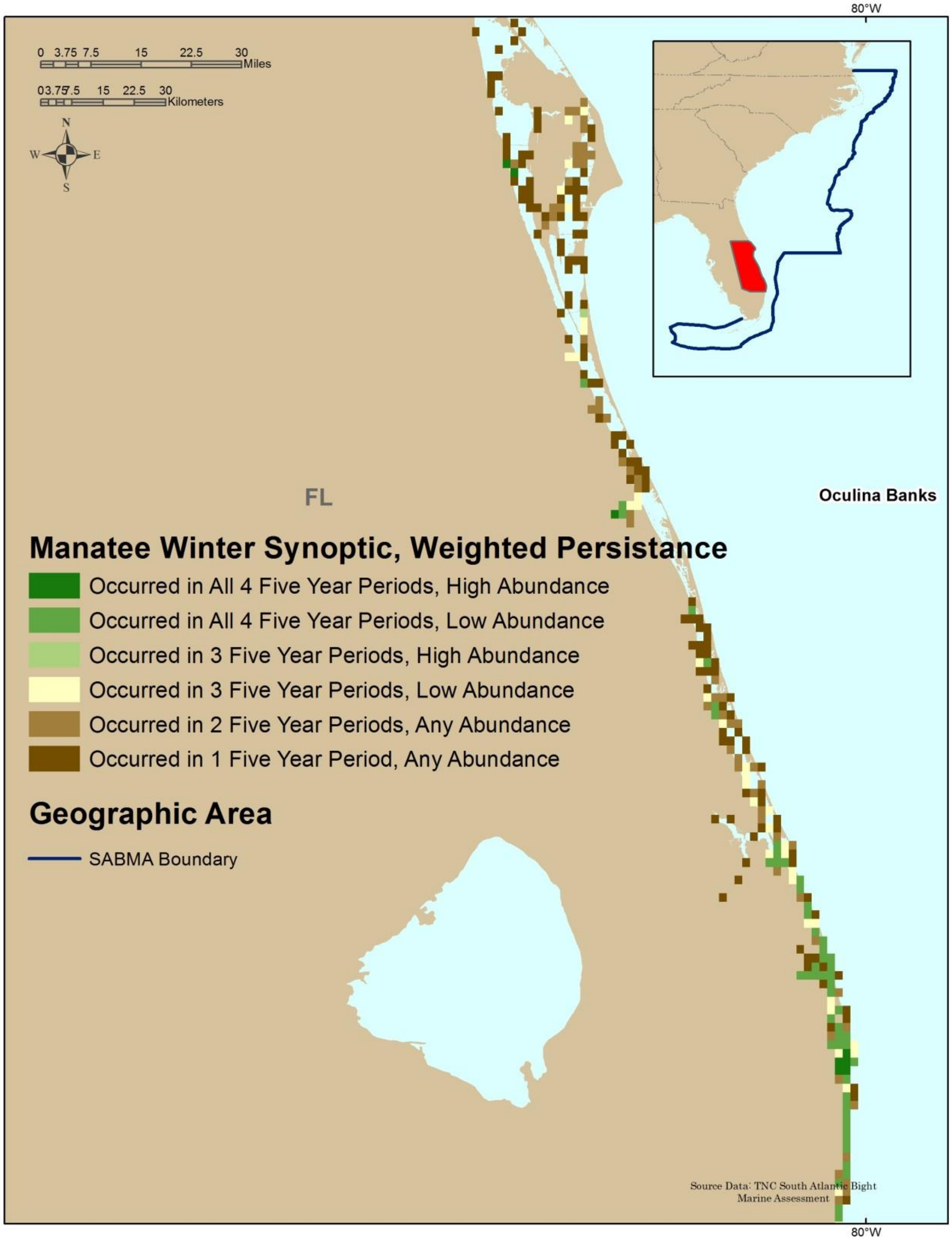

Figure 4.15. Manatee weighted persistence map developed from wither synoptic aerial survey data, east-central Florida

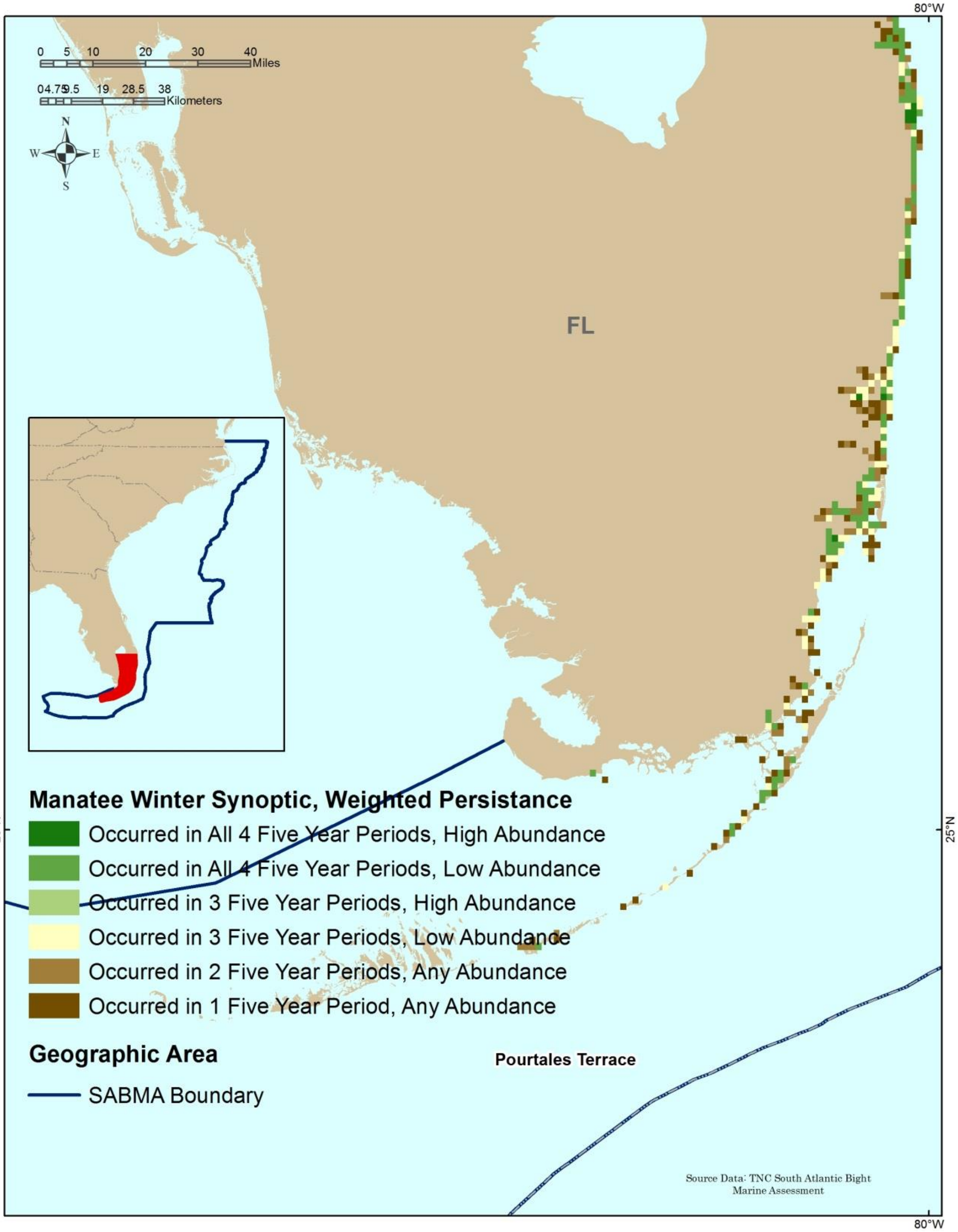

Figure 4.16. Manatee weighted persistence map developed from winter synoptic aerial survey data, southeast Florida

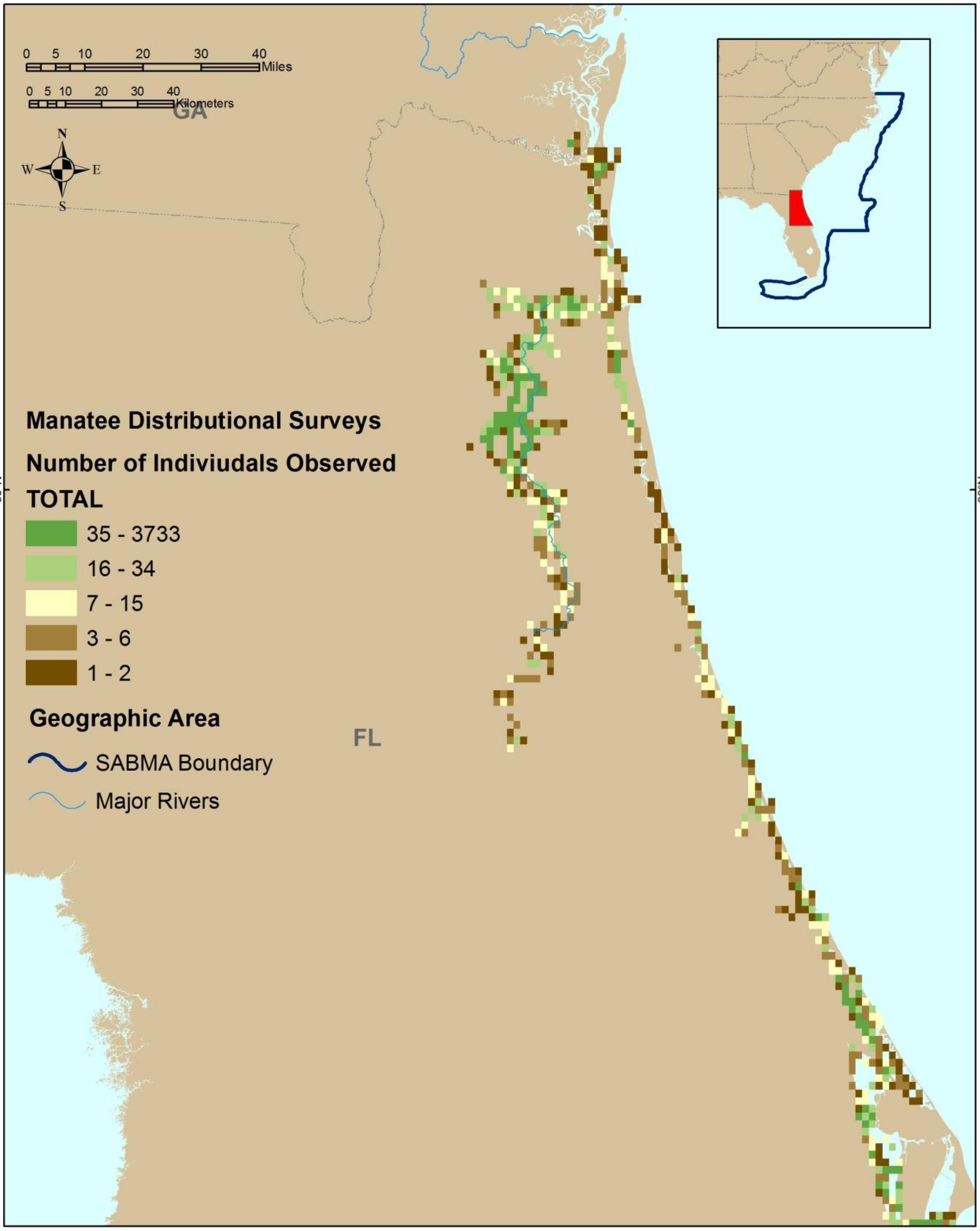

Figure 4.17. Manatee abundance map developed from distributional survey data, northeast Florida

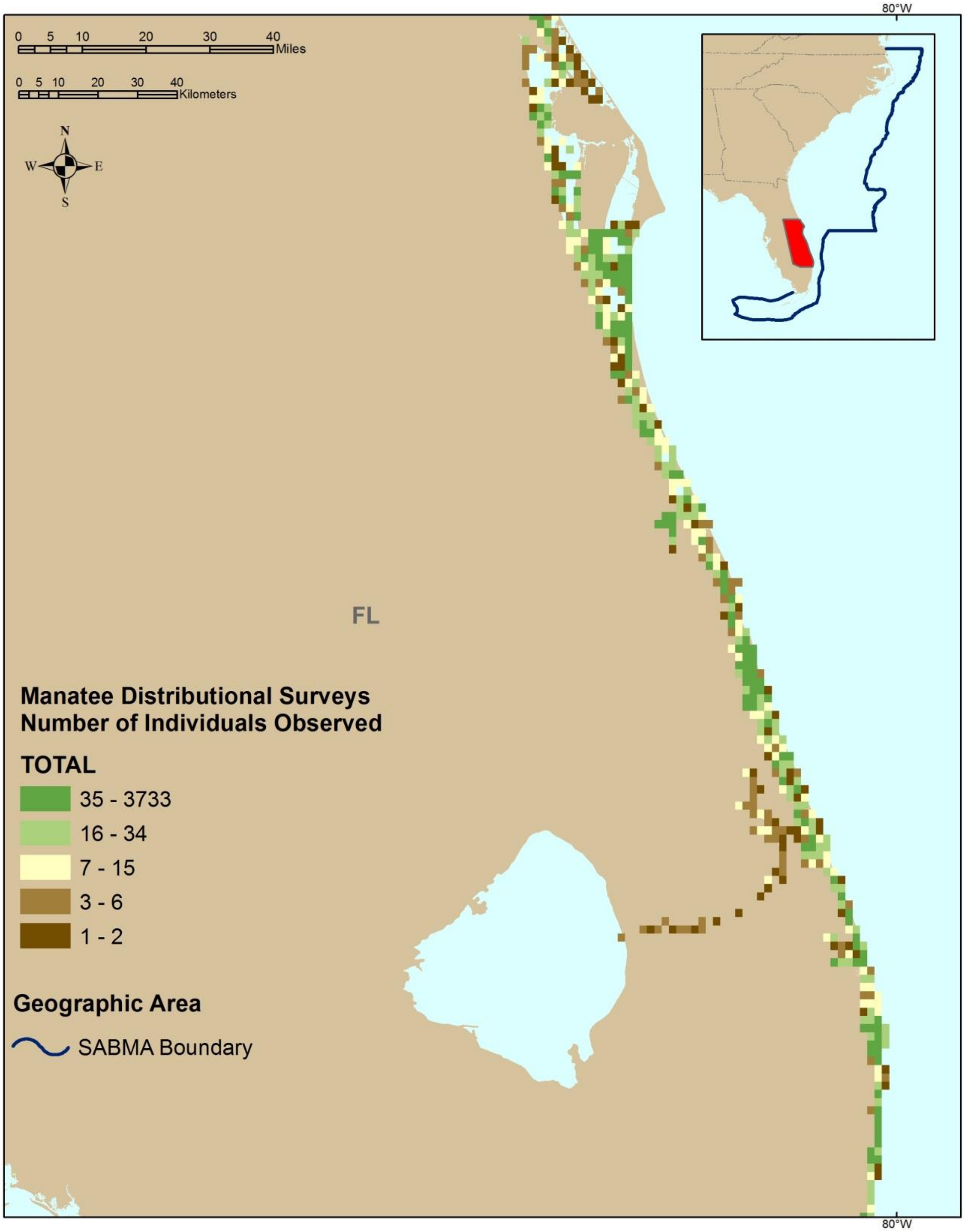

Figure 4.18. Manatee abundance map developed from distributional survey data, east-central Florida

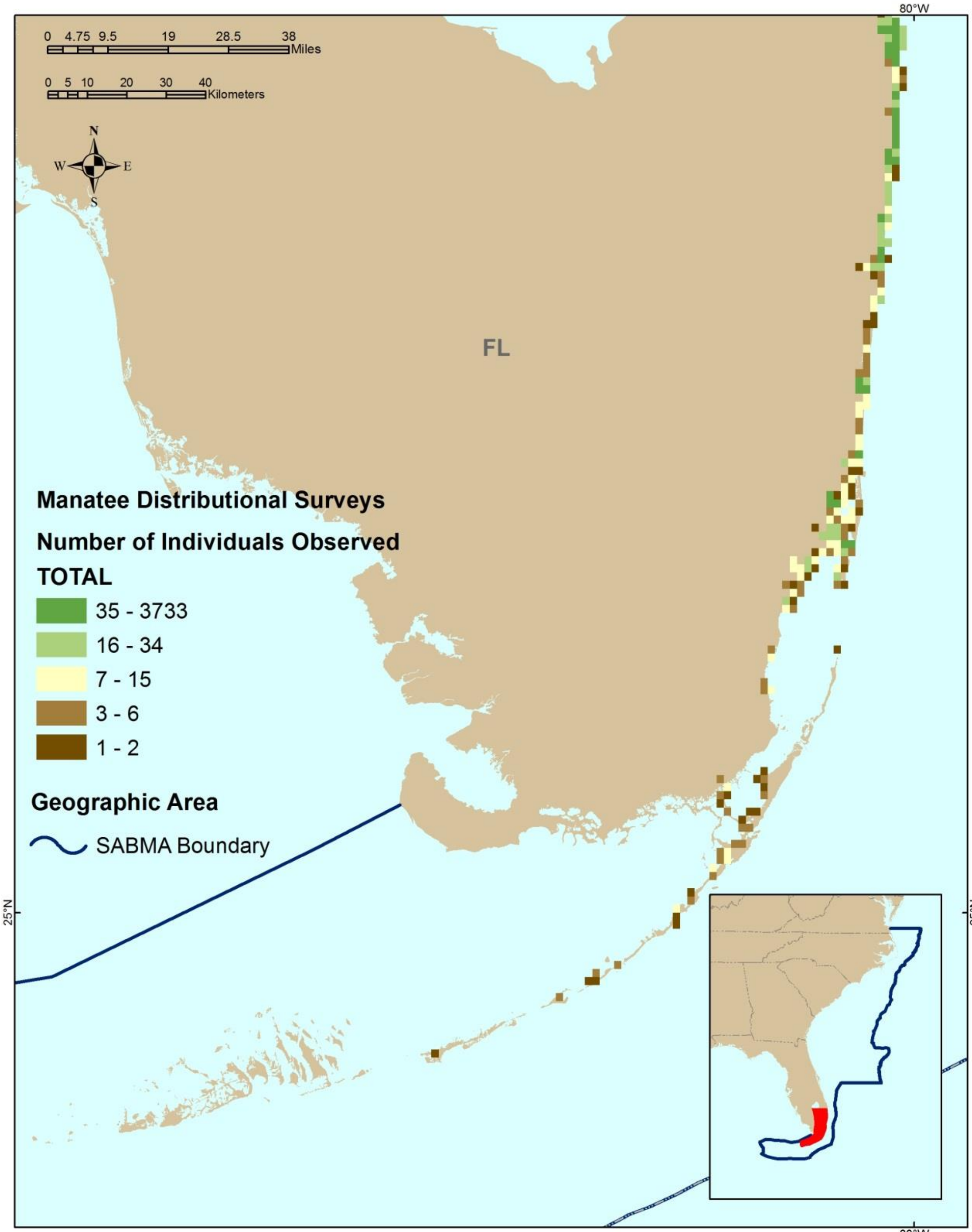

Figure 4.19. Manatee abundance map developed from distributional survey data, southeast Florida

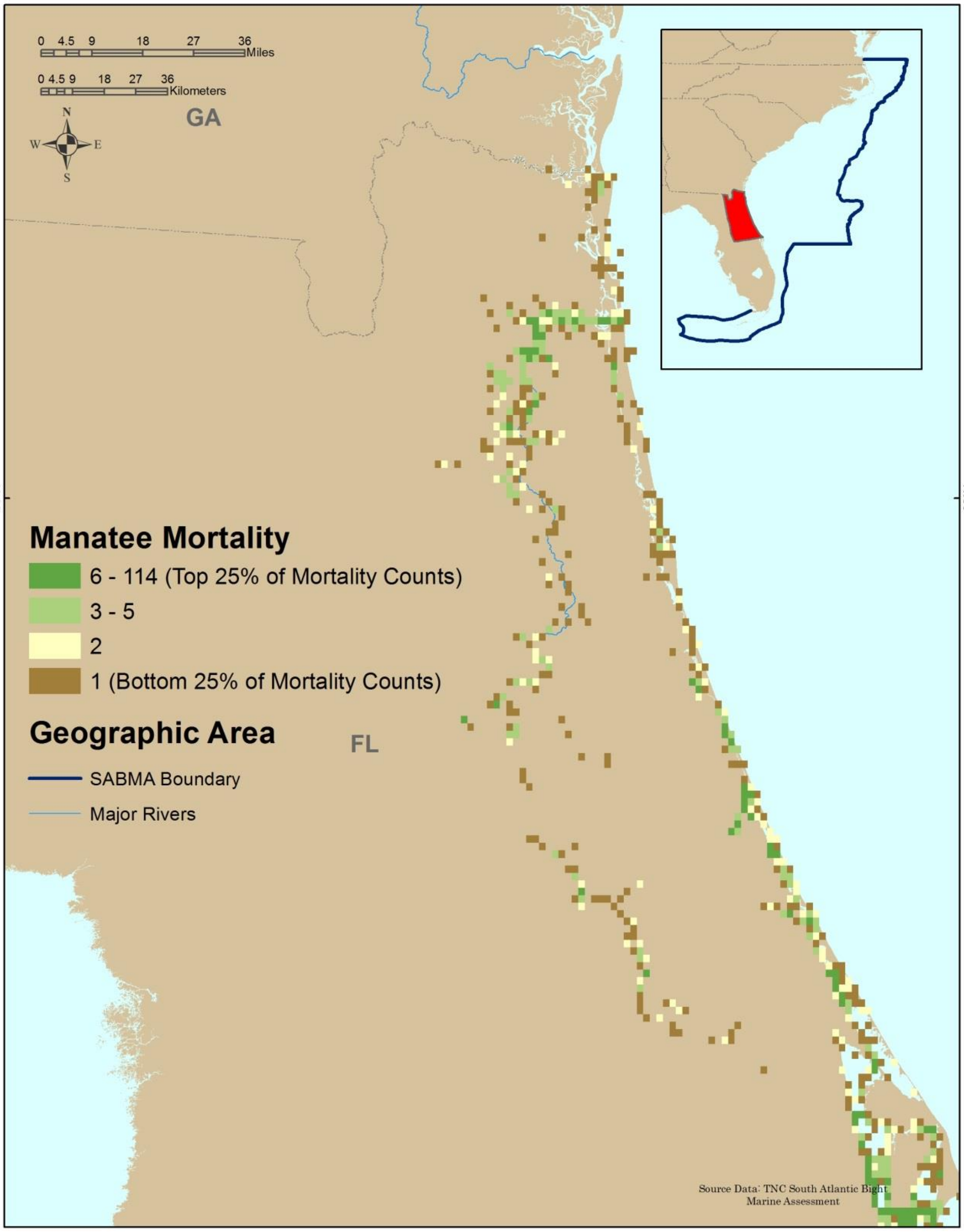

Figure 4.20. Manatee mortality location map, northeast Florida

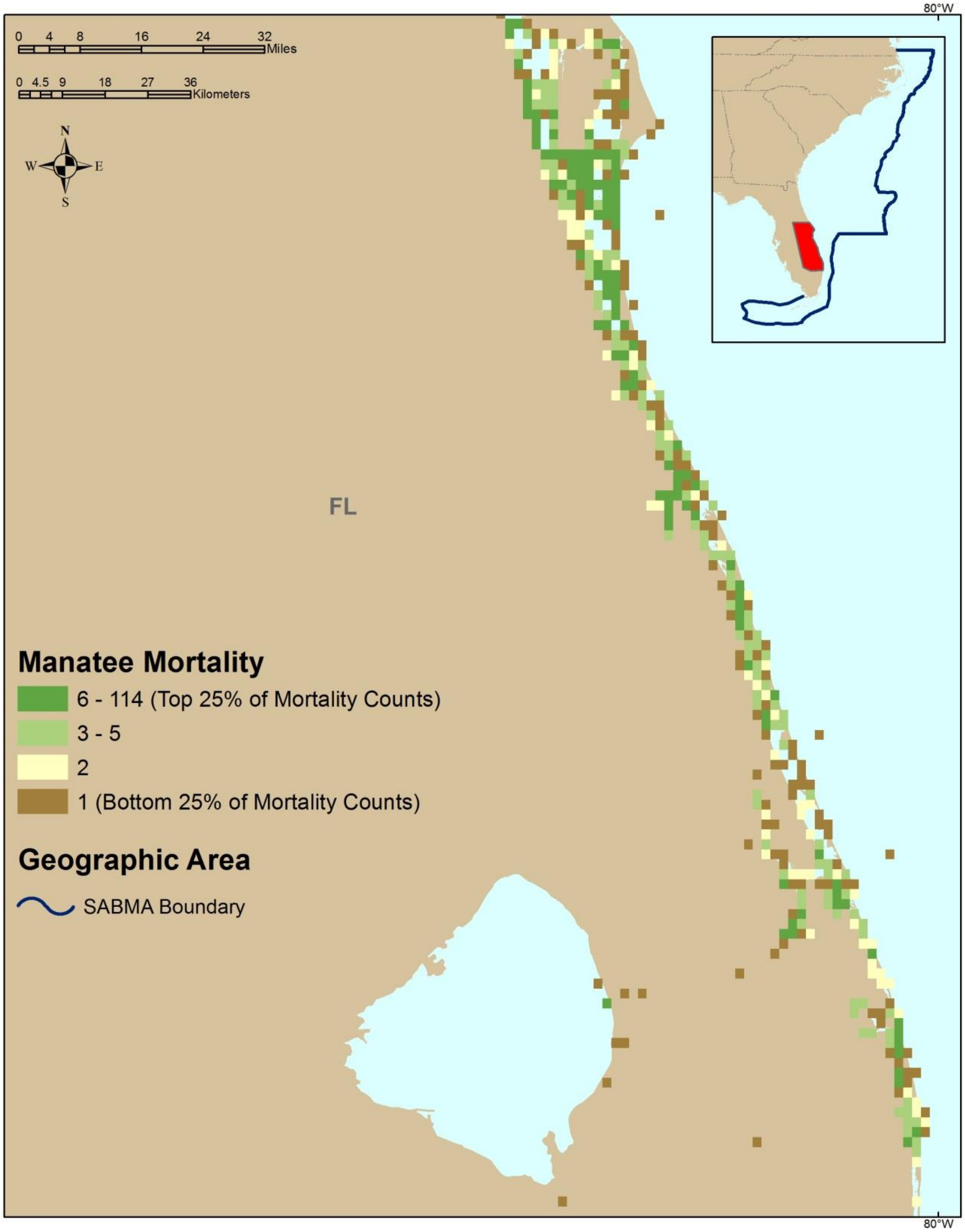

Figure 4.21. Manatee mortality location map, east-central Florida

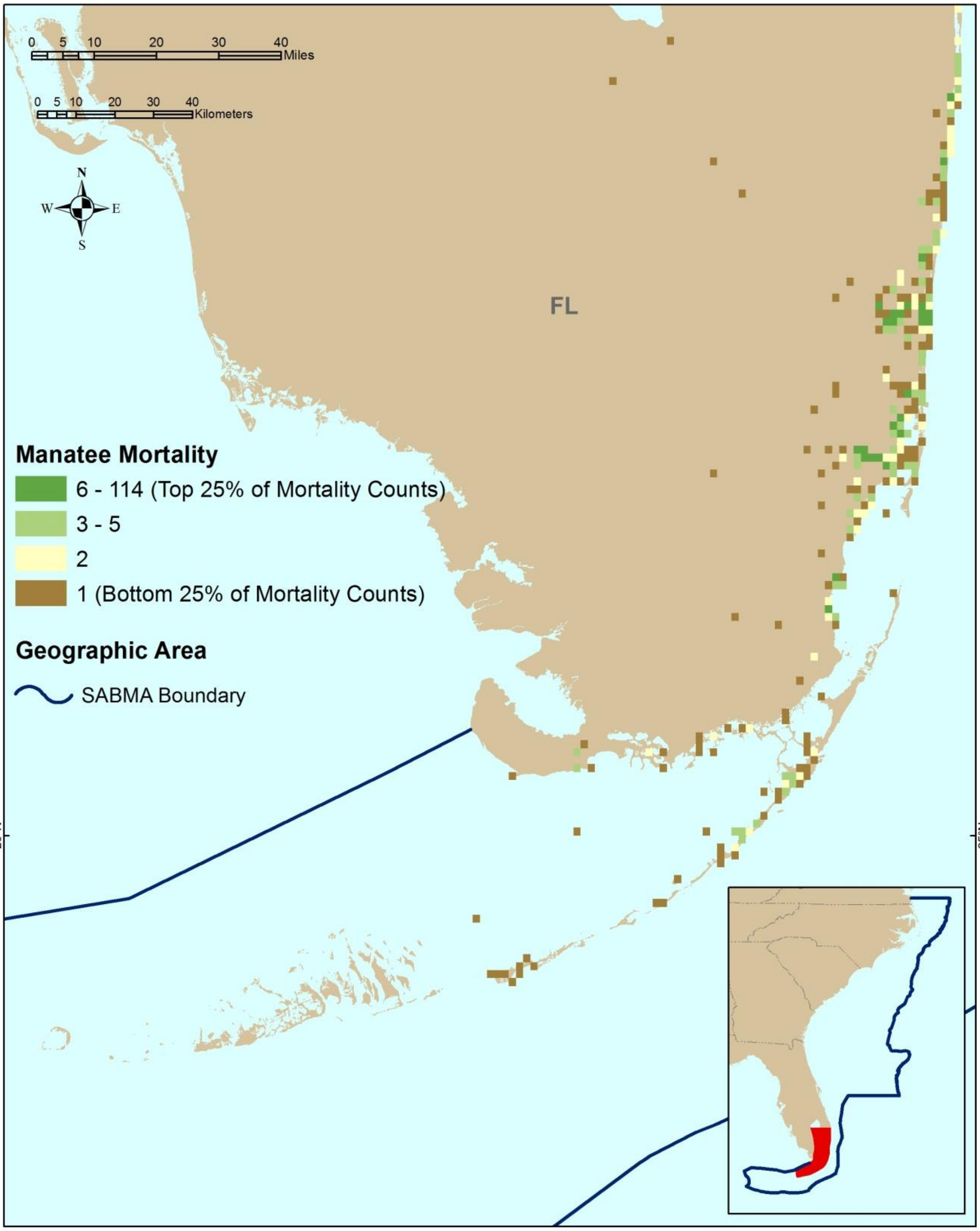

Figure 4.22. Manatee mortality location map, southeast Florida

SEA TURTLES: IN WATER DISTRIBUTION

HARDSHELL SEA TURTLES (LOGGERHEAD, GREEN, HAWKSBILL AND KEMP'S RIDLEY)

For the in-water sea turtle distribution analyses, it is important to note that survey effort is lacking for large portions of the survey area and there are issues with detectability/availability of turtles during warmer water seasons. Consequently, the in-water sea turtle maps may be best used to assess presence or absence of hard shelled turtles rather than patterns of abundance. Results suggest that hardshell turtles have broad distribution in SAB Continental Shelf waters in every season although the pattern of distribution varies (Figure 4.23).

Depending on the season, the greatest effort-corrected number of observations in any one TMS ranged from 234 to 782 sightings per unit effort. During the spring and summer months (March to May and June to August, respectively), two areas of higher concentration were observed: the area from southern Georgia to the southern survey boundary and the area from northern North Carolina to the northern boundary of the SAB region. Observations during the fall months (September - November) appeared to be primarily concentrated in the northern portion of the study area off northern North Carolina and the southern Virginia coast with a smaller concentration area off northern South Carolina, however, very little survey effort took place off northern South Carolina and southern North Carolina during the fall months. In the winter months (December – February), hardshell turtles appeared to move offshore or south and observations were concentrated along the Continental Shelf off central Georgia to the southern boundary of the survey area (Cape Canaveral, Florida). Variations in seasonal abundance may be related more to thermoregulation behavior (sunning during cold water periods) than seasonal movement of animals. The seasonality of the sightings, with a higher concentration of turtles in the southern portion of the study area in winter, follows the general pattern of decreased turtle sightings as waters in the northern portion of the study area cool and prey resources diminish (Braun-McNeil and Epperly 2002; Braun-McNeil et al. 2008).

LEATHERBACK TURTLE

Based on effort-corrected observations, leatherback turtle distribution varies seasonally in the region, with the greatest number of effort-corrected observations in any one TMS ranging from 35 to 166 depending on the season (Figure 4.24). In the summer months, turtles were diffusely spread throughout the survey area, with an area of high concentration observed on the Continental Shelf offshore of Georgia. In the winter and spring months (December - February and March - May, respectively) most turtles were concentrated in the southern portion of the survey area. In fall (September - November) turtles were most concentrated off the Georgia coast. In spring and fall, limited survey effort occurred off the coast of South Carolina and southern North Carolina. In all seasons, sightings were almost exclusively on the Continental Shelf. The relatively high concentration of sightings offshore of the area between southern South Carolina and the southern boundary of the SAB region suggests that this area is of great importance for the leatherback.

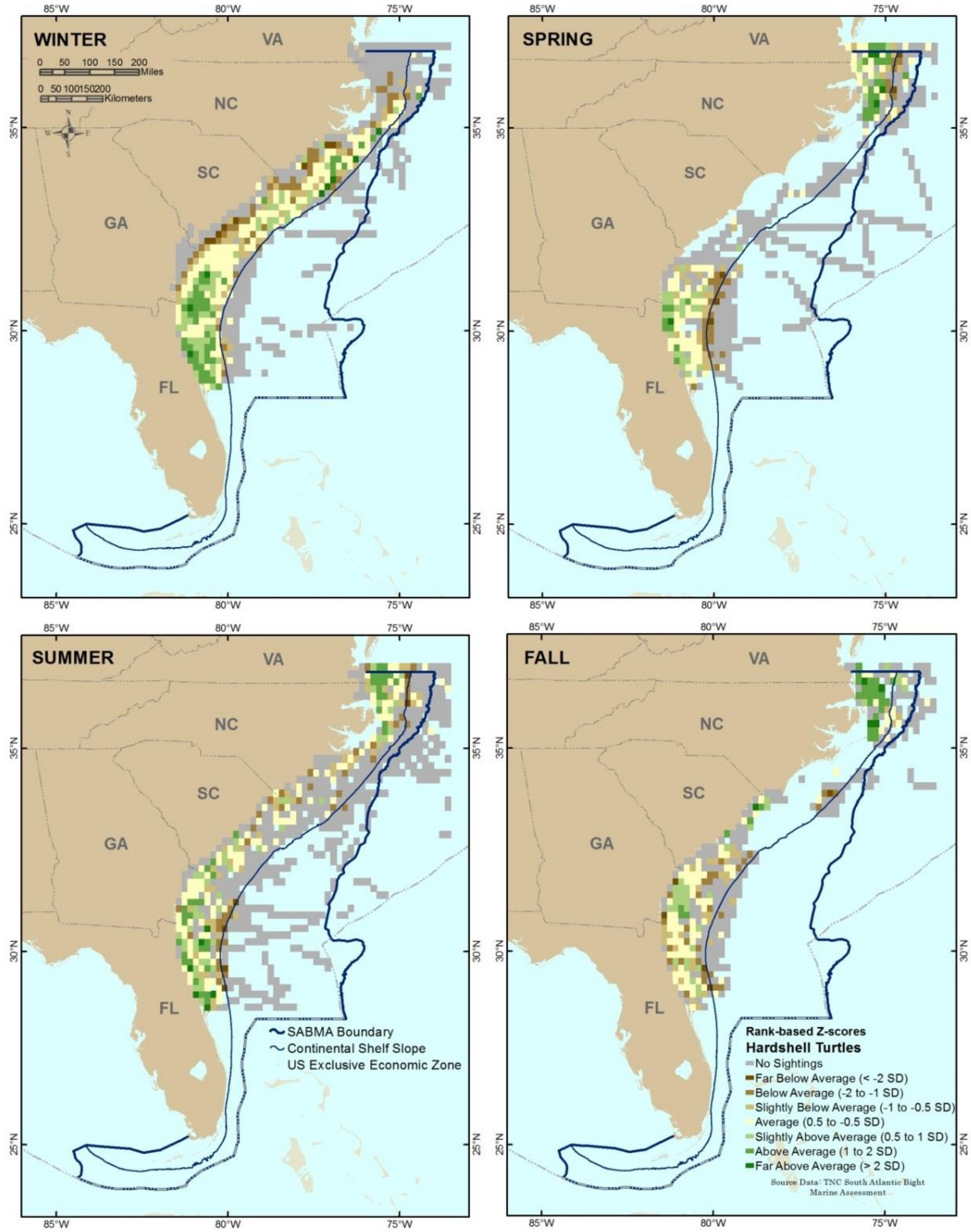

Figure 4.23. Hardshell sea turtle (loggerhead, green, and Kemp's ridley) distribution map by season

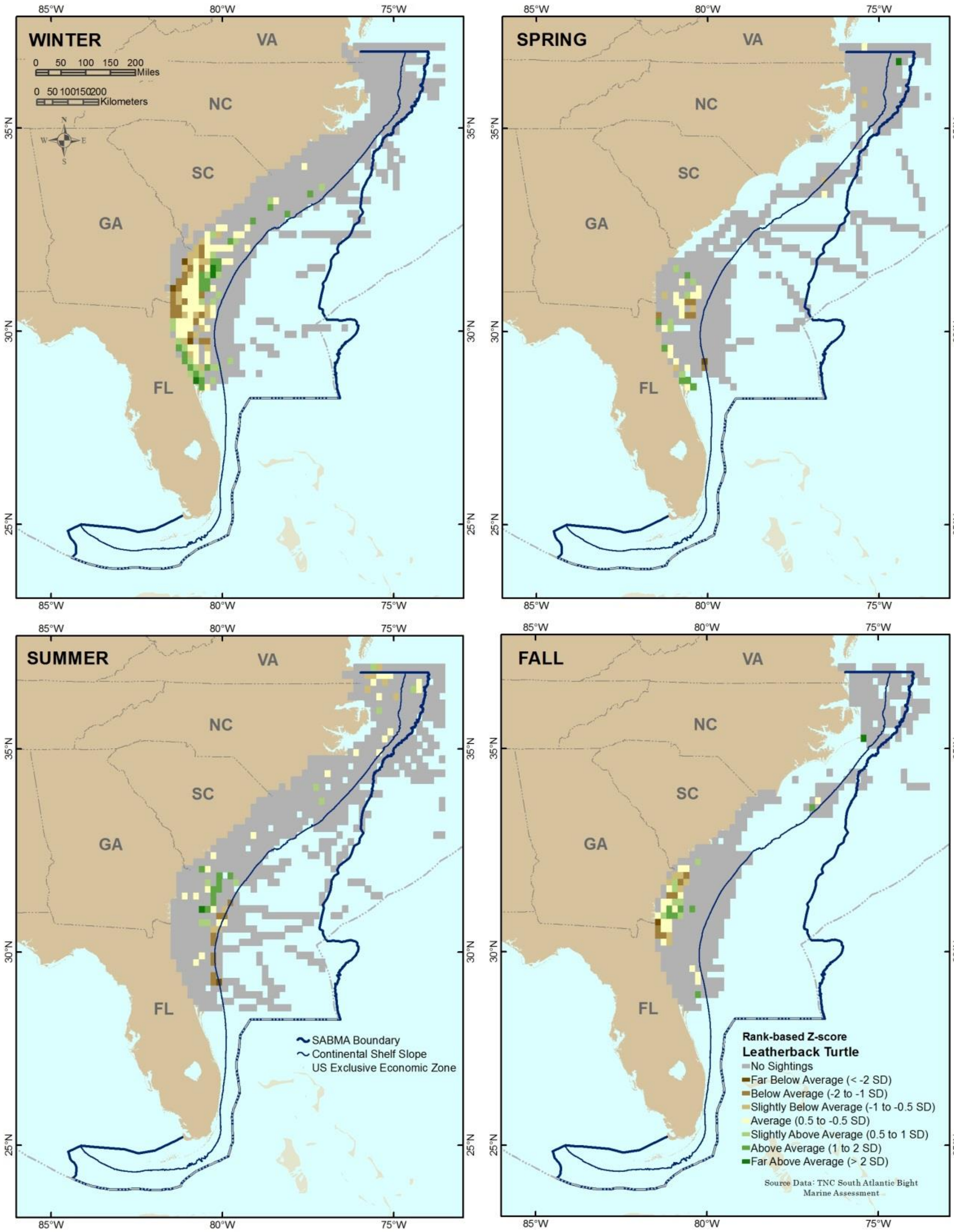

Figure 4.24. Leatherback sea turtle distribution maps by season

SEA TURTLES: NESTING AREAS

Five sea turtle species nest in the SABMA area, however, only the loggerhead turtle nests regularly in the SABMA region outside of Florida. Due to the limited amount of nesting in the SABMA region by two of the target species, the hawksbill and Kemp's ridley turtles, only presence and absence of nests has been recorded. For the three remaining species, loggerhead, green and leatherback turtles, the nesting data are displayed in quartiles to eliminate any subjectivity in selecting the density categories.

LOGGERHEAD TURTLE

Nest densities can exhibit considerable interannual variation in the Northwest Atlantic population (TEWG 2009) as well as among genetic subunits (FWC 2014b); however, there are consistent nesting density patterns in specific regions (Figures 4.25 through 4.29). Nesting density was greatest in the South Florida subunit with values as high as 774 nests per km of beach surveyed (Figure 4.28). This was followed by the Central East Florida subunit where the highest average density for the five-year period reached 336 nests per km (Figure 4.27). The Upper South Atlantic Bight and Dry Tortugas genetic subunits had similar maximum nesting densities of 96 and 109 (Figures 4.25 and 4.29), respectively, per km of surveyed beach. The Northeast Florida genetic subunit had the lowest mean nesting density per km of beach surveyed with a maximum of 16 nests/km (Figure 4.26).

Within the Upper South Atlantic Bight genetic subunit, nesting densities were highest in Georgia and South Carolina and lower further north in North Carolina and Virginia. Within the North Florida genetic subunit, nesting densities were generally low with higher nesting densities interspersed between lower nesting density areas. Highest nesting densities within the East-Central Florida genetic subunit were found south of Cape Canaveral with a second peak area on the north side of the cape. Peak nesting densities within the South Florida genetic subunit were found in the northern portion of this genetic subunit. Nesting dates ranged from May through September with peaks during June and July.

GREEN TURTLE

In the SAB region, an estimated 200 to 1,100 green turtles nest annually, primarily along the central and southeast portions of the Florida coast (NOAA Fisheries 2014a) with nesting extending as far south as the Dry Tortugas in the Florida Keys. Mean nesting densities for the six year period of 2006-2011 along the beach segments surveyed (Florida only) ranged from a high of 207 to a low of 0 nests per km of beach surveyed. The assembled data identify the beaches from Brevard County, FL south to Broward County, FL as major concentration areas for green sea turtle nesting (Figures 4.30 and 4.31). Although nesting survey data are unavailable north of Florida, green turtles are known to nest in small numbers in Georgia, South Carolina, and North Carolina (USFWS 2012).

LEATHERBACK TURTLE

In the SAB region, leatherback turtles nest primarily along the central and southeast portions of the Florida coast; nesting extends south to Key Biscayne (near Miami, Florida) and north to where the St. John's River flows into the ocean (near Jacksonville, Florida). Mean nesting densities for 2006-2011 ranged from a high of 18 to a low of 0 nests per kilometer of beach surveyed. The assembled data identify Florida beaches in Palm Beach, Martin and St. Lucie counties (Southeast Florida) as major concentration areas for leatherback turtle nesting in the SAB region (Figures 4.32 and 4.33). Although no survey dataset is available, leatherback turtles occasionally nest on Georgia, South Carolina and North Carolina beaches (NMFS USFWS 1992; Dodd 2014).

HAWKSBILL TURTLE

Only a few hawksbill turtle nests have been recorded in recent years (2006 – 2011) on Florida index beaches (five beaches along Florida's Central East Coast in Palm Beach County and one in the Florida Keys in Monroe County) (FWC 2014b)). Due to the rarity of nesting of this species in the SAB area, only presence and absence data are presented in Figures 4.34 and 4.35.

KEMP'S RIDLEY TURTLE

Like the Hawksbill turtle, the Kemp's ridley turtle rarely nests within the SABMA Region. From 2006 to 2011, Kemp's ridley turtles were only observed nesting at four Florida index beaches -- two in southeast Florida, and one each in northeast and central-east Florida (FWC 2014b; Figures 4.36 and 4.37). There have been several nests in VA and other states north of Florida in the last few years (Georgia Conservancy 2012; Hampton Roads 2012; Swingle pers. comm.).

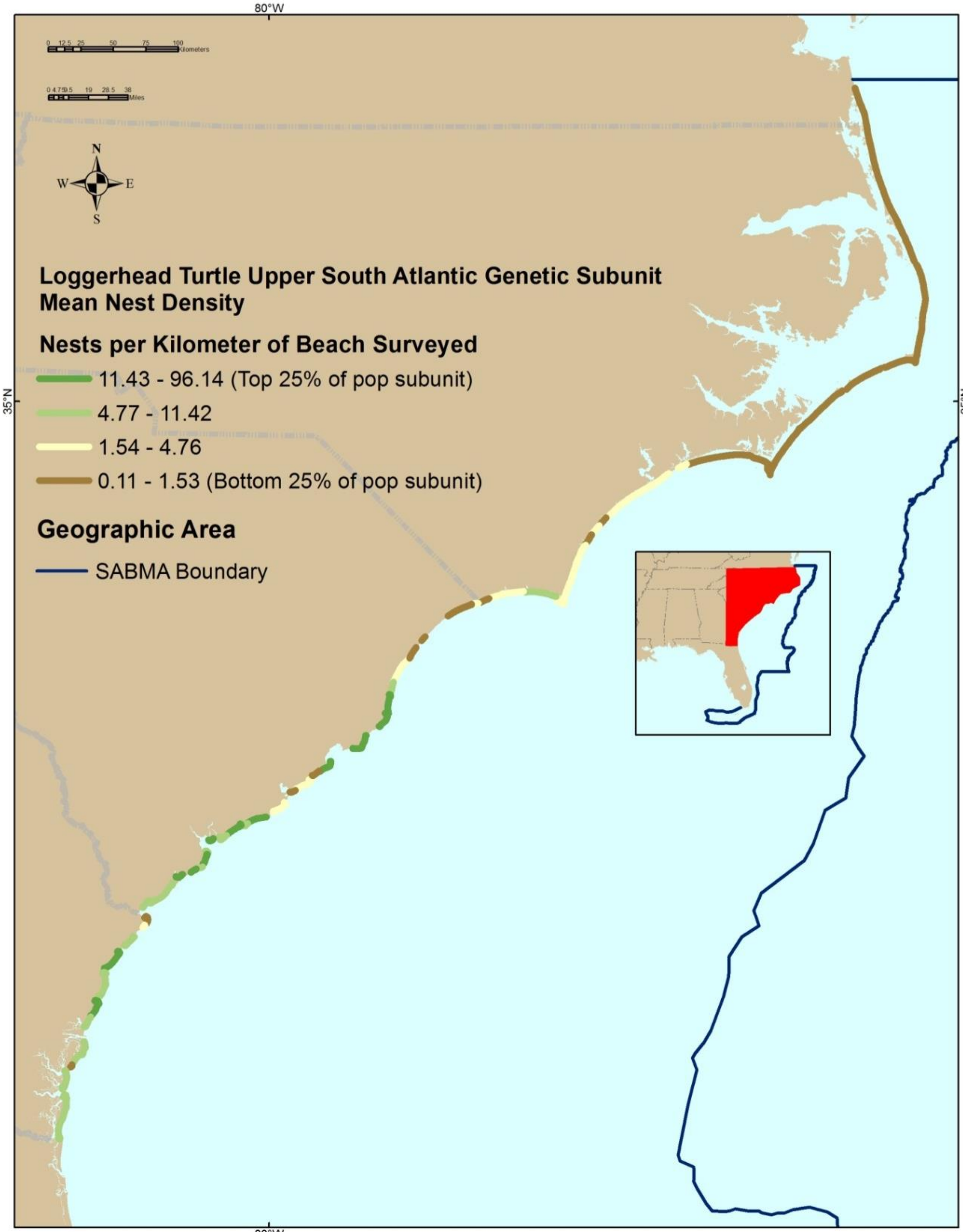

Figure 4.25. Loggerhead turtle nesting density, Upper South Atlantic genetic subunit

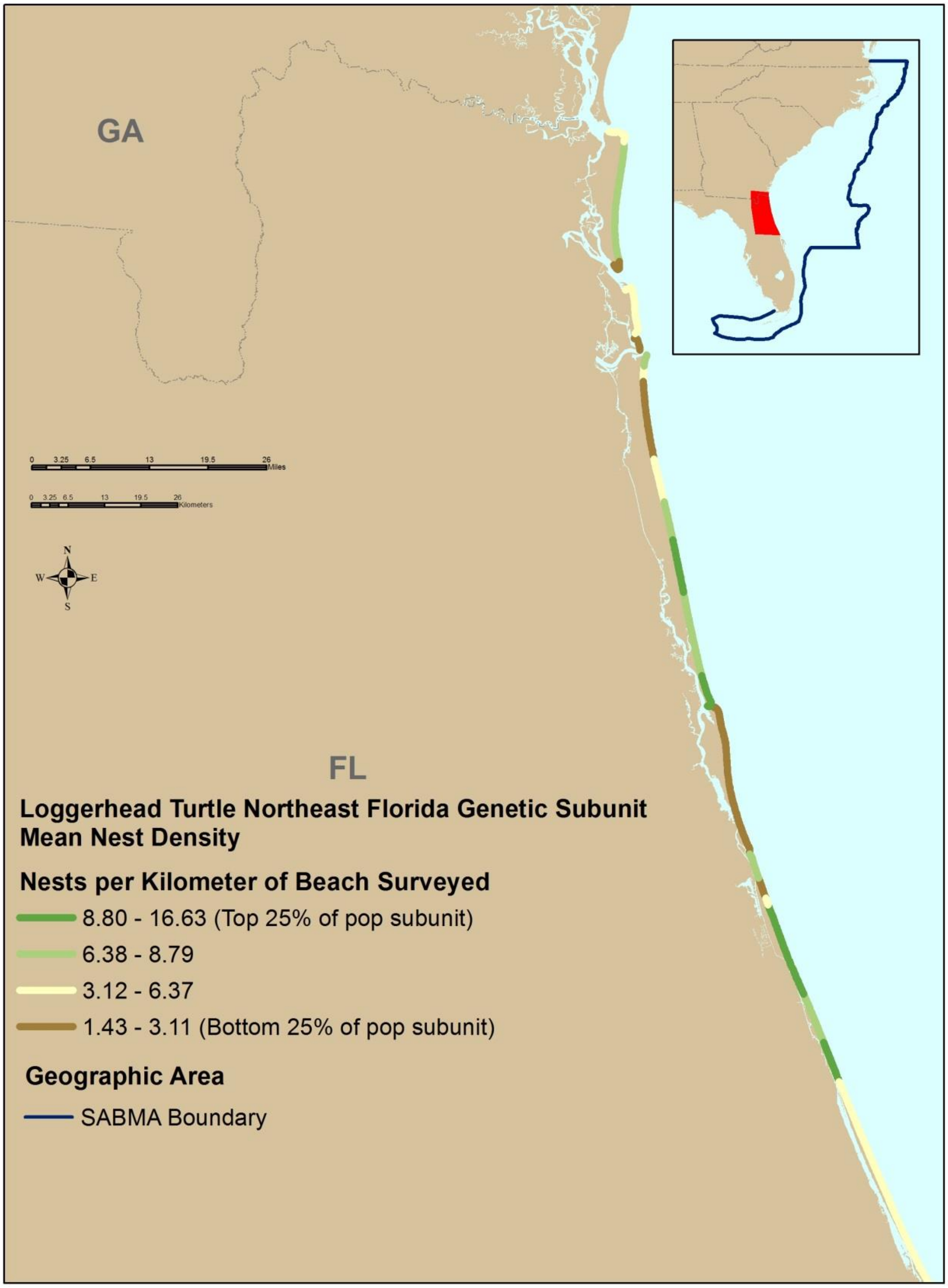

Figure 4.26. Loggerhead turtle nesting, Northeast Florida genetic subunit

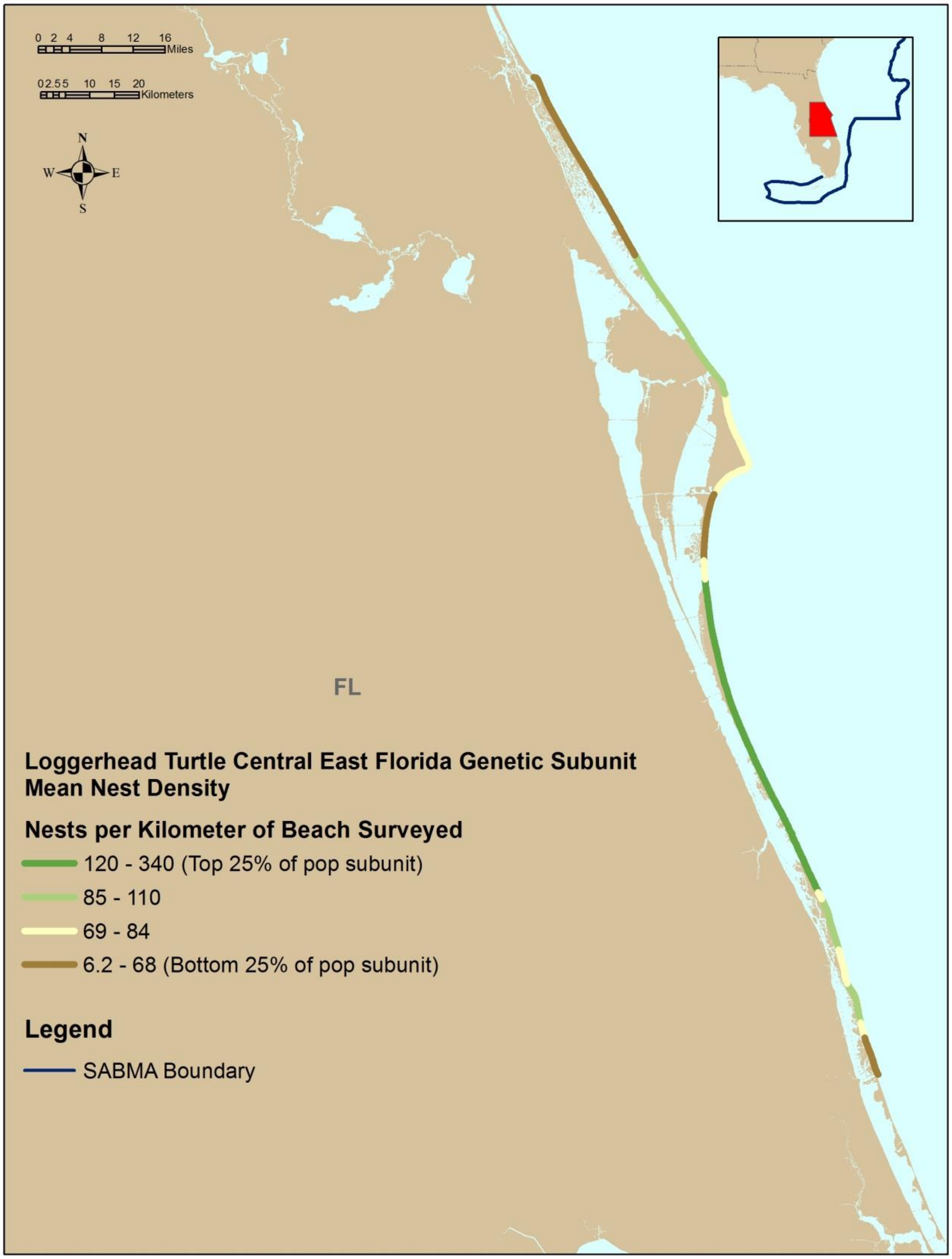

Figure 4.27. Loggerhead turtle nesting density, east-central Florida genetic subunit

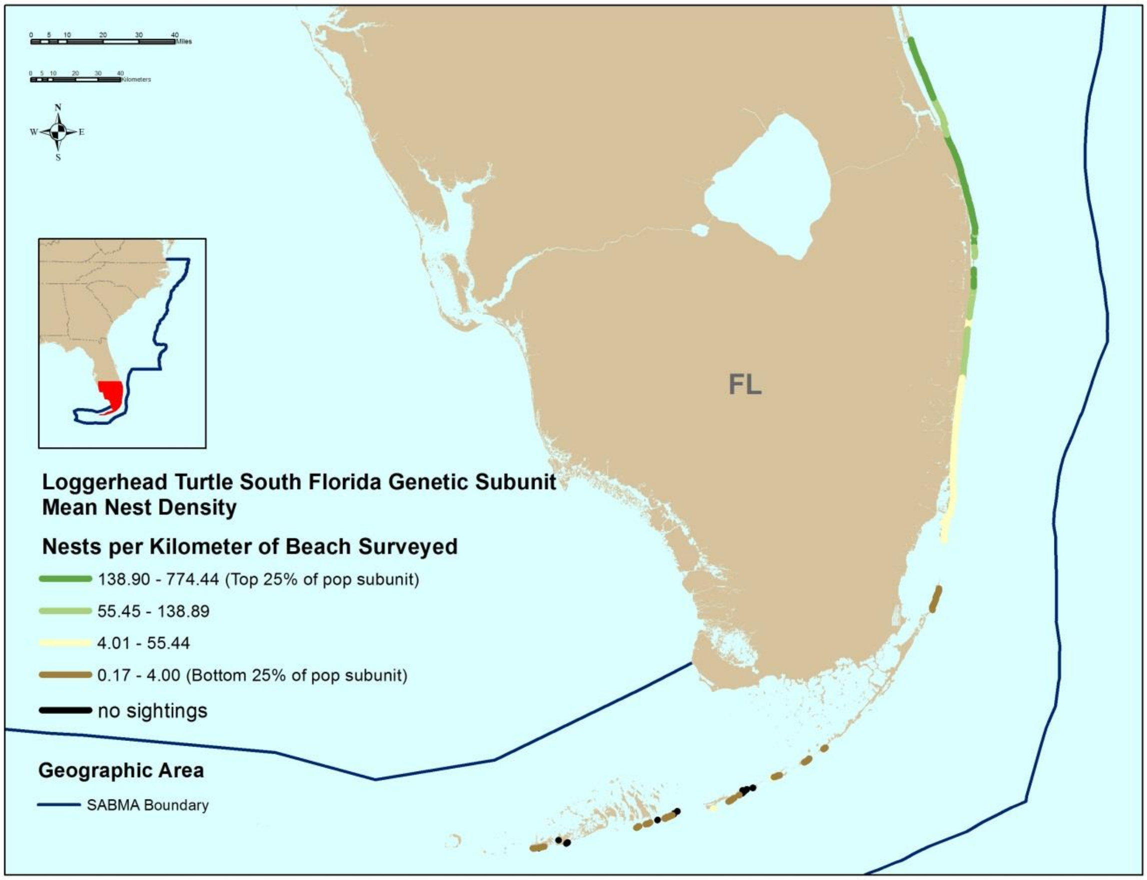

Figure 4.28. Loggerhead turtle nesting density, South Florida genetic subunit

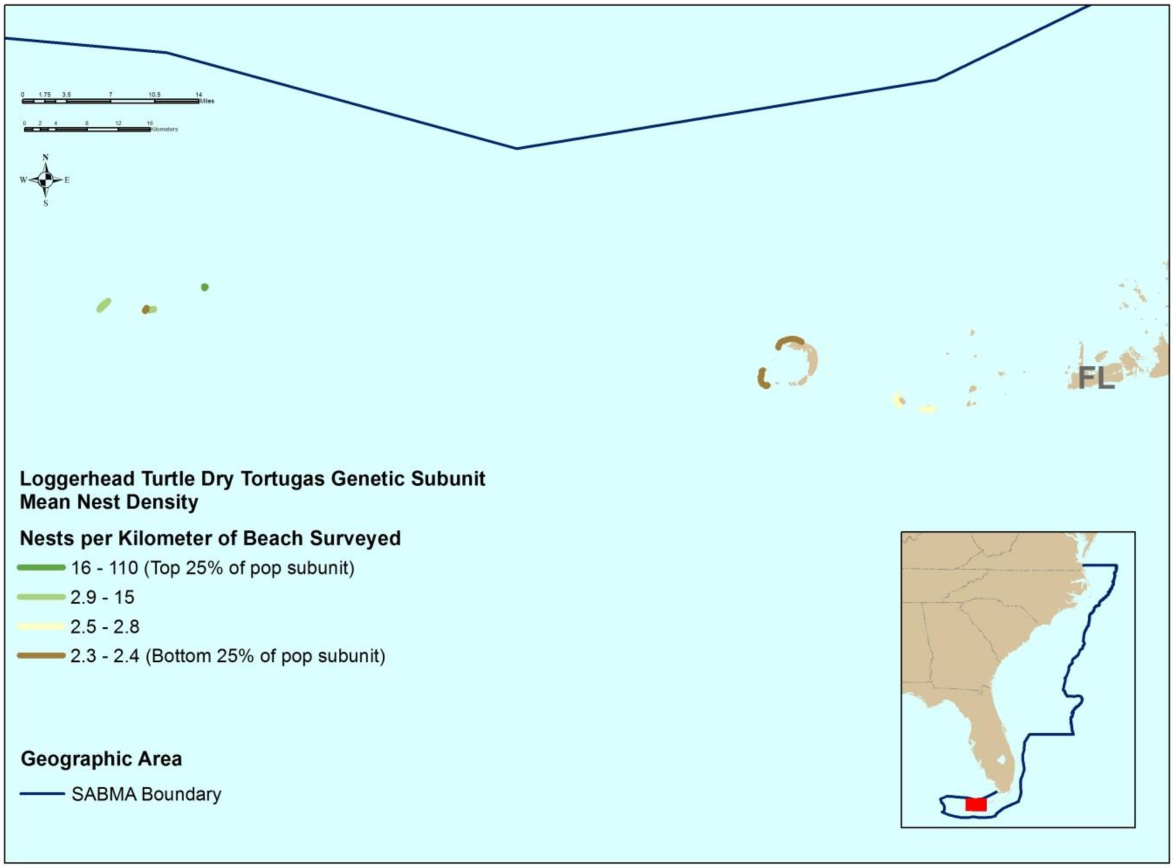

Figure 4.29. Loggerhead turtle nesting, Dry Tortugas genetic subunit

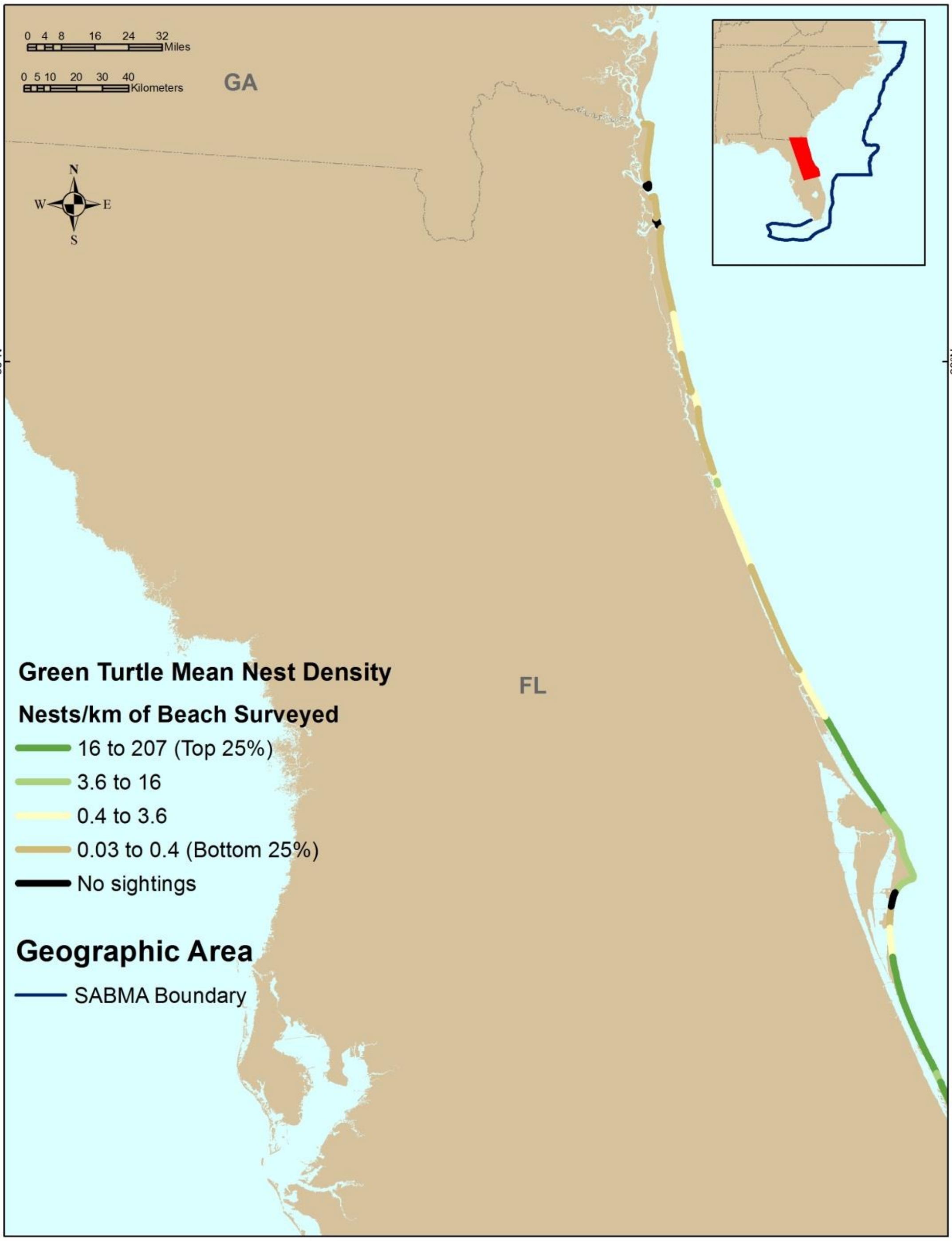

Figure 4.30. Green turtle nesting density, northeast Florida

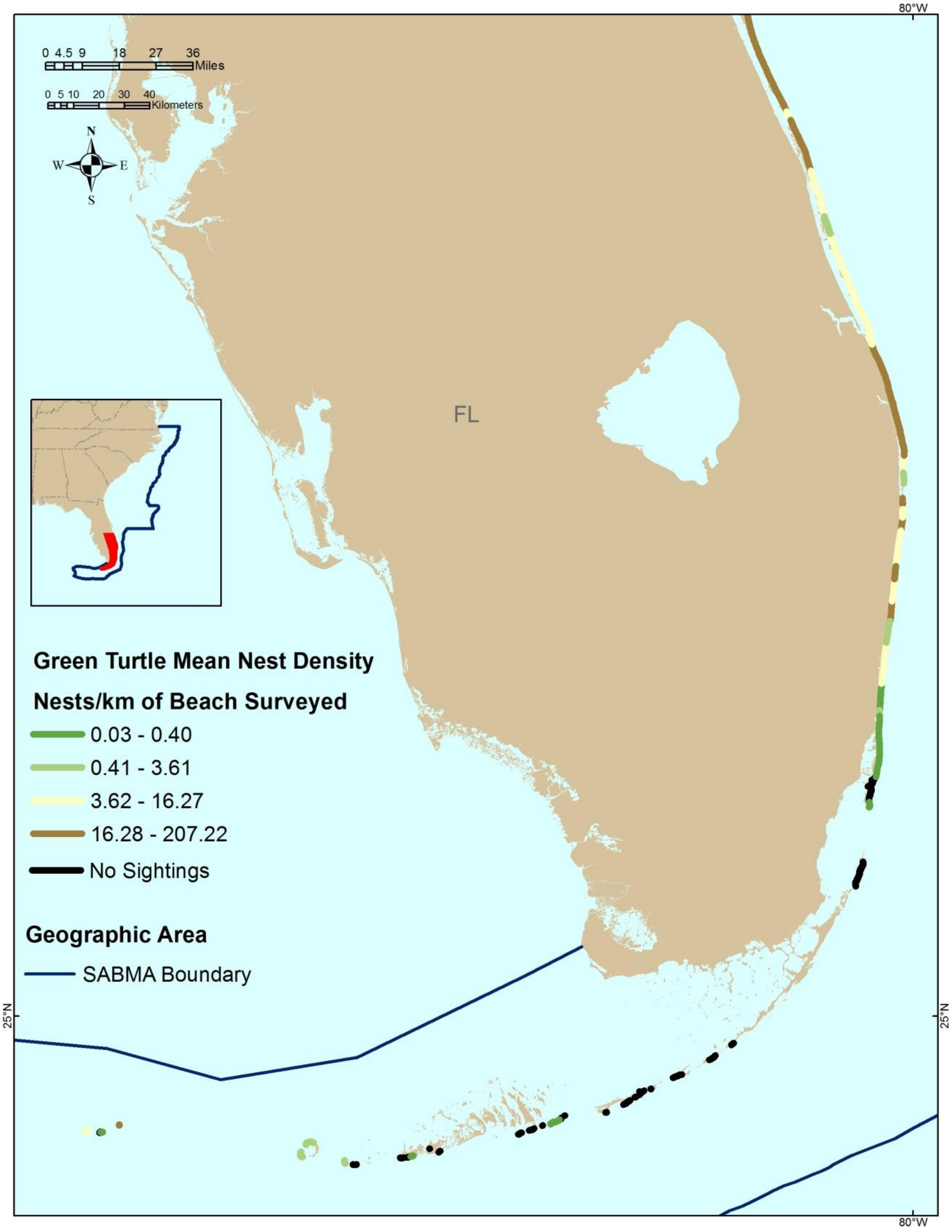

Figure 4.31. Green turtle nesting density, south Florida

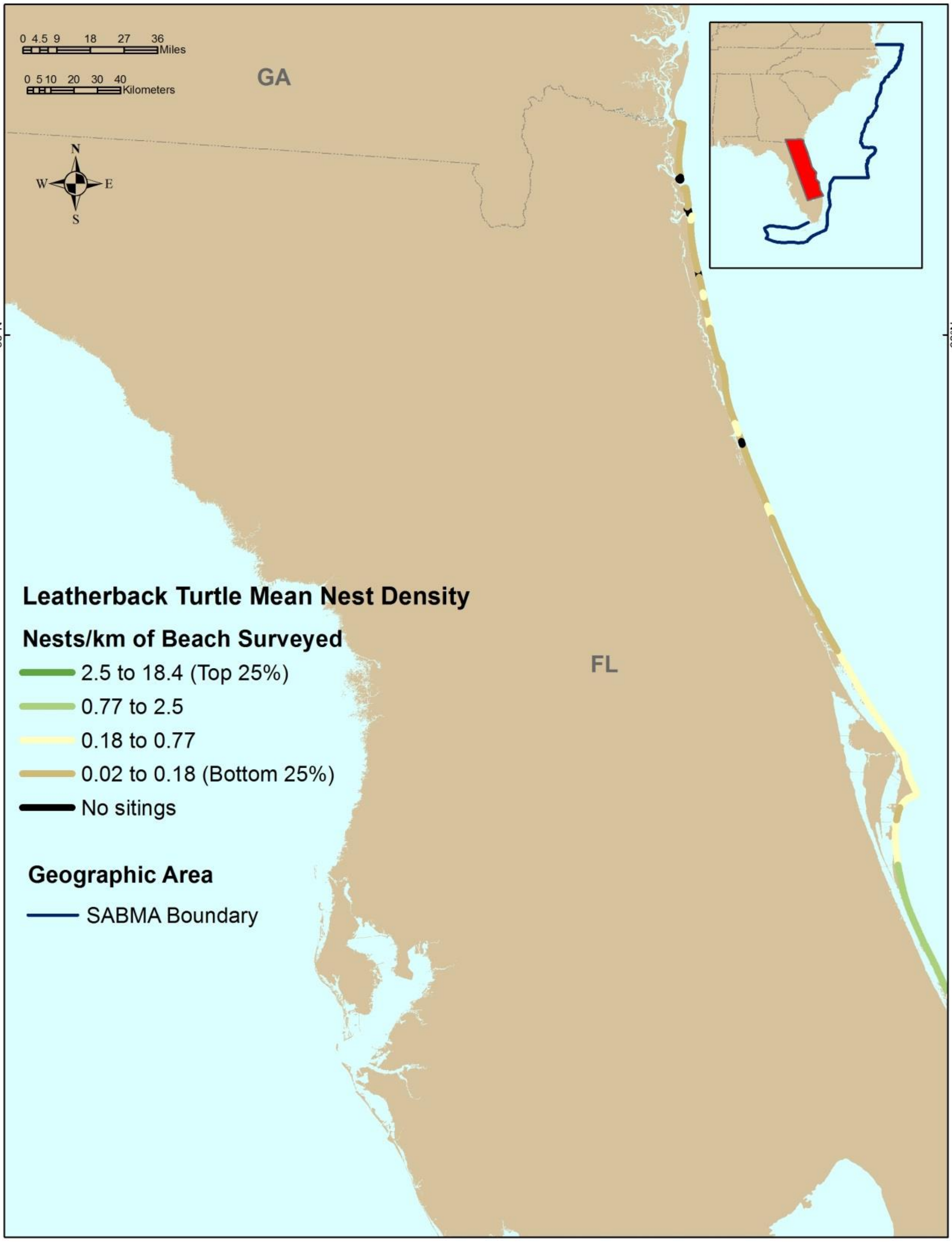

Figure 4.32. Leatherback turtle nesting density, northeast Florida

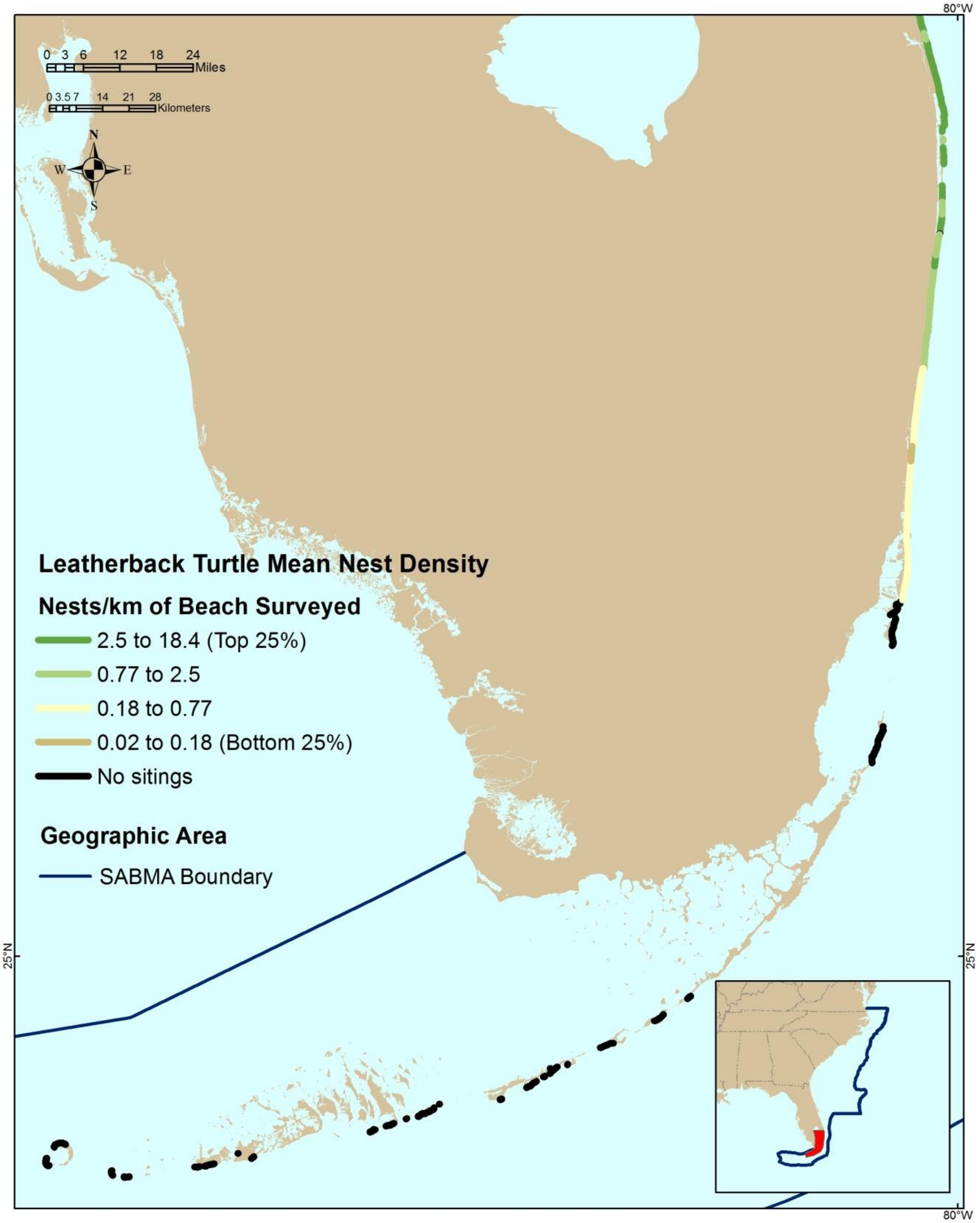

Figure 4.33. Leatherback turtle nesting density, south Florida

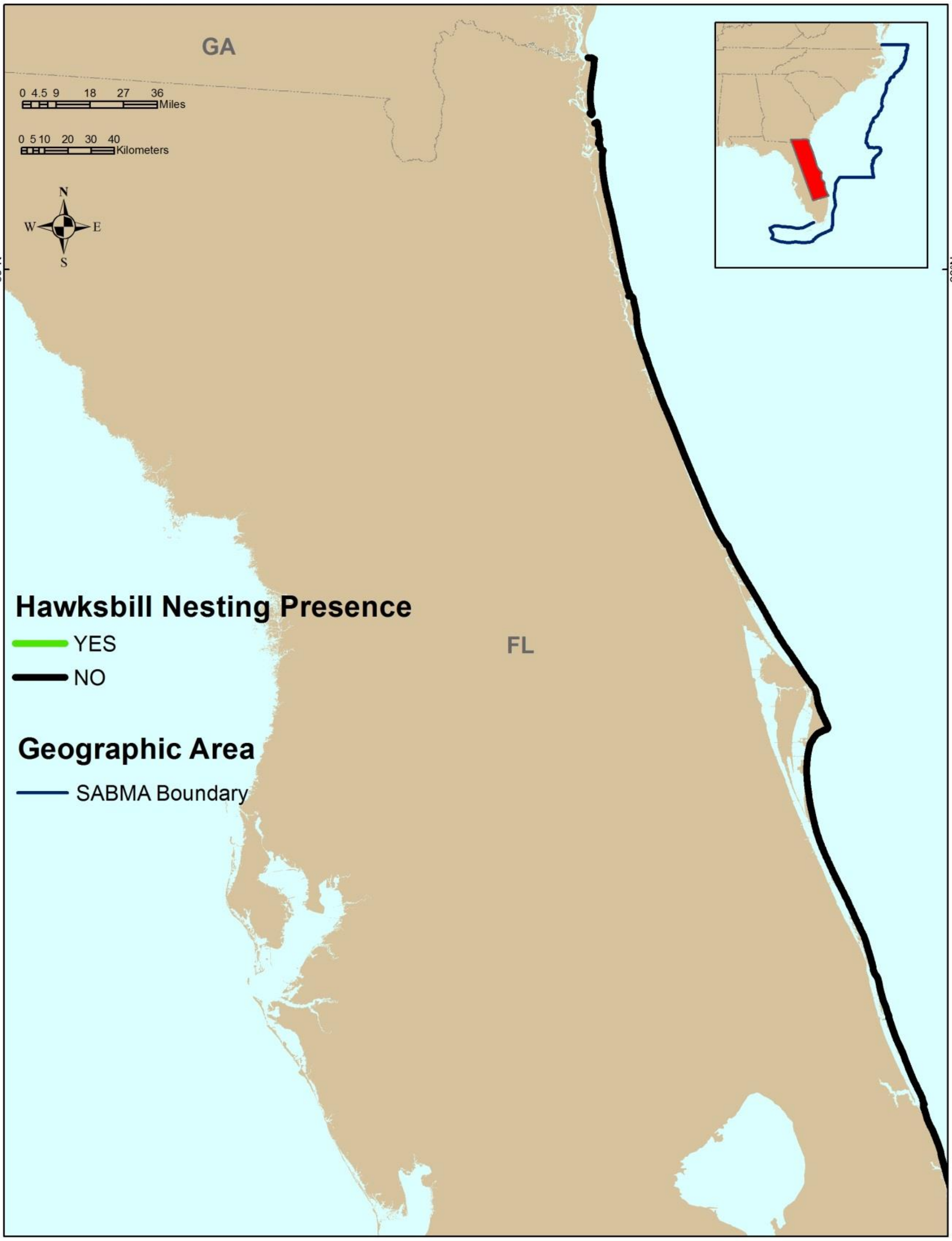

Figure 4.34. Hawksbill turtle nesting presence/absence, northeast Florida

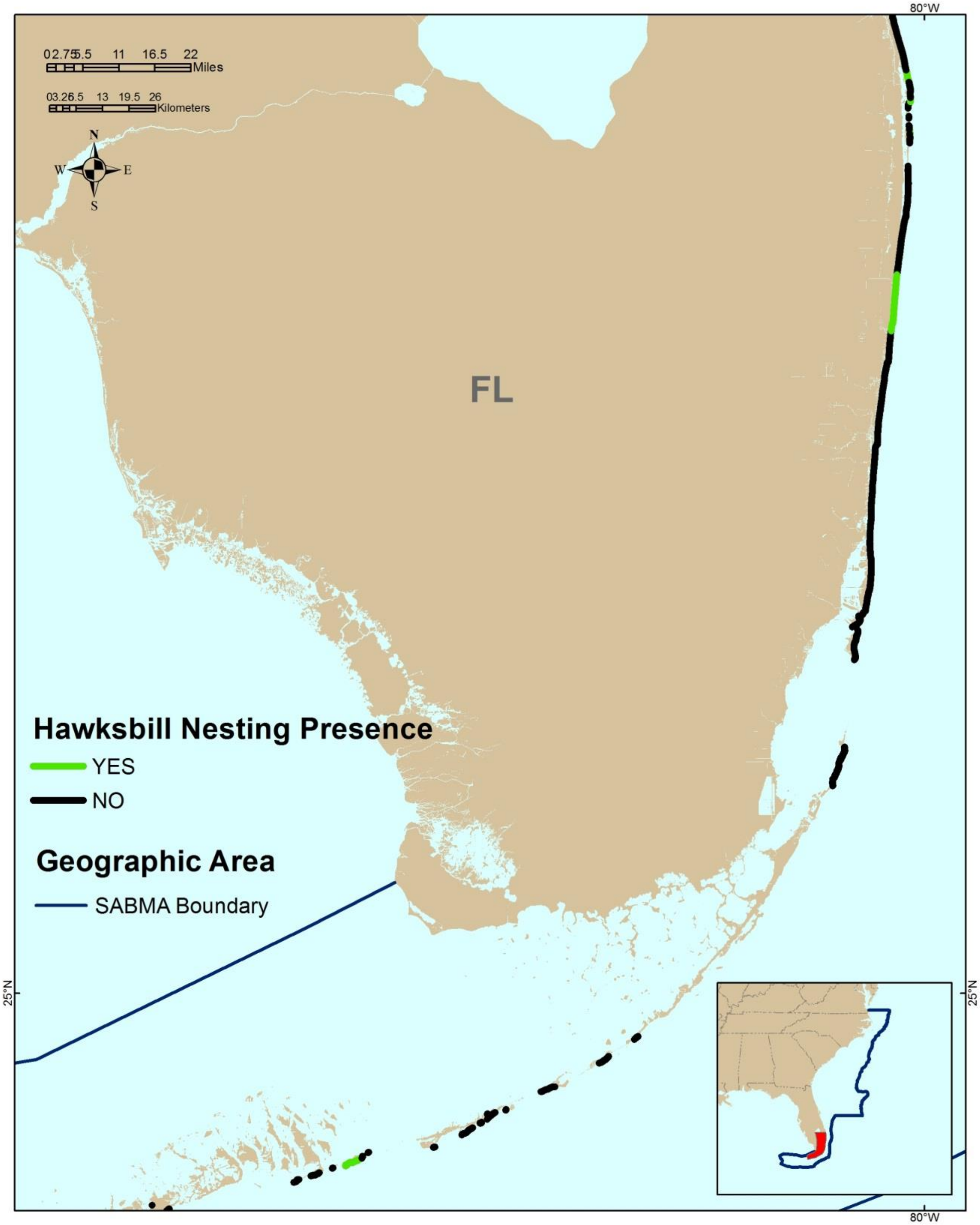

Figure 4.35. Hawksbill turtle nesting presence/absence, south Florida

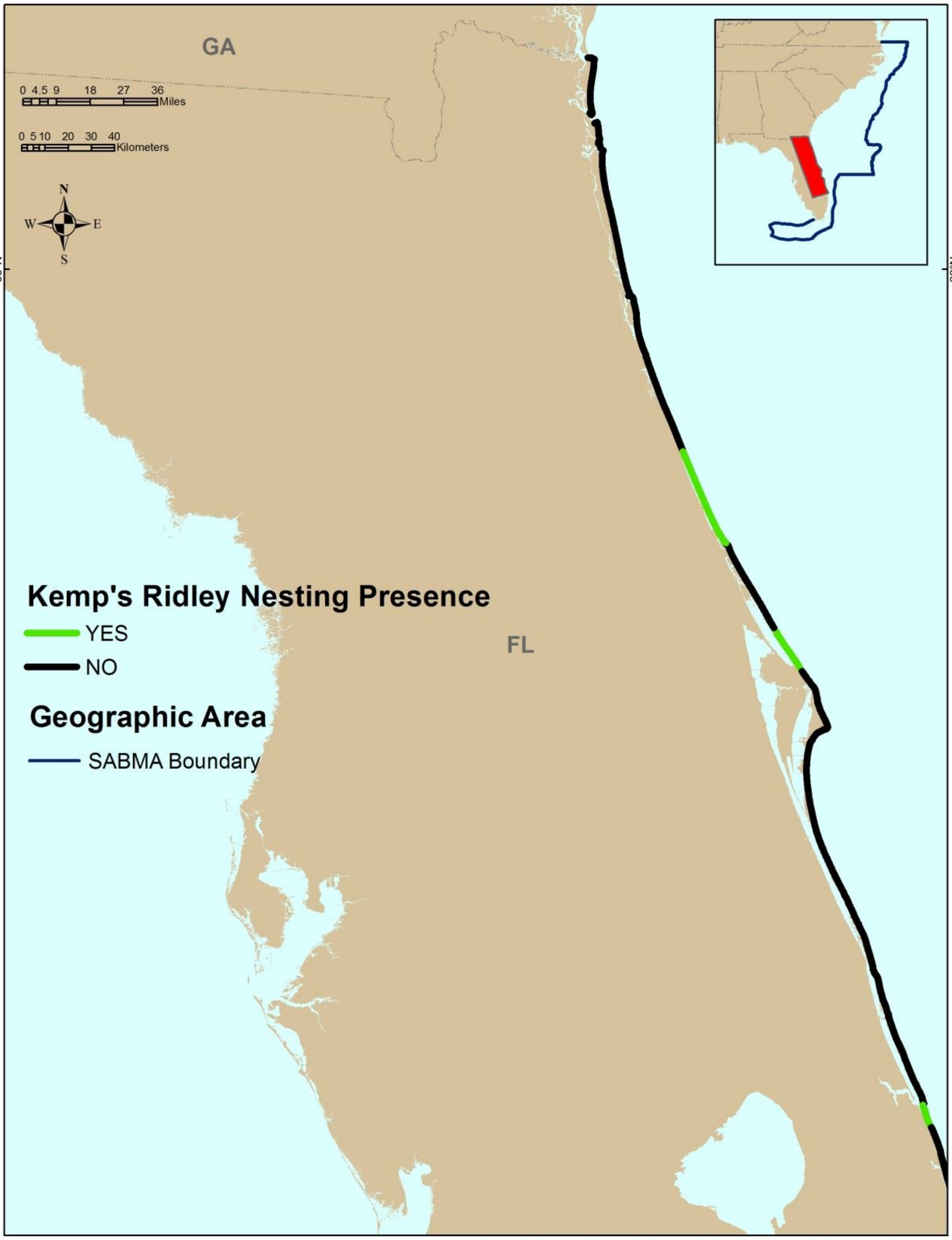

Figure 4.36. Kemp's ridley turtle nesting presence/absence, northeast Florida

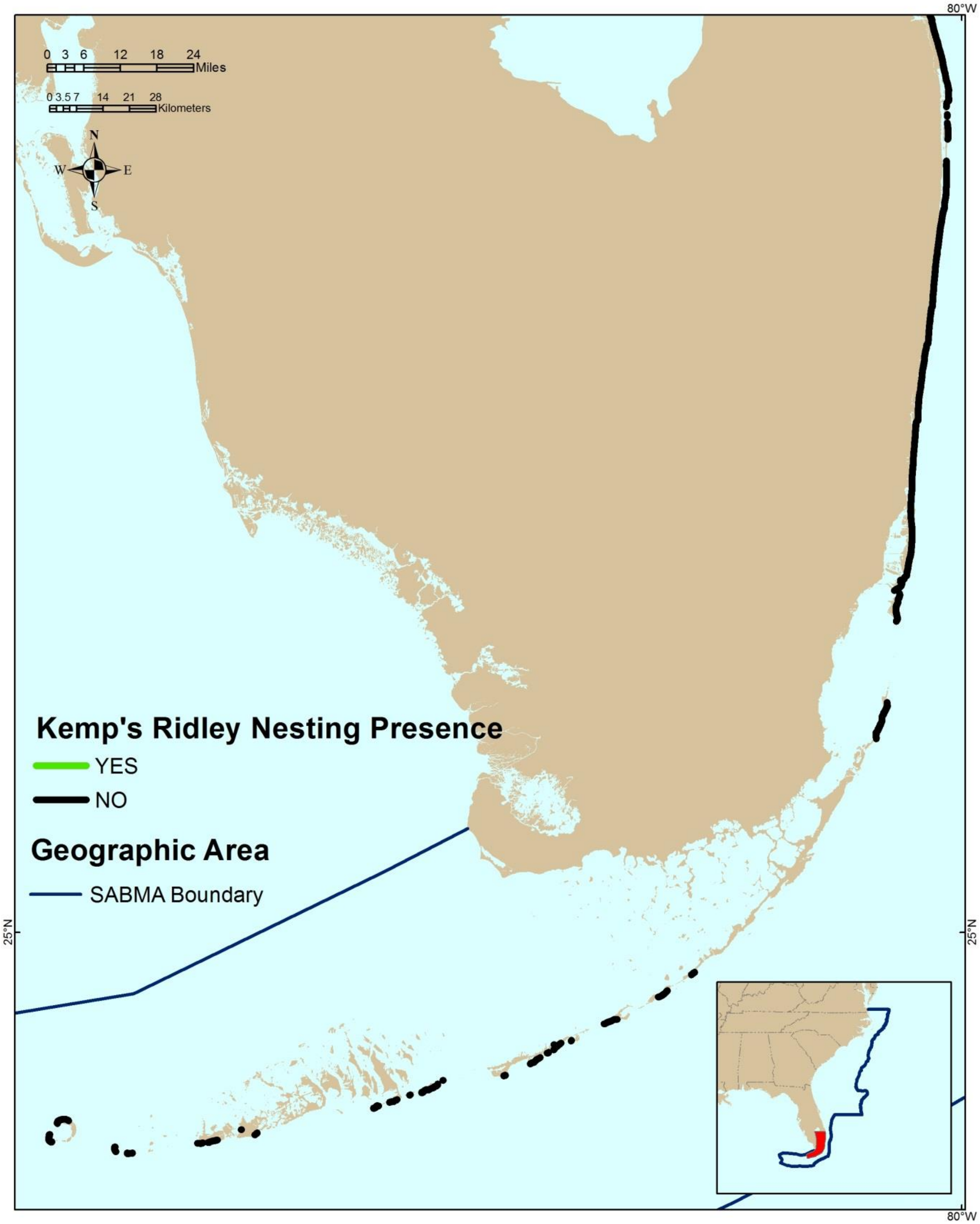

Figure 4.37. Kemp's ridley turtle nesting presence/absence, south Florida

Human Interactions and Other Threats

Marine Mammals

Marine mammals are vulnerable to pressures caused by direct and indirect interactions with humans. Threats to South Atlantic Bight marine mammal populations include collisions with vessels; bycatch and entanglement in fishing gear; depletion of prey resources; acoustic disturbance; exposure to aquatic contaminants; habitat degradation; and climate and ecosystem change (Fertl and Leatherwood 1997; Reeves et al. 2003; NOAA 2014b; O'Shea et al. 1985). As a result of these activities, populations and individuals can have alterations in longevity, reduced fecundity and changes in their migratory nature. The full effects of interactions in the study area are not completely known. However, intensive research on the interactions between cetaceans and humans is taking place (Clark et al. 2009; Hatch et al. 2008; Lightsey et al. 2006, Scheifele and Darre 2005; SBNMS 2009; Wiley et al. 2003; Wiley et al. 2008).

Vessel Strikes

All large whale species in the region are vulnerable to vessel strikes, but the frequency and location of those interactions are poorly understood. Ship strikes accounted for 53% of the resolved deaths in necropsied right whales (Campbell-Malone et al. 2008). There is little evidence that right whales avoid vessels, and whales may even become tolerant to vessel noise and ignore it (Nowacek et al. 2004). A higher frequency of reports of interactions has occurred in recent years, but it is not yet clear to what degree this is due to a greater number of possible observers.

Manatees in the study area are also vulnerable to vessel strikes, usually involving small recreational watercraft in inland waters. A study of recovered dead manatees in Florida between 1993 and 2003 found that watercraft strikes represented the largest percent of identified cause of death at 24% (Lightsey et al. 2006).

Fishing Gear and Entanglement

Interaction between the fishing industry and cetaceans in United States waters has been documented by federal monitoring programs. Entanglement is a documented source of injury and death for a wide range of cetacean species, including endangered large whales in the western North Atlantic (Johnson et al. 2005; Waring et al. 2009; NMFS 2010a). A study of entangled right and humpback whales in the western North Atlantic found that a wide range of gear types was involved, but the vast majority of entanglements (89%) were attributed to pot and gill net gear (Johnson et al. 2005). Small toothed whales, such as bottlenose dolphins, have been observed as bycatch in a variety of fisheries, including those utilizing sink gillnets, bottom trawls, mid-water trawls, and herring trawls (NMFS 2006b; ATGTRT 2007).

Anthropogenic Noise
The effect of human-generated noise on cetaceans remains a controversial and poorly understood conservation issue (see review in Clark et al. 2007 and Parks and Clark 2007; Richardson et al. 1995; NRC 2003). Cetaceans are highly vocal and dependent on sound for almost all aspects of their lives (e.g., food-finding, reproduction, communication, detection of predators/hazards, and navigation), heightening concerns regarding the impacts of human-induced noise (NRC 2003). Human-generated sound in the sea comes from a variety of sources, including commercial ship traffic, oil exploration and production, construction, acoustic research, sonar use and other types of military activities. Sound in the ocean, particularly low frequency sound, can propagate over large distances, thus both spatial and temporal scales of potential impact can be large. A great deal of variation has been observed in noise responses by both cetacean species and individuals of different genders, age classes, and among individuals with different prior experiences with noise and in different behavioral states (Southall et al. 2007).

Observed effects of noise on cetaceans include changes in vocalizations, respiration, swim speed, diving, and foraging behavior; displacement; avoidance; shifts in migration path; hearing damage; and strandings (Parks and Clark 2007). Responses of cetaceans to noise can often be subtle, and there are many documented cases of apparent tolerance of noise. However, marine mammals showing no obvious avoidance or changes in activities may still suffer important consequences. Observed reactions to noise in marine mammals could result in population- level impacts such as decreased foraging efficiency, higher energetic demands, less group cohesion, higher predation, and decreased reproduction (NRC 2005). Much research effort is currently focused on assessing population consequences in better-known cetacean populations that have been exposed to long-term human-induced noise (e.g., North Atlantic right whales, Clark et al. 2009).

Contaminants and Marine Pollution
Cetaceans are exposed to many classes of marine contaminants such as organochlorines, endocrine disruptors, and biotoxins from harmful algal blooms, but the effects on these organisms are not fully known (Weisbrod et al. 2000). Mass stranding events have been documented and connected to ingestion of contaminated food sources. For example, in the winter of 1989, a mass stranding of humpback whales in Cape Cod Bay, Massachusetts was linked to contamination of Atlantic mackerel with saxitoxin produced by the microscopic marine alga *Alexandrium* spp. (Geraci et al. 1989). Determination and tracking of the effects of these contaminants is a rapidly evolving science (see review in Rolland et al. 2007). The size, free-swimming nature, and endangered status of many cetaceans can make it difficult to collect the

type of non-lethal samples (e.g., blood and tissue) needed to diagnose diseases or monitor physiological responses to these contaminants.

Climate Change

Adaptability of marine mammals to climate change is currently unknown for most species. Studies have reported that species with limited ranges or dependence on sea ice or that migrate to feeding grounds in polar regions, such as many of the baleen whales, are most vulnerable (Learmonth et al. 2006; Simmonds and Isaac 2007). Other species may largely be affected through changes in prey distribution and abundance, with more mobile (or otherwise adaptable) species perhaps better able to respond to climate change impacts. Based on an analysis of the impact climate change could have on species ranges, Learmonth et al. (2006) hypothesized that the North Atlantic right whale and northern bottlenose whale could potentially experience a range contraction while the pygmy sperm whale, dwarf sperm whale, Gervais beaked whale, short-beaked common dolphin and long-beaked common dolphin could experience a range expansion.

Manatees could be affected by changes in the distribution and abundance of their primary food source, seagrass. With rising average temperature, seagrass meadows could deteriorate due to increases in harmful algal blooms (HABs) such as red tides. HABs can also be lethal to manatees. Seagrasses could eventually move into newly submerged areas, but this will take time and is uncertain. Manatees may also become more susceptible to vessel strikes as their range expands northward into areas without speed zone restrictions or an awareness of the habits of these slow-moving animals. In addition, their sources of freshwater could be compromised as a result of saltwater intrusion (Edwards 2013; Tripp 2014).

Sea Turtles

The five sea turtle species found in the South Atlantic Bight can all be negatively affected by interaction with human activities. Some common threats include fishing gear bycatch and entanglement; loss of critical habitat, particularly nesting beaches; and direct harvest. The relative impacts of these activities on sea turtle populations in the SABMA region vary by species, as discussed below.

Fishing Gear and Entanglement

Many turtle species and life stages are vulnerable to bycatch and entanglement in fishing gear. Comprehensive threat assessments for the Northwest Atlantic population of loggerheads conclude that a principal threat in the Northwest Atlantic is fisheries bycatch, specifically, in the bottom trawl, demersal longline, demersal large mesh gillnet, and pelagic longline fisheries. The Loggerhead Sea Turtle 2009 Status Review also identified mid-water trawl, dredge and pot/trap fisheries as threats. Total mortality from fisheries was not estimated, but is assumed to be significant. Entanglement in derelict fishing gear was also identified as a source of mortality for this species (Conant et al. 2009; NMFS USFWS 2008).

In U.S. waters, the pelagic longline and shrimp trawl fisheries have been identified as the largest documented source of leatherback mortality (NMFS 2001). Alternative methods and gear innovations (e.g., circle vs. J hooks; bait switching, TEDs) have reduced bycatch levels in recent years (NMFS USFWS 2007b). Fixed fishing gear (e.g., gill nets, pot/trap buoy lines, pound nets) is problematic in coastal foraging grounds (James et al. 2005) and in close proximity to nesting areas.

Various assessments also identify bycatch and entanglement as serious threats to green sea turtles (Seminoff 2004), leatherbacks (Wallace et al. 2011 as reported in Tiwari et al. 2013), hawksbill turtles, and Kemp’s ridleys. The greatest threat to the Kemp's ridley turtle has been unintentional bycatch in fishing gear, primarily in shrimp trawls, but also in gill nets, longlines, traps and pots, and dredges in the Gulf of Mexico and North Atlantic including the SAB region.

Harvest
Sea turtles are harvested legally and illegally in many places in the world. The greatest current threat to green sea turtles is the global legal and illegal harvest of eggs, juveniles, and adults from both terrestrial nesting beaches and neritic foraging areas. Of particular concern to the recovery of this slow-to-mature species is the harvest of juveniles in the Caribbean Sea, Southeast Asia, Eastern Pacific, and Western Indian Ocean (NMFS USFWS 2007a). For loggerheads, legal harvest of neritic juveniles and adults (in the Caribbean) results in estimated mortality similar to demersal longline and gillnets (Conant et al. 2009; NMFS USFWS 2008). Human consumption of eggs, meat, or other products was found to be the second highest source of mortality for leatherbacks (Wallace et al. 2011 as reported in Tiwari et al. 2013). At one time egg collection was an extreme threat to the Kemp’s ridley turtle, but protection efforts in place in the U.S. since 1966 have reduced this threat (NOAA Fisheries 2014b). Harvest of eggs and meat of the hawksbill is also a threat.

Habitat Degradation
Habitat degradation, particularly of nesting habitats, is a serious issue for all turtle species. For green turtles, habitat degradation of nesting areas in the form of beach replenishment and armoring, coastal development, and sand removal have been identified as key threats during terrestrial life stages (Lutcavage et al. 1997). Light pollution at nesting beaches results in disorientation of emerging hatchlings and

decreased nesting success. Declines in suitable coastal estuary habitat for green turtles are also widespread throughout their range including the larger systems along the western Atlantic coast (NMFS USFWS 2007a).

Degradation of nesting habitats has also been cited as a threat for loggerheads (Conant et al. 2009; NMFS USFWS 2008), leatherbacks (Wallace et al. 2011 as reported in Tiwari et al. 2013; NMFS USFWS 2007b), and hawksbills. Modifications from beach replenishment projects and armoring, erosion of active nesting beaches due to climatic events, light pollution on nesting beaches, predation by native and non-native species, accumulation of wood and marine debris (reducing access to the sand) are listed as specific impacts. Many of these impacts can alter habitat indirectly by modifying thermal profile and advancing erosion. Currently, many of the globally significant nesting areas for the leatherback turtle remain remote and are not as subject to these types of activities.

Marine Pollution

Marine pollution, including oil pollution from spills, is a threat to all sea turtle species in the study area. For example, important secondary sources of mortality identified by the Recovery Plan for loggerheads include general marine pollution and, more specifically, oil pollution (Conant et al. 2009; NMFS USFWS 2008). For green sea turtles, degradation of estuarine water quality due to development-related increases in effluent and contaminant loading (PCBs, heavy metals) has been linked to adverse impacts including recent increases in disease (e.g., Fibropapilloma, which results in internal and external tumors) (George 1997). Red tide events in coastal feeding areas have been linked to increased mortality in juveniles and adults (NMFS USFWS 2007a). Oil spills have been of secondary concern for hawksbills, but not so for the Kemp's ridley turtle which has experienced dramatic declines in nesting activity at their primary nesting beaches on the Gulf Coast of Mexico following the Deepwater Horizon BP oil spill in the Gulf, the first declines in more than 20 years (Dodd 2014).

Marine Debris

Sea turtles famously can ingest floating plastic bags, thinking they are jellyfish. Ingestion of marine debris is a threat to most sea turtle species. Entanglement in derelict fishing gear and ingestion of marine debris have been cited as sources of mortality for loggerhead, leatherback and hawksbill turtles, but these threats are likely to affect other species as well.

Vessel Strikes

Turtles resting at the surface are susceptible to vessel strikes. For loggerheads, vessel strikes (propeller and collisions) were identified as a large mortality source for neritic juveniles and adults (Conant et al. 2009). In Florida, boat strikes have been singled out as a large source of injury and mortality for green sea turtles (Singel et al. 2003).

Other Sources
One additional significant threat for hawksbills is the tortoiseshell trade, which threatens hawksbill populations globally (Mortimer and Donnelly 2008). Other threats to hawksbills include hybridization with other species (where population size is particularly low). Resource limitation in the eastern Pacific during cyclical climatic events (El Niño Southern Oscillation) has been linked to decreased reproductive success and increased vulnerability to anthropogenic mortality (NMFS USFWS 2007b). This is not currently the case in the Northwest Atlantic Ocean; however, future climatic changes may alter oceanic currents that influence prey availability and subsequent reproductive capacity. Increased temperatures at nesting sites have been linked to changes in hatchling sex ratios on some beaches (NMFS USFWS 2007b).

Management and Conservation

Marine Mammals

Regulatory Authorities
The species selected for this assessment are federally protected under the Marine Mammal Protection Act (MMPA). The MMPA prohibits, with certain exceptions, the "take" of marine mammals in United States waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States (NOAA 2007). The Endangered Species Act (ESA) lists the Florida manatee and fin, humpback, sei, sperm, and North Atlantic right whales as endangered. This designation prohibits "take" of these species; requires the development and implementation of species recovery plans; and mandates, where appropriate, designation of critical habitat. Where these species are found within National Marine Sanctuaries, they are also protected under the United States National Marine Sanctuaries Act. At the state level, the Florida manatee is also protected by the Florida Manatee Sanctuary Act (§379.2431(2), Florida Statutes).

Current Conservation Efforts
Many ongoing cooperative conservation efforts focus on marine mammals, including those conducted by federal, international, and state agencies, academic institutions, and non-profit organizations. One of the first international protections for whales was the First International Convention for the Regulation of Whaling in 1935 which

specifically targeted right whales. Their protected status has been continued by the International Whaling Commission since its founding in 1946 (Donovan 1991).

As noted above, NMFS is required to develop and implement recovery plans for whale species listed as endangered in the U.S. Final recovery plans have been published and are being implemented for most of the large whale species included in this study, including the North Atlantic right, fin, humpback and sperm whales (NMFS 1991 2005, 2010b, 2010c). The plans call for improving knowledge of stock sizes, habitats, and migration patterns; better understanding the impact that threats have on the stocks; and reducing known threats. The North Atlantic right whale recovery plan takes the most comprehensive approach to reducing threats due to the highly vulnerable nature of this population of whales. The recovery plan includes a number of actions to reduce ship collisions (e.g., mandatory vessel speed restrictions and ship reporting systems), entanglement in fishing gear, fisheries bycatch, exposure to contaminants and excessive noise and harassment by whale watching operations (NMFS 2005). Critical habitat has been designated for the North Atlantic right whale, including off the southern coast of Georgia and northern coast of Florida (NMFS 1994). Changes to the critical habitat area were proposed by NMFS in 2015 and are currently under review. The other recovery plans recommend actions to maintain and enhance historical and current known habitats, identify and reduce human related injury and mortality, research population structure, improve administration and coordination, and maximize efforts to obtain scientific information from stranded or entangled individuals (NMFS 1991, 2010b, 2010c, 2011).

Under Section 118 of the Marine Mammal Protection Act, NMFS has developed and implemented several take reduction plans (TRPs) to reduce injury and death of certain marine mammals vulnerable to commercial fishing activities. TRPs typically include both regulatory and non-regulatory measures. The four operating in the SABMA study area include the Large Whale TRP, Bottlenose Dolphin TRP, Pelagic Longline TRP and Harbor Porpoise TRP. Following are examples related specifically to the South Atlantic Bight region:

- Large Whale TRP: Focused on the critically endangered North Atlantic right whale, the Large Whale TRP also takes into consideration humpback, fin, and minke whales. The TRP consists of regulatory and non- regulatory measures related to commercial gillnet and trap/pot fisheries, including broad-based gear modifications, time/area closures, and extensive outreach efforts (NOAA 2010).

- Pelagic Longline TRP: Focused on reducing incidental mortality and serious injury of pilot whales and Risso's dolphins in the Atlantic pelagic longline fishery, the TRP created the Cape Hatteras Special Research Area (CHSRA). Requirements for operating in the CHSRA include specific observer and research participation for fishermen operating in the area year-round (NOAA 2009).

To reduce manatee injury and mortality caused by watercraft collisions, the FWC, US FWS and some local governments have established seasonal and year-round manatee protection areas. Most of these zones require slower vessel speeds but some restrict vessel access into manatee congregation areas (e.g., winter warm water refugia). Slowing vessel speeds provides greater reaction time for the vessel operator and manatee and reduces the severity of injuries to the manatee if hit by the vessel (Calleson and Frohlich 2007).

There are no recovery or management plans that address the common dolphin, beaked whales, dwarf and pygmy sperm whales or spotted dolphins as they are not listed as endangered or threatened under the Endangered Species Act and are not subject to high fisheries-related mortality in the SABMA study area.

Box 4.4. It Takes a Village: Organizations Involved in Marine Mammal Research and Conservation

Research and conservation needs are great for most marine mammal species in the SABMA study area (and beyond). To try to address these needs, a wide range of government agencies, academic institutions and non-profit organizations are actively involved in cetacean research and/or conservation in the region.
U.S. East Coast colleges and universities at which there are research programs studying many aspects of cetacean biology, genetics, and distribution include (but are not limited to) Coastal Carolina University, College of Charleston, Duke University, and University of North Carolina at Wilmington.

Non-profit organizations involved in study area cetacean research or conservation include the American Cetacean Society, American Society for Mammalogy, Cetacean Society International, Ecological Society of America, Georgia Aquarium, Georgia Environmental Policy Institute, Harbor Branch Oceanographic Institution, Hubbs-Sea World, International Fund For Animal Welfare, Marine Mammal Commission, North Atlantic Right Whale Consortium, North Carolina Sea Grant, Ocean Conservancy, Society for Conservation Biology, Society for Marine Mammalogy, South Carolina Marine Mammal Stranding Network, The Humane Society of the United States, The Marine Mammal Center, Virginia Aquarium & Marine Science Center, Whale and Dolphin Conservation Society, WhaleNet and World Wildlife Fund.

State and federal agencies engaged in study area marine mammal research and conservation activities include the Florida Fish and Wildlife Conservation Commission/Fish and Wildlife Research Institute, Georgia Department of Natural Resources/Coastal Nongame and Endangered Wildlife Program and the Office of Naval Research Marine Mammal Program, NOAA Fisheries Services/Office of Protected Resources.

Sea Turtles

Regulatory Authorities

All life stages of the five turtle species included in this analysis are currently protected on U.S. nesting beaches and in U.S. waters by the Endangered Species Act. NMFS and USFWS jointly manage all three species; USFWS has lead jurisdiction on nesting beaches while NMFS has lead jurisdiction for marine waters.

Current Conservation Efforts

Global conservation efforts for the five species included in this analysis are principally comprised of international conventions and treaties. The United States is one of 12 signatory nations on the only international treaty dedicated solely to sea turtles: Inter-American Convention for the Protection and Conservation of Sea Turtles. One of the most significant conservation efforts to date for sea turtle species is the United States embargo (November 21, 1989) on shrimp harvested with commercial gear that may adversely impact sea turtles (Public Law 101-162, Section 609 (16 U.C.S. 12537)). Under authority of the ESA and the Magnuson-Stevens Fishery Conservation and Management Act, NMFS has initiated a series of regulations designed to reduce adverse impacts to sea turtles including requiring use of turtle excluder devices (TEDs) and circle hooks, gillnet closures, and pound net modifications. In 2003, NMFS initiated a program, the Strategy for Sea Turtle Conservation and Recovery in Relation to Atlantic and Gulf of Mexico Fisheries, to identify strategies to reduce bycatch across jurisdictional boundaries for priority gear types on a per-gear basis (instead of by individual fishery) for the Atlantic and Gulf of Mexico (NOAA Fisheries 2003). There are currently NMFS/USFWS Recovery Plans for U.S. populations in the Atlantic (October 29, 1991), Pacific (January 12, 1998), and Eastern Pacific (January 12, 1998) for green sea turtles, and for U.S. Caribbean, Atlantic, and Gulf of Mexico (April 6, 1992) and the U.S. Pacific (January 12, 1998) populations for loggerheads. Five year reviews of these Recovery Plans occurred in 1991 (56 FR 56882) and 2007 (70 FR 20734).

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