

Final Report

Comprehensive Spatial Data on Biological Resources and Uses in Southeastern Coastal Waters of the U.S.



Submitted To:
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Introduction:

In 2012, the South Carolina Department of Natural Resources (SCDNR) received funding from the Southeast Coastal Ocean Observing Regional Association (SECOORA) through a grant from NOAA entitled “*Enabling Coastal and Marine Spatial Planning in the South Atlantic through User Engagement, Comprehensive Data Management and Development of Spatial Decision Support Tools*” (NA12NOS4730007). This study was part of a broader initiative by the Governors’ South Atlantic Alliance (GSAA) to begin a comprehensive spatial management plan and provide information critical to that effort through a Regional Information Management System. The primary objectives of the SCDNR component were to develop and assemble various regional databases that provide information on the distribution and relative abundance of key biological resources and evaluate the distribution and level of activity (where relevant) of selected human uses. Databases targeted included those that were regional in scope and associated with the coastal ocean environment (beach to approximately 200 m depth) of the southeast coast from North Carolina to Florida. Many of the biological and human uses databases were identified as priority information desired by the Healthy Ecosystems Technical Team of the GSAA. The area of focus for this project is shown in Figure 1.

The purpose of this document is to provide a brief description of the GIS data layers developed by the SCDNR or assembled from other sources, and how they were analyzed. Greater detail on each of the GIS data layers is provided in metadata files available online from the SCDNR’s online data resources (<http://www.dnr.sc.gov/GIS/gsa.html>).



Figure 1. GSAA Project Area for Coastal and Ocean Data

Biological Resources:

Shallow Water Finfish Data:

The Southeast Area Monitoring and Assessment Program-South Atlantic (SEAMAP-SA) Coastal Survey, which is funded by the National Marine Fisheries Service (NMFS) represents a long-term fishery independent monitoring program that has been conducted by the South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD) since 1986. Only the most abundant finfish and crustacean species collected by this program were summarized for the shallow water finfish data layers. These species include: Atlantic croaker, Atlantic sharpnose shark, bluefish, southern kingfish, spot, weakfish, white shrimp, and brown shrimp.

SEAMAP-SA provides the only existing region-wide, long-term fishery independent survey program in coastal waters (10 to 20 m depth) off the Atlantic coast of the southeastern United States that primarily targets sand bottom finfish and crustacean communities. Field sampling is conducted seasonally: spring (April-May), summer (July-August), and fall (October-November) in established strata between Cape Hatteras, North Carolina (35° 13.2'N) and Cape Canaveral, Florida (28° 30.0'N). Up to one hundred and twelve stations in a band delineated by 4.6 and 9.1 meter contours are sampled each season. Stations are allocated to strata according to results of an Optimal Allocation Analysis. Sampling is conducted during daylight hours. Operations at each site include collections with paired 22.9 m mongoose-type Falcon trawls with tickler chains towed for 20 minutes (bottom time) from the R/V *Lady Lisa*, a 22.9 m St. Augustine shrimp trawler. Nets do not contain TED's or BRD's so that density estimates for all sizes of each species can be calculated, and to maintain comparability with previous survey data. A total of 102 stations were sampled per season in the region during 2006-2008 (306 stations/year) and 112 stations were sampled in 2009-2010 (336 total).

For each of the dominant species identified above, a mean catch per unit effort (CPUE) was calculated using data from all trawls sampled within a 1 x 1 minute grid of latitude and longitude within a recent five-year time frame (2006-2010). Mean catch per unit effort within a 1 x 1 minute (latitude and longitude) grid was determined by calculating the number of a specific species caught per net towed for 20 minutes, divided by the total number of net tows made in that grid. Coefficient of variance for the catch per unit effort was determined by dividing the standard deviation of the catch per unit effort by the mean catch per unit effort.

The layer files developed for the SEAMAP-SA data summarize the relative abundance of each species in every 1 x 1 minute grid cell where that species was collected using quantiles as follows: Those grid cells where the mean CPUE of a species was high ($> 75^{\text{th}}$ numeric percentile of all grid cell CPUE values observed within the region) were coded as red. Grid cells where the mean CPUE of a species was moderate ($\geq 25^{\text{th}}$ and $\leq 75^{\text{th}}$ numerical percentile of all CPUE values observed within the region) were coded as yellow, and grid cells where the mean CPUE of a species was low ($< 25^{\text{th}}$ numerical percentile of all CPUE values observed within the region) were coded as green. Grid cells sampled where a species was not caught have no color. An

example of the distribution observed for Atlantic croaker within the 1 x 1 minute grid cells where this species was captured is shown in Figure 2.

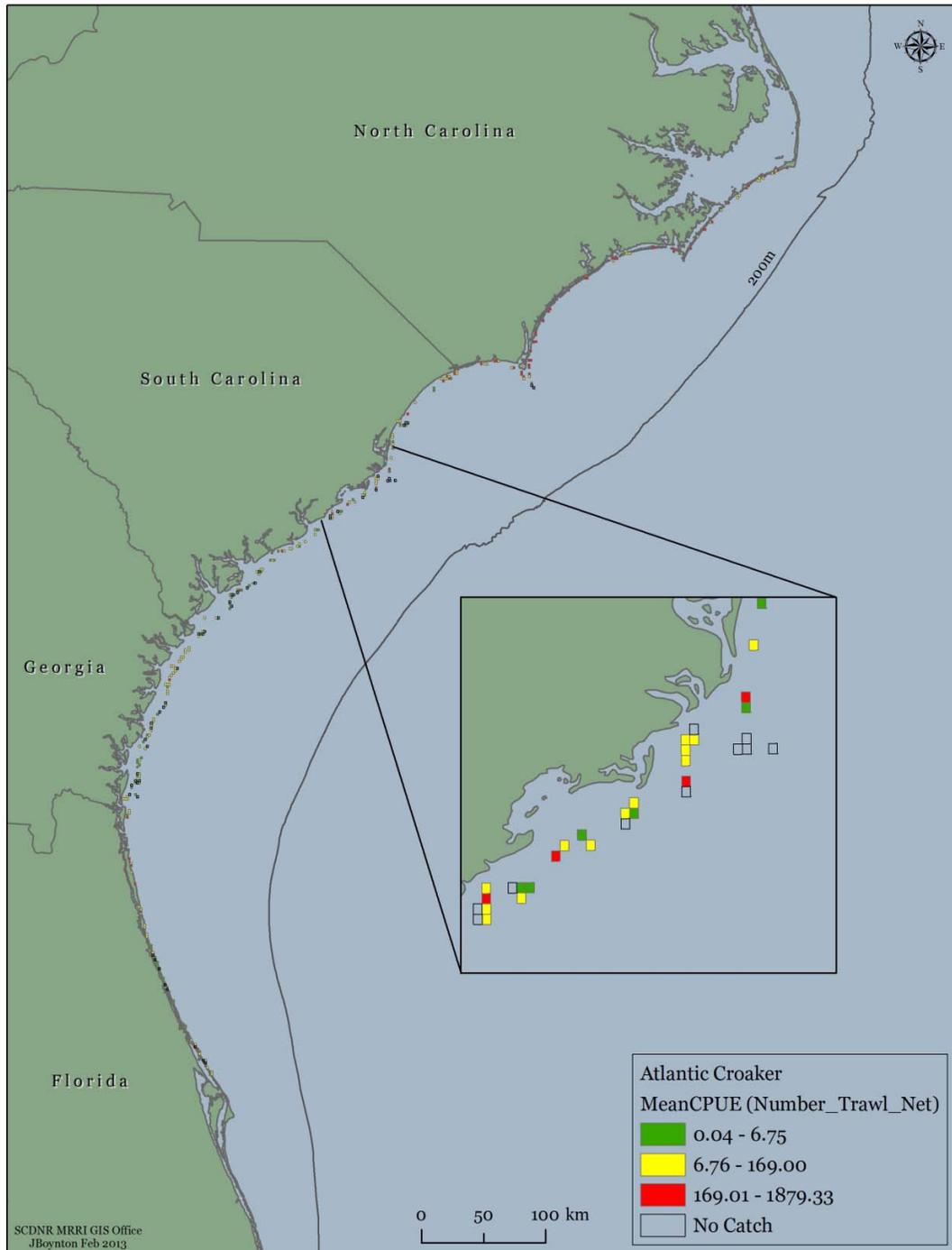


Figure 2. Example of SEAMAP-SA data summary of the relative abundance and distribution of Atlantic croaker in shallower waters of the study area.

Deep Water Finfish Data:

The Marine Resources Research Institute (MRRI) at the South Carolina Department of Natural Resources (SCDNR), has conducted fisheries-independent research on deep water groundfish, reef fish, ichthyoplankton, and coastal pelagic fishes within the region between Cape Lookout, North Carolina, and Ft Pierce, Florida for over 30 years through the Marine Resources Monitoring, Assessment and Prediction (MARMAP) program. The overall mission of the program has been to determine distribution, relative abundance, and critical habitat of economically and ecologically important fishes of the South Atlantic Bight (SAB), and to relate these features to environmental factors and exploitation activities. While the research and monitoring conducted by this program has varied over the years, the fishery-independent chevron trap survey of reef fish is the most important dataset with respect to the distribution of commercially and recreationally important species in depths ranging from 14-94 m. Details of the specific sampling methodology and gear characteristics are provided in the metadata.

While many bottom fish species have been collected by this program, the following reef fish were considered by MARMAP staff to be the most abundant and relevant species collected by chevron trap to summarize with respect to distribution and relative abundance: bank sea bass, black sea bass, gag grouper, grey triggerfish, knobbed porgy, red grouper, red porgy, red snapper, sand perch, scamp, scup, spottail pinfish, spotted moray eel, tomtate, vermilion snapper, and white grunt. For any given species, a mean catch per unit effort (CPUE) was calculated using data from all traps sampled within a 1 x 1 minute grid of latitude and longitude within a recent five-year time frame (2006-2010). All catches used in the calculations were from traps that were soaked between 45 and 150 minutes. CPUE was calculated as the number of a selected species present per trap per hour of soak time. The number of traps deployed, the percent occurrence (the number of traps containing a species divided by deployed in a grid cell), and coefficient of variance for CPUE were calculated for each 1 x 1 minute grid cell.

The layer (.lyr) files developed for the MARMAP chevron trap data summarize the relative abundance of each species in every 1 x 1 minute grid cell where that species was collected using quantiles as follows: Those grid cells where the mean CPUE of a species was high ($> 75^{\text{th}}$ numeric percentile of all grid cell CPUE values observed within the region) were coded as red. Grid cells where the mean CPUE values of a species were moderate ($\geq 25^{\text{th}}$ and $\leq 75^{\text{th}}$ numerical percentile of all CPUE values observed within the region) were coded as yellow, and grid cells where the mean CPUE values of a species were low ($< 25^{\text{th}}$ numerical percentile of all CPUE values observed within the region) were coded as green. Grid cells where traps were deployed but the species was not caught have no color. An example of the distribution observed for black sea bass within the 1 x 1 minute grid cells where this species was captured is shown in Figure 3.

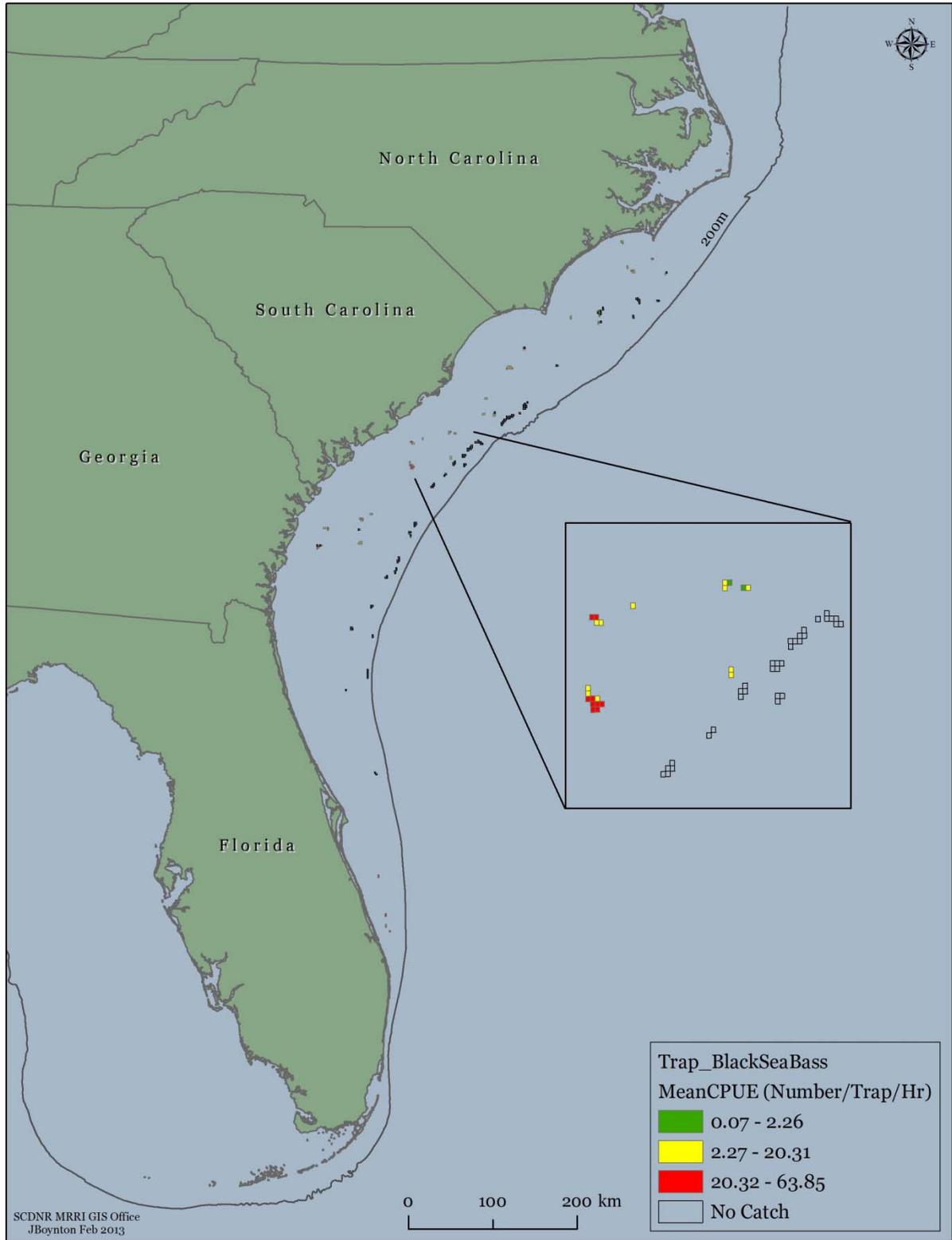


Figure 3. Example of MARMAP data summary of the relative abundance and distribution of black sea bass in deeper waters of the study area.

The MARMAP program also conducts both short bottom long-line and long bottom-long-line sampling in the same region, but this sampling is targeted at deeper water species. Species considered to be most important to summarize were scamp, red grouper, golden tilefish, and black belly rosefish for the short bottom long-line deployments, and snowy grouper and golden tilefish for the long bottom longline deployments. For any given species, a mean catch per unit effort (CPUE) was calculated using data from all longlines deployed within a 1 x 1 minute grid of latitude and longitude within a recent five-year time frame (2006-2010). Short bottom longlines were deployed for approximately 90 minutes in sets of six. Long bottom longlines were generally deployed for 45-150 minutes. Because the long bottom longlines groundline is approximately 1,220 m, the longlines frequently extend beyond a grid cell boundary, but each longline was identified by the start deployment location. Additional details on how each longline type was deployed is described in the metadata files. CPUE in both longline types was calculated as the number of a selected species present per line (100 hooks for long bottom longline and 20 hoods for short bottom longline) per hour of soak time. The number of sets, the percent occurrence of a species in the total sets, and coefficient of variance for the CPUE was calculated for each 1x1 minute grid cell.

The layer (.lyr) files developed for the MARMAP longline data summarize the relative abundance of each species in every 1 x 1 minute grid cell where that species was collected using quantiles as follows: Those grid cells where the mean CPUE of a species was high ($> 75^{\text{th}}$ numeric percentile of all grid cell CPUE values observed within the region) were coded as red. Grid cells where the mean CPUE values of a species were moderate ($\geq 25^{\text{th}}$ and $\leq 75^{\text{th}}$ numerical percentile of all CPUE values observed within the region) were coded as yellow, and grid cells where the mean CPUE values of a species were low ($< 25^{\text{th}}$ numerical percentile of all CPUE values observed within the region) were coded as green. Grid cells where longlines were deployed by a species was not present have no color.

Marine Mammals:

Marine mammals are of particular concern related to adverse impacts from offshore activities, especially for the endangered North Atlantic right whale (*Eubalaena glacialis*). Right whales have been surveyed by the North Atlantic Right Whale (NARW) Consortium for many years, but only the data collected and provided by the NARW between November and April from 2002-2010 were included in this project. These months were chosen because right whales were rarely or never observed at other times of the year. The longer time period was used (compared to other data sets that were limited to the most recent five years) due to the rare occurrence of this species. Additionally, the scarcity of sightings for this endangered species was not conducive to summarizing the data in 1 x 1 minute grid cells as was done for other data sets. Rather, the data are presented in 5 x 5 minute latitude and longitude grid cells based on the recommendations of NARW experts. The data layer shows the sightings per unit effort (SPUE) of the North Atlantic right whale in units of 1000 km of valid survey track, which is the effort-adjusted relative

abundance index, and parsed into the appropriate grid cell. All sightings came from aerial surveys conducted in sea states of Beaufort 3 or lower, with visibility at least two nautical miles, at least one observer on watch, and at altitudes less than 1,200 ft. The spatial data layers summarized the relative abundance of whales sighted over the entire time frame.

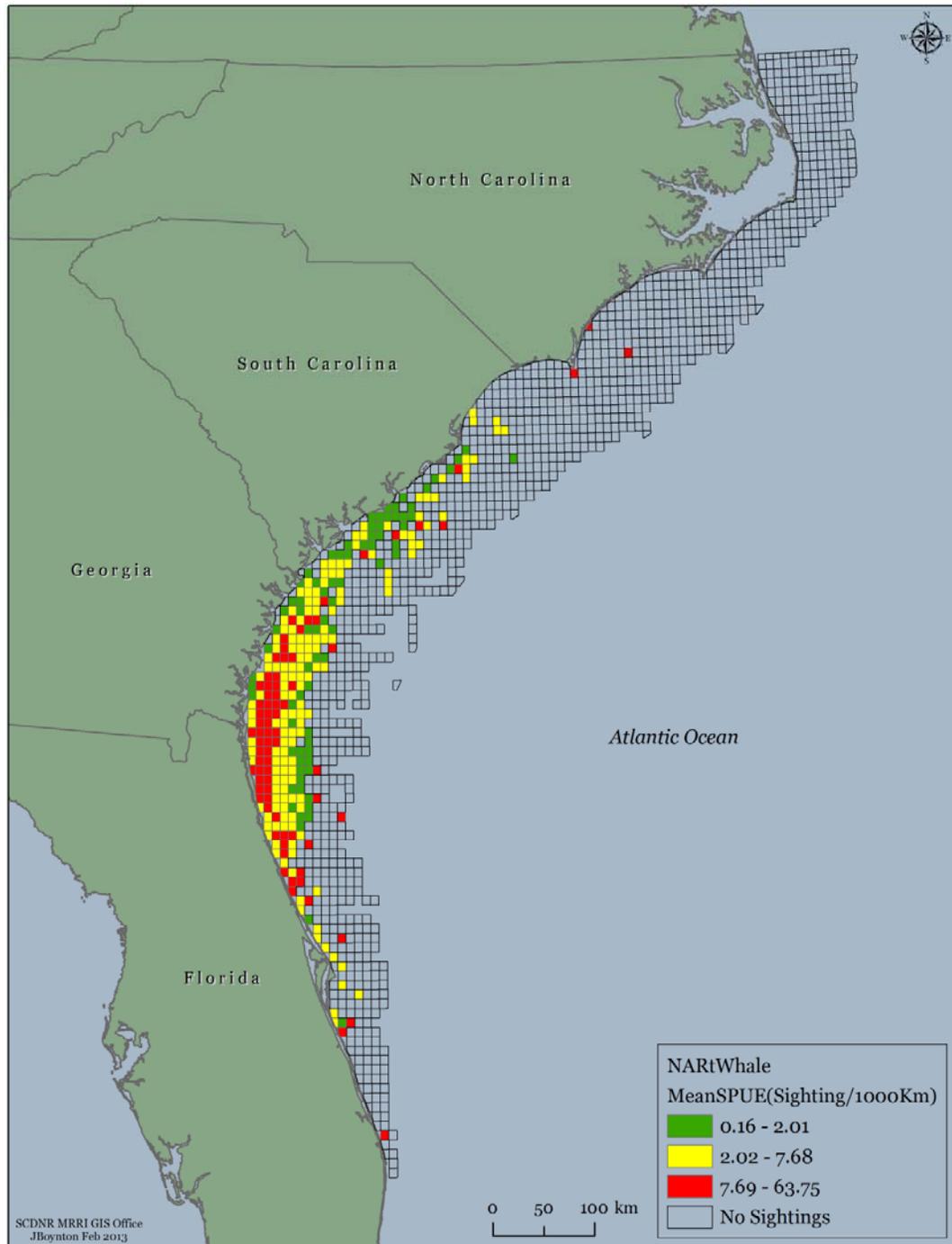


Figure 4. Example of NARW data summary of the relative abundance and distribution of North American right whale sightings in the study area.

The layer file developed for the NARW data summarized the relative abundance of each species in every 5 x 5 minute grid cell where that species was observed using quantiles as follows: grid cells where the whale sightings were relatively high ($> 75^{\text{th}}$ numeric percentile of all whale sightings observed per grid cell within the region) were coded as red. Grid cells where whale sightings were moderate ($\geq 25^{\text{th}}$ and $\leq 75^{\text{th}}$ numerical percentile of all whale sightings per grid cell within the region) were coded as yellow, and grid cells where whale sightings were low ($< 25^{\text{th}}$ numerical percentile of all whale sightings per grid cell within the region) were coded as green. Grid cells where no whales were observed have no color. A summary of the whale sightings data is provided in Figure 4.

The Multipurpose Marine Cadastre (MMC) data portal managed by the Bureau of Ocean Energy Management (BOEM), and the National Oceanic and Atmospheric Administration (NOAA), provide additional data layers on the seasonal distribution of North American Right whale and other mammals. These include: fin whale (seasonal), minke whale (seasonal), sperm whale (seasonal), and bottlenose dolphin (seasonal). As described on the MMC site, the marine mammal density estimates "...are model results that show estimates of the average number of animals present during a given season for each 1 km² block. Because marine mammals often occur in groups and are highly mobile most of the average numbers of animals/km² values are less than 1. For example, a value of 0.5 animals/ km² for bottlenose dolphins during the summer for a particular block can mean that on average 1 animal would be expected to be present in that block every other day or, 1 group of 10 animals over a 5 day period. These data originate from reports prepared for or by the US Navy and NOAA Fisheries. The data were intended for use in determination of potential impacts of military operations to marine mammal and sea turtle species, and for preparation of associated Marine Mammal Protection Act take permit authorizations and Endangered Species Act Section 7 Consultation." Data user agreements and source reports can be found on the MMC portal.

Sea Turtles:

Loggerhead sea turtles (*Caretta caretta*) have been thoroughly monitored in the southeastern region, both in terms of monitoring nesting density and sampling for juvenile loggerhead turtles in shallow coastal waters. All sea turtle species are globally listed as threatened or endangered species. The loggerhead sea turtle was listed as a "threatened" species in 1978.

Sea Turtle Nesting Locations:

Each of the four states in the GSAA region have been conducting intensive monitoring of sea turtle nests for many years using authorized trained participants to survey beaches to locate sea turtle nests. Other activities involved in some or all of the state programs include physical relocation of nests when necessary, often protecting nests with predator-proof screening, monitoring nests during incubation, and conducting an inventory of nests after they emerge to determine hatching success. Nest protection project participants include individuals that belong

to conservation organizations, federal, state, or local agencies, and universities. All nests are verified by the presence of eggs or hatching activity.

Monitoring in North Carolina is coordinated by the NC Wildlife Resources Commission, in South Carolina by the SC Department of Natural Resources, in Georgia by the GA Department of Natural Resources, and in Florida by the FL Fish and Wildlife Conservation Commission. The FL database provides nest density information on loggerhead, green and leatherback turtles, and presence/absence information only on Hawksbill and Kemp's turtles. Furthermore, the Florida loggerhead turtle ranking of beaches by nest density was done within genetic subunits. Ranking of the beaches for the other species was done on a state-wide basis. In North Carolina, South Carolina, and Georgia, only loggerhead nest densities are reported in the database developed for the GSAA portal, and all beaches are ranked with regard to nest density based on all beaches within each state. All turtle nesting data reported for this dataset were based on nesting data collected from 2006 through 2011. This dataset does not necessarily include information for all turtle nesting areas on the coast in each state, only those beaches that are routinely monitored. Nest density/km of beach is reported in the database as an average for all years surveyed in state. Some state data do not include the entire six year (2006-2011) time frame. The length of the beach surveyed may vary slightly over the years in one or more of the states.

The relative abundance of sea turtle nests on the various beaches surveyed have been summarized in the GIS layer files using quantiles to represent turtle nest densities. For NC, SC, and GA beaches, those beaches where loggerhead turtle nest densities were relatively high ($> 75^{\text{th}}$ numeric percentile of all beach nesting densities along that state's coastline) were coded as red. Beaches with moderate nest densities ($\geq 25^{\text{th}}$ and $\leq 75^{\text{th}}$ numerical percentile of all beach nesting densities along that state's coastline) were coded as yellow, and beaches where turtle nest densities were relatively low ($< 25^{\text{th}}$ numerical percentile of all beach nesting densities along that state's coastline) were coded as green (Figure 5). Use of the quartile-based ranks (low, medium, high) to compare the level of nesting activity across beaches is recommended over the use of average nesting densities due to the variation of survey parameters (e.g. frequency, duration) and the dynamic nature of sea turtle nesting. Direct contact by managers with the appropriate state data provider is highly recommended to obtain more detailed information about the surveys of a particular beach. Figure 5 provides an example summary of the nesting data for loggerhead turtles.

Coastal Sea Turtle Trawl Surveys:

The Marine Resources Division of the SCDNR manages a regional trawl survey to assess the relative abundance, distribution, health and demographics of sea turtles. This research endeavor has been funded by the National Marine Fisheries Service via four awards since FY99. The survey is carried out through numerous regional partnerships, notably the University of Georgia Marine Extension Service which conducts trawling aboard their R/V *Georgia Bulldog* south of the SC/GA border. Trawling off SC is conducted by SCDNR's R/V *Lady Lisa*. Data have been collected in five phases since inception, but the data summarized for the in-water

turtle trawl surveys are limited to the most recent regional trawl surveys conducted from 2008-2012. Sampling extends from Winyah Bay SC to St. Augustine, FL. Overall results from the regional trawl survey indicate that most of the sea turtles collected are loggerheads (*Caretta*

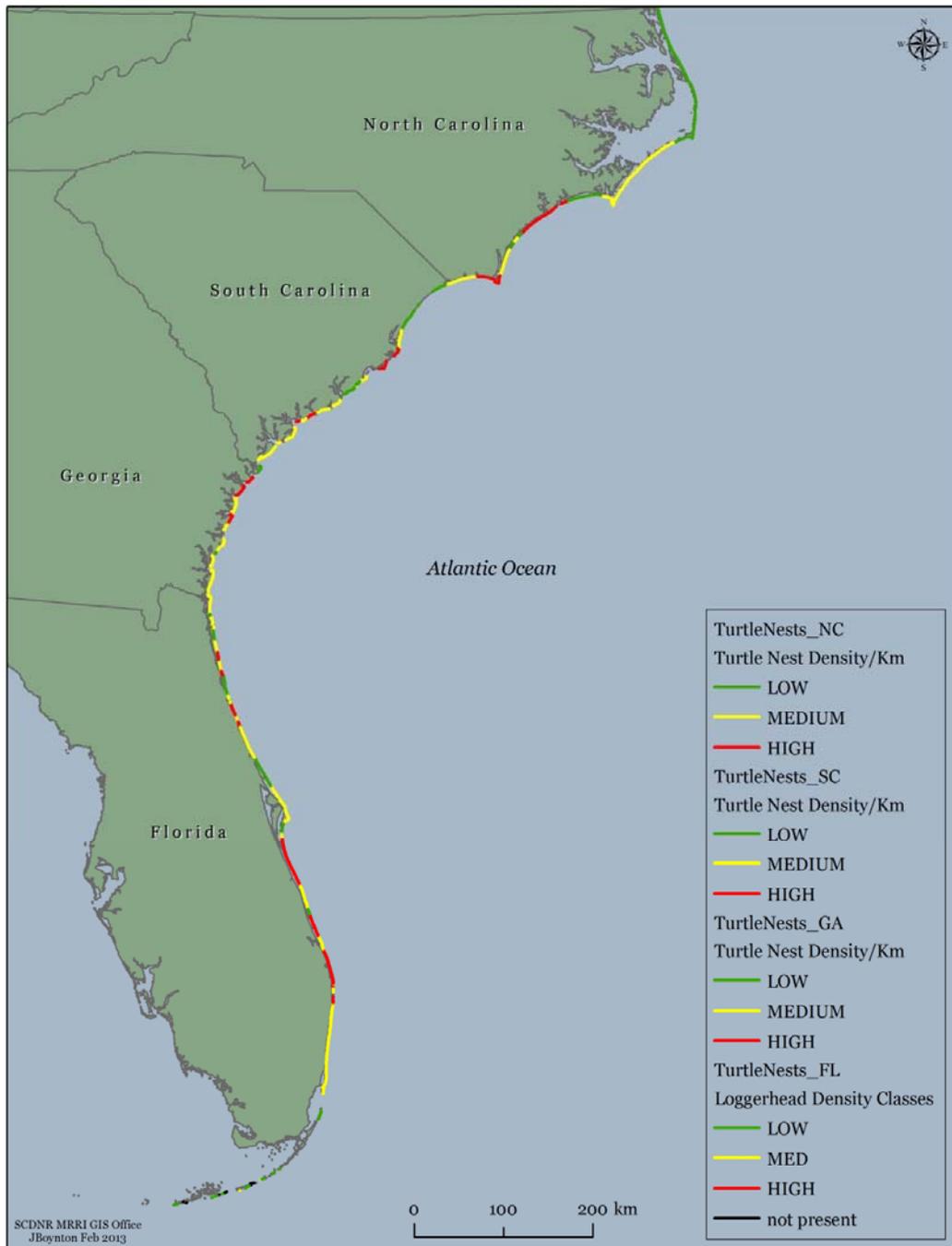


Figure 5. Example of the data summary of the relative abundance and distribution of loggerhead sea turtle nests along the southeastern coastline in the study area.

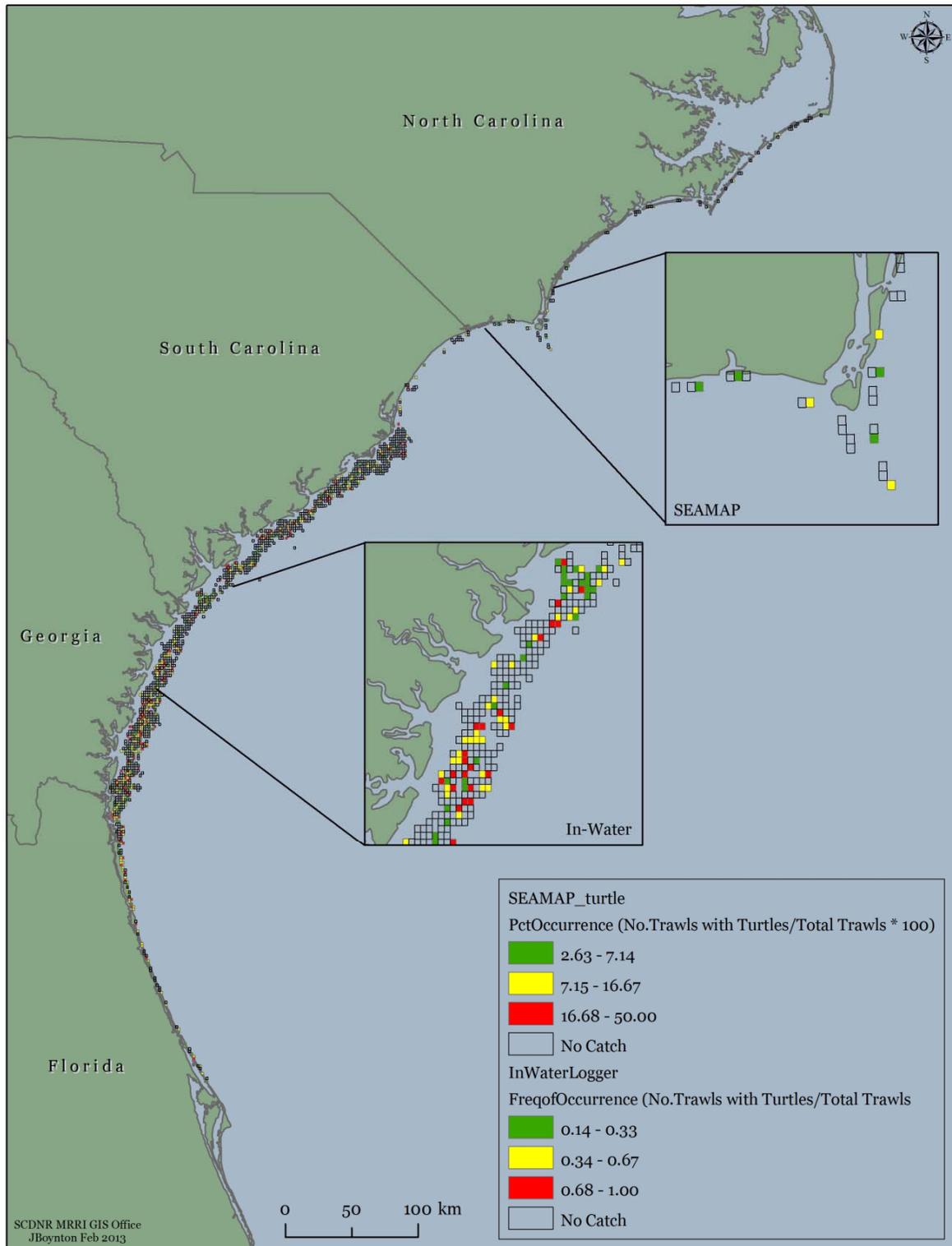


Figure 6. Example of the data summary of the relative abundance and distribution of loggerhead sea turtle collected in trawl surveys in the study area.

caretta), with Kemp's ridley (*Lepidochelys kempi*) and Green turtles (*Chelonia mydas*) representing the second and third most captured species.

All turtle trawling was conducted using NMFS Turtle nets at sites randomly selected from a sampling universe representing the center of 3.4 km² grids of trawl-able bottom in water depths 4.5 to 17.5 m deep. The start latitude and longitude of each trawl were used to assign it to a 1' x 1' grid cell of ocean area. The frequency of occurrence (0-1) of positive sea turtle catch events in each grid cell was used to display the distribution of turtles among the grid cells sampled in the study area. Those grid cells where the frequency of occurrence loggerhead turtles was relatively high (> 75th numeric percentile of all frequency of occurrence values observed per grid cell within the South Carolina study area) were coded as red. Grid cells where the frequency of occurrence of turtles was moderate ($\geq 25^{\text{th}}$ and $\leq 75^{\text{th}}$ numerical percentile of all occurrence values observed per grid cell within the South Carolina study area) were coded as yellow, and grid cells where the frequency of occurrence was low (< 25th numerical percentile of all percent occurrence values observed per trawl per grid cell within the South Carolina study area) were coded as green (Figure 6). Grid cells where no turtles were caught have no color. Mean catch per unit effort (CPUE) was calculated as the mean loggerhead count per trawl collection as well, but since turtle densities tend to be very low per trawl (often only 1-2), the frequency of occurrence in all trawls taken in a grid cell was deemed as a more useful measure to identify where juvenile loggerhead turtles are most frequently captured in the trawl surveys.

By-catch of loggerhead sea turtles is also included in the SEAMAP-SA bottom trawl survey previously described for shallow-water finfish and crustacean catches. These data are included in the summary data shown in Figure 6 since SEAMAP-SA cruises extended further north than the in-water trawl survey specifically dedicated to evaluating the distribution and relative abundance of loggerhead sea turtles (described above), and were coded relative to the percent of occurrence per SEAMAP-SA bottom trawl per grid cell (0-100%) rather than the frequency of occurrence values (0-1) used for the in-water turtle survey.

Avian Fauna:

Bird Nesting Locations:

Bird nesting locations represent a resource of considerable concern related to any coastal activity that may impact those sites. Each of the four coastal states have collected nesting data that were either solicited from the state provider or available through the appropriate agency's web site, or a combination of both approaches.

North Carolina's coastal colonial waterbird nesting information was obtained from an online database (<http://ncpaws.org>) provided by the NC Wildlife Resources Commission. The data is a subset from that database and includes data from 2006-2010 of all available species and was spatially selected to include nests within five miles of the coast. Information is provided for 27 species.

South Carolina has a number of transient washover islands that are critical habitat used by seabirds for nesting in the state's coastal zone. Multiple species are typically observed on these islands, including the Eastern brown pelican, black-crowned night heron, great egret, snowy egret, tricolored heron, black skimmer, cattle egret, gull-billed tern, royal tern, sandwich tern, glossy ibis, least tern, and common tern. South Carolina Department of Natural Resources staff survey annually to obtain nest counts or estimates made from counting adults that appear to be incubating or brooding young. Nests counts were conducted by walking through the colony and counting nests with eggs or chicks. The number of wading bird nests at these sites is also included. Wading bird counts were primarily estimates from counting adults that were assumed to be nesting. Each site was only counted once, thus these numbers may not represent peak numbers of nests at the site. These data do not include all species that nest on a site. For example, laughing gulls, shorebirds, and uncommon species are not included. This dataset also does not include all sites in SC that have nesting seabirds, thus totaling all nests for a species during one year, may not be the total number of nests in SC for that species. All numbers represent the annual average number of nests over a recent five year period (2006-2010).

The Georgia Department of Natural Resources provided the seabird colony data provided in this geodatabase. The survey period represented is from 2010 through 2012 and information is available for seven seabird species, including brown pelican, laughing gull, royal tern, sandwich tern, least tern, gull-billed tern, and black skimmer. Nest counts were done at 18 locations, with colonies visited several time during the nesting season. Data were collected using various methods including ground and aerial surveys and involving a number of partners, all members of the Georgia Shorebird Alliance, plus graduate students working on certain species.

The Florida Fish and Wildlife Conservation Commission (FWC) maintains two databases that were mined for shorebird information. One database (Wading Bird Colonies – Florida) provides data from a state-wide aerial survey conducted from January 26 to June 25, 1999 to locate waterbird breeding colonies and estimate colony size and species composition. Primary species targeted include herons, egrets, ibises, spoonbills, storks, anhingas, cormorants, and pelicans. As described in the metadata files obtained from the FWC web site, fixed-wing aircraft flew state-wide east-west transects at 5-km intervals. Survey routes deviated at times to allow inventory of previously known colonies from earlier surveys. A summary of the general distribution of nesting areas in the state is provided in more detail in the metadata file, but the largest number of active colonies (42%) was located in central Florida (27-29°N latitude), with 19% and 38% of the remaining colonies located in the more northern (>29°N) and southern (<27°N) portions of the state respectively. “The FWC database contains records for all known and verified colonies in the state of Florida that were surveyed by the FWC during the period 1999 nesting season. Nests discovered more recently than this are not included in the database. Each year, a number of new colony sites are found. For this reason, users of this database are cautioned that the absence of a colony record for a given property does not necessarily mean wading birds are not present.

This colony locator service is not meant to replace a specific on-the-ground survey. Disturbance to the colony may occur if a visit is made, and many of the colonies are located on private land.



Figure 7. Example of bird nesting locations identified along the southeastern coastline. Information on the bird species utilizing each site can be found by clicking on the site.

Providing these locations does not confer any permission by FWC to access private property.” Data provided in the database include the location of the colony, county, status of the colony in previous surveys conducted in the 70’s and 80’s, and percent composition of a colony represented by each bird species, along with other miscellaneous information.

A second database (Florida Shorebird Nesting) is available from the FWC Florida Shorebirds Database (FSD) that allows online entry and viewing of data on Florida’s shorebirds and sea birds (<https://public.myfwc.com/crossdoi/shorebirds>). The database was created in 2010 as an improvement to the original database which became operational in 2005. Although the database is managed by the FWC, the success of this platform is dependent on a network of participants. The data for 2011 and 2012 were obtained from the FSD website. Species targeted in this database include the American oystercatcher, black skimmer, brown pelican, gull-billed tern, killdeer, laughing gull, least tern, royal tern, sandwich tern, and willet. The data file provided in the GSAA geodatabase developed by the SCDNR mined just a portion of the original database based on consultation with FWC staff, deletion of records not in the east coast of Florida, incomplete survey route coverage, and observations with “null” nest count values. As a result, only 6% of the total database is included representing 26 routes. Mean nest counts and the coefficient of variation associate with these counts were computed for the mined data.

Due to the transient and constantly changing nature of these islands, a single point was used to represent the island. The average nests for all species observed on each island over the most recent five year period (2006-2010) are provided in the GIS database. The locations of known coastal nesting sites available in this GIS layer are shown in Figure 7.

Piping Plover Overwintering Critical Habitat:

The U.S. Fish and Wildlife Service has identified the location of critical habitat units for the Great Lakes and Northern Great Plains populations of piping plover which is a federally listed species. The Great Lakes population is federally listed as endangered, while the Atlantic and Northern Great Plains populations are listed as threatened. Piping plovers are considered threatened on their wintering grounds. In the United States these populations winter along the Atlantic Ocean from North Carolina south, along the Gulf coast to Texas, and the Caribbean. Piping plovers spend the majority of the year on the wintering grounds. Due to the difficulty of separating out the populations of piping plover (Great Lakes, Northern Great Plains, and Atlantic) when on their wintering grounds, critical habitat was designated for all wintering piping plover. Critical habitats are areas considered essential for the conservation of a listed species. These areas provide notice to the public and land managers of the importance of these areas to the conservation of this species. The locations of those sites are available in the data portal.

Ocean Use Information:

Commercial Finfish Harvest Data:

The National Marine Fisheries Service (NMFS) requires all commercial fishermen with a permit to harvest finfish collected in federal waters to report their landings and identify the location of harvest within a grid cell of 1 x 1 degree of latitude and longitude. The Atlantic Coastal Cooperative Statistics Program (ACCSP) is a cooperative state-federal program to design, implement and conduct marine fisheries statistics data collection programs and to integrate those data into a single data management system that will meet the needs of fishery managers, scientists and fishermen. ACCSP staff provided the SCDNR with two data layers containing information on landings of the dominant finfish species (comprising 80% of the total regional catch) landed during the period from 2007 through 2011.

One dataset provides information on the average aggregate landings (aggregated across species) by area code (representing 1x1 degree of latitude and longitude) for finfish species ranked in the top 80% of all landings for the region. These data are provided and displayed in the GIS file as average pounds per trip, average total pounds annually per area code, and number of years represented. Data are only provided for area codes that had at least 4 years of landing data and met non-confidential criteria established by the ACCSP. Only area codes that had at least that landed for blocks of ocean waters representing 1 by 1 degree of latitude and longitude. Species that represented the top 80% of all finfish landings included American shad, Atlantic croaker, ballyhoo, big eye tuna, black sea bass, bluefish, dolphin, flounder, forktail catfishes, gag grouper, greater amberjack, king mackerel, king whiting, little tunny, menhadens, smooth dogfish, Spanish mackerel, spiny dogfish, spot, striped bass, striped mullet, swordfish, trigger fishes, vermilion snapper, and yellowfin tuna. Figure 8 shows the area code information provided by the ACCSP.

The second dataset provides landings summaries by species for each one degree latitude bin between 24 and 37° N latitudes. These data had to be summarized at the courser one degree latitude bins rather than area code bins due to confidentiality issues. Only the landings for the species representing the top 80% of all finfish landings for the region are provided. The same species noted in the first database are listed with respect to average total pounds landed annually per one degree latitude bin, and number of years represented in the five year period for each species.

Commercial Shrimp Harvest Data:

Three species of penaeid shrimp are commercially harvested in the southeastern U.S., with the majority of the catch caught offshore by trawlers working in the nearshore zone. The relative percentage of the catch off each state is largely dependent on location, with brown shrimp (*Farfantepenaeus aztecus*) generally being most abundant in the northern latitudes of the region and/or caught early in the shrimping season. White shrimp (*Litopenaeus setiferus*) are most abundant later in the shrimping season and tend to be the dominant species caught off SC, GA, and FL. The third species, pink shrimp (*Farfantepenaeus duorarum*), is primarily harvested commercially in Florida, although this species is found further north.

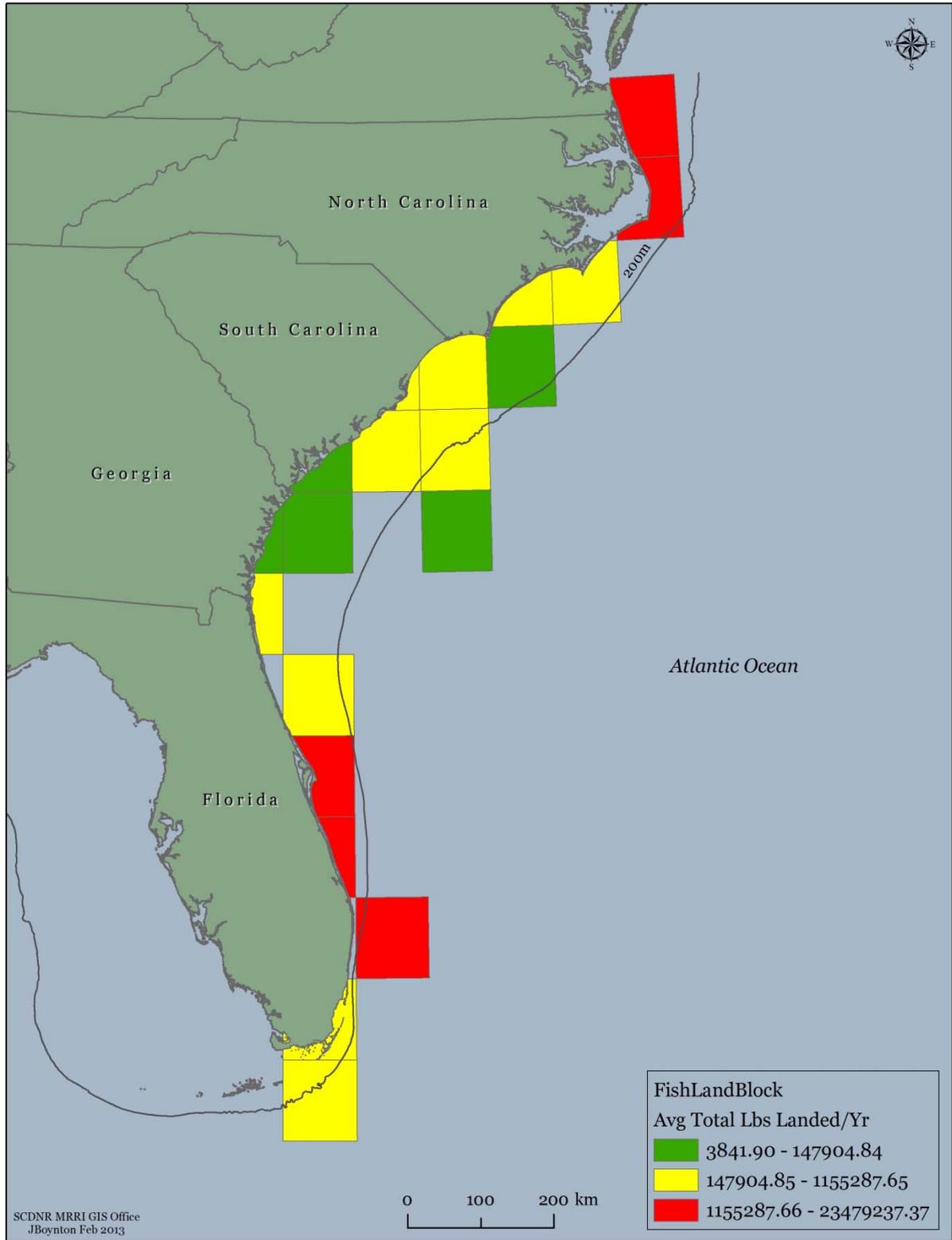


Figure 8. Summary of the NMFS commercial landings data for reporting zones located within the study area.

Commercial shrimp harvests are reported differently in each state. In North Carolina and Florida, landings are available only at the county level. In South Carolina and Georgia, the state's coastal or inshore and coastal waters are divided into sub-zones generally finer than the county level. Commercial shrimp trawling for the three penaeid species are generally limited to each state's coastal boundary (3 mile limit) although some shrimping activity can occur seaward of that line unless it is closed by the South Atlantic Fishery Management Council. In order to provide summary information on the relative amount of shrimp landings in of each state, a five-year period of landings data was requested from the appropriate agency. Most of the data represent the period 2006-2010, although the South Carolina data represent 2005-2009 since this database was recently completed for another project. Average annual reported weights (lbs heads on) of the commercial trawl landings are reported either by species and collectively for all species, or just collectively for all species, dependent on the state and confidentiality rules.

Within each state, areas where landings were relatively high ($> 75^{\text{th}}$ numeric percentile of all average annual landings data within that state) were coded as red. Areas where landings were moderate ($\geq 25^{\text{th}}$ and $\leq 75^{\text{th}}$ numerical percentile of all average annual landings data within that state) were coded as yellow, and areas where landings were relatively low ($< 25^{\text{th}}$ numerical percentile of all average annual landings data within that state) were coded as green. Landings data and the economic value of those landings are also provided for some of the states. Figure 9 shows a summary of the shrimp landings information among the states.

Vessel Monitoring System Data:

The NOAA Office of Law Enforcement (NOAA OLE) is responsible for ensuring compliance with a multitude of fisheries regulations across multiple ocean basins and geographic regions. NOAA OLE relies heavily on sophisticated technologies, such as vessel monitoring systems (VMS) to accomplish this task. Not all fishing vessels are required to use VMS, but VMS coverage includes all areas where U.S. fishing interests occur. In the Southeast U.S., vessels that fish for highly migratory species in pelagic habitats, or target Atlantic rock shrimp, have been required to participate in the VMS since fall 2003. The NOAA OLE provided the SCDNR with VMS data for the South Atlantic rock shrimp fishery during the period 2006-2010. However, it should be noted that vessels equipped with VMS, as required for this fishery, are also required to have the VMS operational during all sea expeditions and many of these vessels target other fisheries, such as penaeid shrimp species. Thus, this data layer should be used to indicate the general location of all shrimping activities conducted by those vessels required to have VMS in the southeast region, regardless of the species targeted by those vessels. Furthermore, the VMS data summary provided includes records that represent vessels transiting an area, drifting, anchored, and marking bottom. Since the rock shrimp and royal red shrimp fisheries are prosecuted in deeper waters > 100 ft, those grid cells (blocks) with records in nearshore waters are most probably associated with fishing for penaeid shrimp. Furthermore, since the rock shrimp fishery has been primarily conducted by Florida based shrimp boats during the 2006-2011 period reviewed, VMS vessel activity in the nearshore waters off FL, GA, SC, and NC only represents a fraction of the penaeid shrimping activity being conducted off those states since vessels that are only shrimping for penaeid shrimp are not required to use VMS.

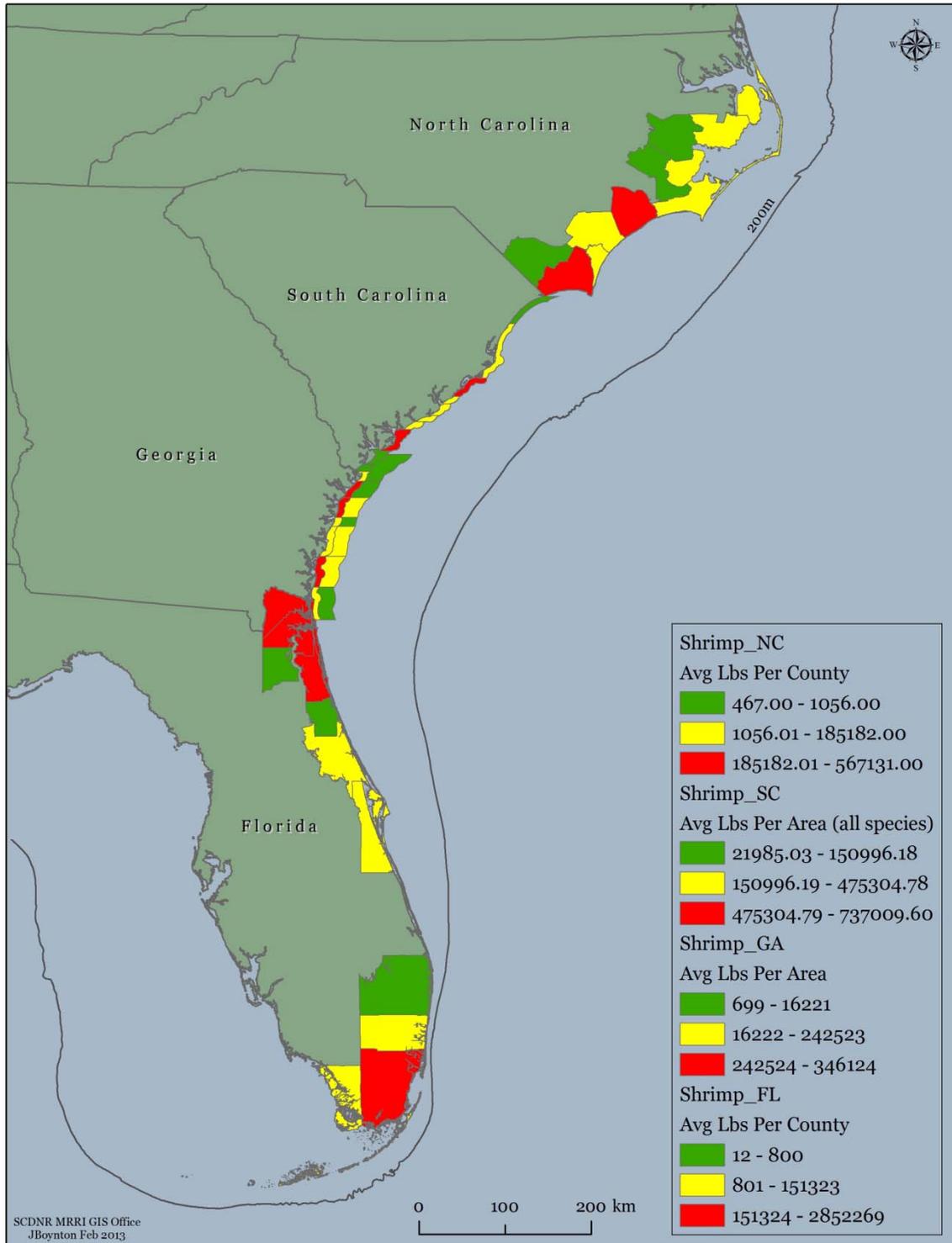


Figure 9. Summary of shrimp trawling activity along the southeastern coast based on landings data. Counties are color coded for NC and FL since those states do not have designated coastal zone segments where shrimpers are required to report where they fished; only county where the shrimp were landed.

Data received from NOAA included monthly records for each of the five years consisting of date, time, latitude, longitude, and a label confirming the fishery type (see caveat above). These data were then consolidated to exclude records outside the study area (e.g. Gulf coast, records north of NC-VA border), which left 1,643,310 records (57%) for further processing. These geographic locations were then plotted and clipped to land boundaries, providing a total of 729,009 records (25% of original file) for plotting. Vessel position records for all five years collectively were then matched to the 1-minute latitude by 1-minute longitude grid cells (blocks) established for the SEAMAP-SA bottom mapping program. All data points observed in a grid cell over the five year period were then assigned to the mid-point of that grid cell with respect to latitude and longitude. Thirty-four percent (8107) of SEAMAP-SA grid cells contained just one location, and a maximum of 4,953 locations were contained within a single SEAMAP-SA block. Ninety-five percent of SEAMAP-SA grid cells contained fewer than 132 locations. Initial examination of the grid cells with fewer than 6 locations indicated that the majority of these records were likely to represent transit activities rather than fishing activities. Those grid cells were excluded for the purposes of the .lyr file established for this feature dataset; however, all of the records are retained in the feature class in the geodatabase. Grid cells were then categorized as having low VMS activity (6-10 records), moderate VMS activity (11-100 records), or high VMS activity (> than 100 records) as shown in Figure 10.

The above data distillation process may include grid cells showing VMS activity within areas that prohibit such activity, such as the Deepwater Coral Habitats of Particular Concern (CHAPC). This does not indicate illegal activity, but rather is a function of records present in these areas that represent transit or the fact that activity within a grid cell could occur within the portion of that cell that is open to the fishery. It should also be noted that the relatively low activity in the northern portion of the region is largely due to the limited activity of Florida based boats in these areas. VMS data is more representative of shrimping efforts in Florida, but may serve as a general representation of shrimping activities conducted by shrimp boats not required to have VMS.

Artificial Reef Locations:

All four states in the GSAA have established artificial reef programs to enhance recreational fishing and sport diving opportunities in coastal waters. These reefs are generally constructed and maintained by the North Carolina Department of Environment and Natural Resources for NC, The South Carolina Department of Natural Resources for SC, the Georgia Department of Natural Resources of GA, and the Florida Fish and Wildlife Commission for FL. Information on the locations of the reefs off each state was obtained from the respective web sites for each of the above agencies. These data are only accurate to the date of publication and new zones can be created at any time within one or more of the states. Only a portion of the artificial reef locations are shown in Figure 11.

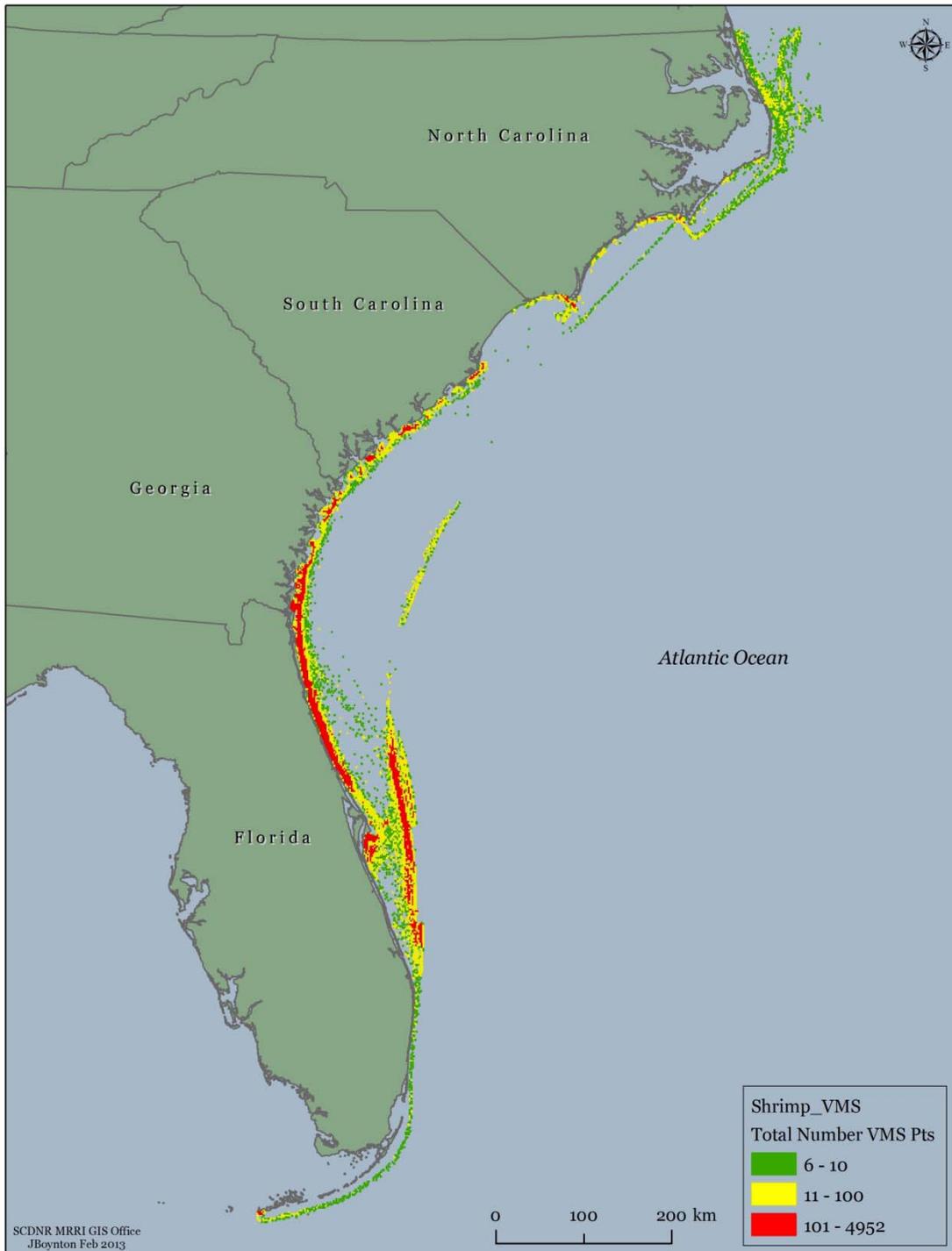


Figure 10. Summary of VMS activity associated with Florida vessels fishing in the southeast region. Deep water records are most likely tied to rock shrimp and royal red shrimp fishing. Shallow water records are most likely representative of penaeid shrimp fishing.

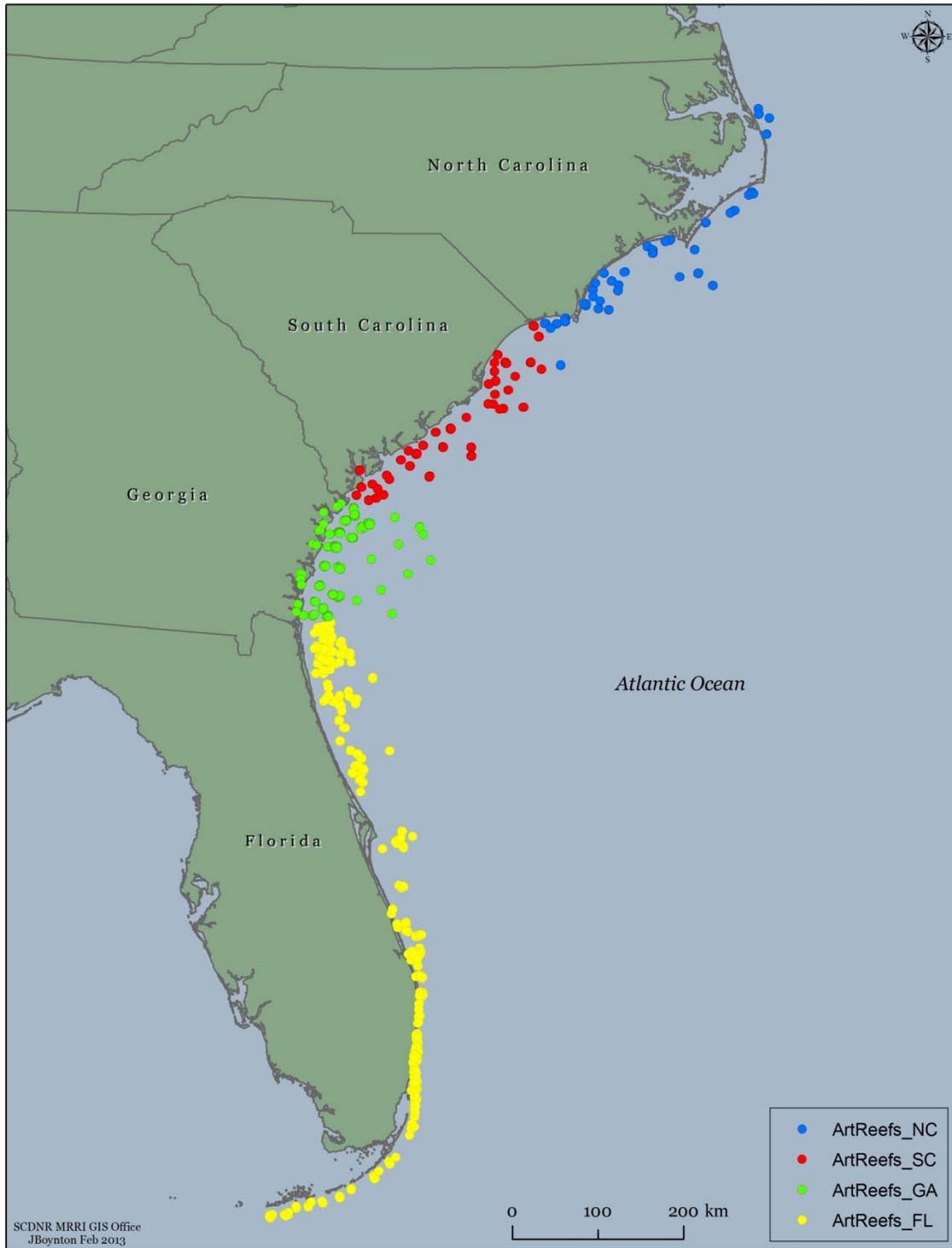


Figure 11. General location of artificial reefs along the southeastern coast. Information on each reef can be obtained by clicking on the point of interest in this data layer.

Ocean Disposal Area Locations:

Each of the four states have designated Ocean Dredged Material Disposal Sites (ODMDS) where ocean dumping occurs under a permit the Marine Protection, Research, and Sanctuaries Act (MPRSA) issued by the U.S. Army Corps of Engineers (USACE) using the U.S. Environmental Protection Agency's (EPA) environmental criteria and subject to EPA's concurrence. The locations of all designated ODMDS sites are provided in the GSAA geodatabase provided by the SCDNR. Some of the boundary information was provided directly by the USACE and other site boundaries were obtained from the EPA. Boundaries of these areas are subject to change over time. For example, the current boundaries of the Charleston ODMDS are being re-evaluated by the USACE, EPA and other relevant state and federal agencies in order to accommodate increase sediment volume related to the planned Charleston Harbor "Post 45" deepening project. Figure 12 shows the general location of the ODMDS sites off each state.

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Since portions of the data presented in this report represent MARMAP information, the report is represents MARMAP report number 2013-022.

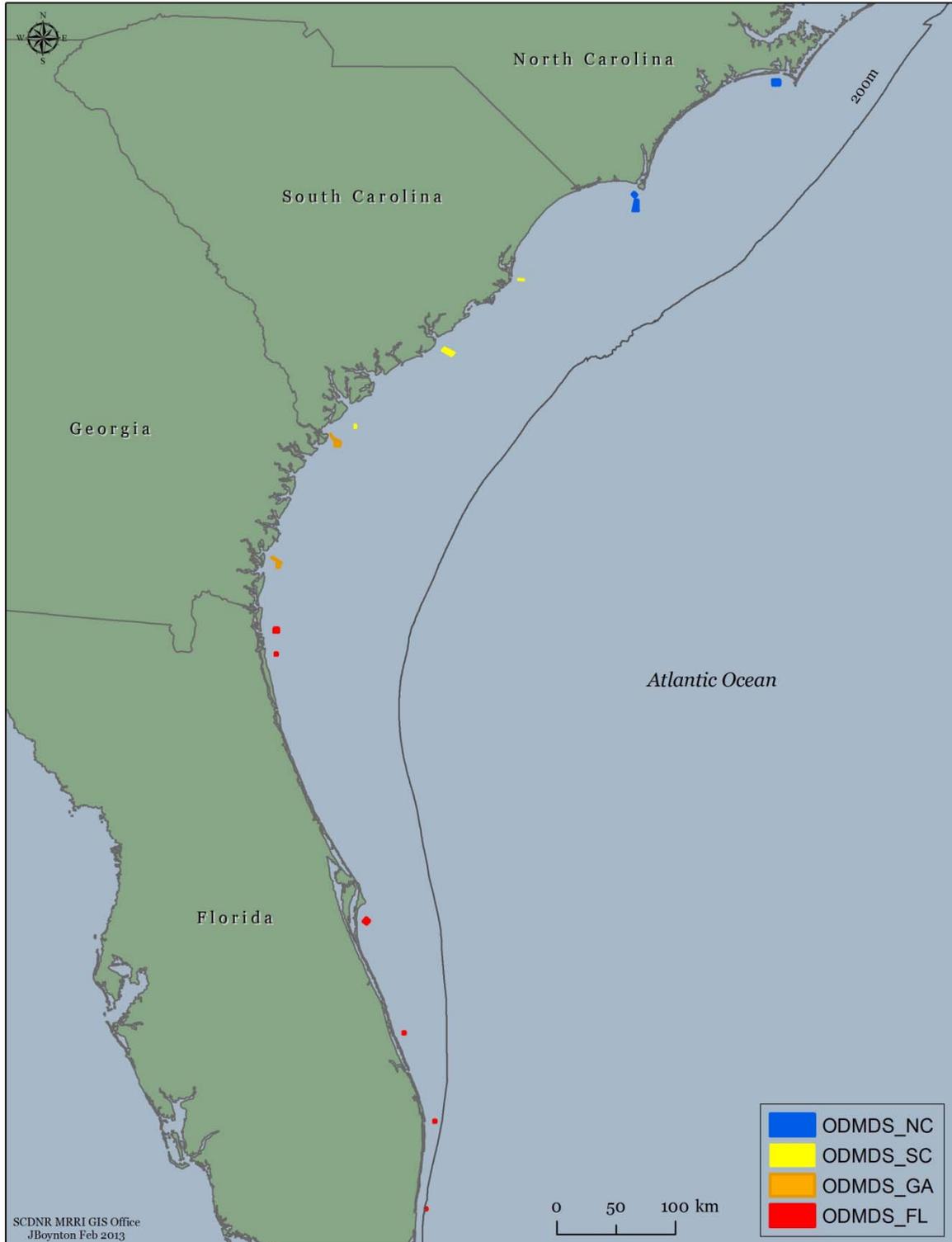


Figure 12. General location of Ocean Dredged Material Disposal Sites (ODMDS) in the southeastern U.S.