10.0 ESSENTIAL FISH HABITAT

10.1 INTRODUCTION

The Magnuson-Stevens Act requires NOAA Fisheries to describe and identify essential fish habitat for each life stage in the fishery management unit, the physical, biological, and chemical characteristics of EFH, and, if known, how these characteristics influence the use of EFH by the species/life stage. FMPs and FMP amendments must also include maps of the geographic locations of EFH or the geographic boundaries within which EFH for each species and life stage is found (Magnuson-Stevens Act, 16 U.S.C. 1801 *et seq*.). Under National Standard 2, conservation and management measures, including the identification and description of EFH, shall be based on the best scientific information available. As described in Section 3.3, and in greater detail below, a review of available literature and information was undertaken to assess habitat use and ecological roles of some species in the HMS fishery management unit. Published and unpublished scientific reports, fishery independent and fishery dependent data, and expert and anecdotal information detailing the habitats used by the managed species were evaluated and synthesized for inclusion in this FMP Amendment (See Section 10.3). Descriptions of EFH, including geographic location, physical, biological and chemical characteristics, and maps showing the extent of EFH for each species and life stage are provided.

A thorough review and identification of EFH for HMS was completed in the 1999 Fishery Management Plan (FMP) for Atlantic Tunas, Swordfish and Sharks. The current FMP Amendment addresses only those species for which there has been a change in management status (blacktip, sandbar, and finetooth sharks), or for which new information has become available (dusky and nurse sharks). The complete five-year review required by the EFH regulations for all other HMS, including other shark species, will be undertaken in 2004.

The Magnuson-Stevens Act also requires that FMPs or FMP amendments minimize to the extent practicable adverse effects on EFH and identify other actions to encourage the conservation and enhancement of EFH (MSA § 303(a)(7)). FMPs or FMP amendments must contain an evaluation of the potential adverse effects of fishing on EFH designated under the FMP, including effects of each fishing activity regulated under the FMP or other Federal FMPs. This evaluation should consider the effects of each fishing activity on each type of habitat found within EFH. FMPs must describe each fishing activity and review and discuss all available relevant information (such as information regarding the intensity, extent, and frequency of any adverse effect on EFH; the type of habitat within EFH that may be affected adversely; and the habitat functions that may be disturbed)(§ 600.815(a)(2)).

Habitat protection is vital to all species and life stages of sharks. EFH for sharks may encompass a wide range of habitats including coastal and estuarine pupping and nursery areas to deep offshore pelagic waters where some species, such as the longfin mako shark, spend their entire lives. Due to their proximity to land, shallow water and poor circulation, coastal and estuarine areas may be most susceptible to environmental and human impacts. Many commercial and recreational fisheries are also located close to shore, potentially increasing impacts on shark EFH. Offshore areas are not immune to impacts however, as pollutants generated onshore may be transported offshore via river plumes, currents and other hydrographic features. Offshore areas may also by subject to impacts from deep sea fishing vessels. The following sections provide information on the current status of EFH for several shark species, as well as a review of potential impacts from both fishing and non-fishing related activities.

10.2 EFH IDENTIFICATION PROCESS

10.2.1 Process Used for Identification of EFH for Atlantic Sharks

EFH for all HMS species, including sharks, was originally identified in the 1999 HMS FMP. Per Section 600.815 (a)(10) of the EFH regulations, this FMP Amendment updates information on several shark species based on a change in the management status of the species, or on new information that has become available since the 1999 HMS FMP. The 1999 HMS FMP highlighted the importance of coastal nursery and pupping areas in maintaining viable shark populations. As a result, several studies and cooperative research projects aimed at improving NOAA Fisheries' understanding of EFH and shark reproductive habitat requirements have been undertaken since the 1999 HMS FMP.

For example, in 1995, pilot studies of shark nursery areas in Delaware Bay were initiated by the NOAA Fisheries Apex Predator Program (APP). In 1998, the studies were expanded to other coastal states as the Cooperative Atlantic Shark Pupping and Nursery (COASTSPAN) Survey (McCandless and Pratt, 2002) to further identify and delineate shark nursery habitat on the U.S. Atlantic coast. Surveys are conducted by cooperating fisheries agencies and institutions in coastal areas from New Jersey to Georgia. Florida also contributes data, both historical and current. Researchers from the NOAA Fisheries APP and the University of Rhode Island conduct the COASTSPAN survey in Delaware Bay. Results of this research are included in the current update of EFH for several shark species.

Another study initiated since the 1999 HMS FMP was a synthesis document of information on shark nursery grounds along the U.S. Atlantic east coast and the Gulf of Mexico. Researchers from universities and state and Federal agencies in twelve different states from Massachusetts to Texas contributed information to the report (McCandless *et al.*, 2002). This information was included in the current review of EFH.

Finally, the Nurse Shark Mating and Nursery Grounds Project, conducted cooperatively by the NOAA Fisheries APP and Albion College (Albion, Michigan) has recently been included in the COASTSPAN program. Since 1991, the researchers have undertaken studies on nurse shark (*Ginglymostoma cirratum*) behavioral ecology in the Dry Tortugas National Park, Florida, focusing on habitat utilization for mating and as nursery grounds.

EFH information from most of these studies is based on distribution information (level 1) derived from systematic presence/absence sampling and relative abundance (CPUE) data. Density information (i.e. number of sharks/m^3) is generally not available due to the type of gear used to collect sharks. For example, the data from the research contributed by the McCandless *et al.* (2002) report were gathered using a wide variety of sampling techniques including gillnet, longline, and trawl surveys. Of the 15 separate research studies conducted from New York to Texas that contributed to the McCandless *et al.* report, only one provided trawl data that might have been used to generate habitat related densities. Additional equipment would have been needed however to collect information on water volume sampled. The other sampling techniques (gillnet and longline) provide presence/absence or relative abundance through CPUE data (e.g. number of sharks/gillnet hour, or number of sharks/100 hooks), but not density data. Additionally, due to the differences in fishing effort, a cross comparison of CPUE among the different studies was not possible.

Despite the lack of density information, other valuable information was derived from these studies, including data on growth rates from recaptured tags and habitat utilization information through sampling, telemetry, and tagging efforts (level 3 data). By determining the life stage of a shark at capture, through size measurement or external features such as umbilical scars on neonates, or parturition signs on mature females, additional information may be derived about habitat utilization. Information on where and when young sharks were pupped, how long they may have been in the area, when they began migrating to deeper water, and whether they returned in subsequent years to the same area may be determined. In combination, all of these data help to determine habitat value and provide a more complete overview of habitat utilization than simple distribution data might suggest.

To the extent possible, these and other types of information from studies of life history dynamics of sharks, reports, and expert opinion were utilized to identify EFH. The sources that were used to identify EFH areas are referenced in the text and in the life history tables in Section 10.4. When environmental information was available, it was included in the EFH descriptions and tables. The information included temperature, dissolved oxygen, salinity ranges, depths, seasons, and geographic locations. The textual accounts for each species serve as the legal description of EFH, and where environmental characterizations are known they have been included. Maps are provided as supplemental material to facilitate visualization of the EFH locations. Based on analyses of the available data, polygons marking the boundaries of EFH for each life stage have been drawn on the maps.

10.2.2 Methodology for Identification of EFH for Atlantic Sharks

The overall approach to be used in analyzing data and identifying EFH is described in the EFH regulations (§ 600.815(a)(1)). The regulations recommend using an organizational approach of categorizing the data according to different levels. The regulations require that, at a minimum, distributional data (level 1 information) be used in the identification of EFH. This level 1 information is based on presence/absence data of the species or life stages in specific habitats used. Where possible, data sets and information on habitat related densities of species (level 2), growth, reproduction and survival within habitats (level 3) and production rates by habitat (level 4) should be used to identify EFH. The preferred alternatives for EFH in this FMP Amendment (See Section 4.7) propose using existing EFH, and, as appropriate, identifying EFH for each species and life stage as those habitats necessary for spawning, breeding, feeding, or growth to maturity. Additionally, existing EFH is used, and, as appropriate, increased or decreased for species with special needs (e.g., overfished). In the following sections, existing EFH from the 1999 HMS FMP is described, and modifications are included in text and in maps for easy comparison.

Identifying EFH based on species distributional information, such as presence/absence and catch data, is subject to certain limitations. The potential exists to identify habitat that may not be essential, or conversely, to exclude important habitat. In situations where questions of delineating EFH arose, a precautionary approach was used, meaning that an attempt was made to include rather than exclude potential habitats to ensure adequate EFH areas were identified. Several data sets were used in order to provide the broadest possible overview of the habitats utilized by sharks. The data sets are described in greater detail below. Both fisheries dependent and fisheries independent data sets were analyzed.

Description of Data Sets Used to Identify EFH

The Cooperative Shark Tagging Program (CSTP), a research program managed by the Northeast Fisheries Science Center (NEFSC), APP, provided one of the most comprehensive, long-term data sets available on sharks. The data set has a continuous time series of observations dating back to 1962. Between 1962 and 2001, more than 171,000 sharks of 52 species have been tagged and more than 10,000 sharks of 33 species have been recaptured. Information is collected by distributing tags to scientists and commercial and recreational fishermen who record information on the date, location, gear, size and sex of the tagged shark prior to releasing it. In the event that a tagged shark is recaptured, information about migration, species distribution, age and growth, and mortality may be determined.

The Commercial Shark Fishery Observer Program (CSFOP), administered by the Florida Museum of Natural History, University of Florida, has been collecting information on the directed shark bottom longline fishery since 1994. A voluntary program for many years, it became mandatory in 2002. Trained observers collect fishery-dependent information on the location of each longline set, species composition, number of each species caught, and information on individual sharks such as length and sex. The coverage for this data set extends from the Atlantic east coast into the Gulf of Mexico. Data from this program are essential to monitoring the fishery and providing distributional information for many different sharks species.

The COASTSPAN program, also administered by the NEFSC, APP, has been collecting information on shark nursery areas for several Atlantic east coast states since 1998. The purpose of these surveys is to assess the geographical and seasonal extent of shark nursery habitat, determine which shark species use these areas and gauge the relative importance of these coastal habitats. The information is collected by NOAA scientists and state and university researchers who monitor shark populations in Delaware, North Carolina, South Carolina, and Georgia. Historical and current data has also been contributed by Florida.

In 2002, a synthesis document of shark nursery research conducted along the U.S. Atlantic and Gulf of Mexico coasts was completed, resulting in additional information on shark EFH. The data collected by the various researchers were synthesized into a single standardized data set to provide a comprehensive view of shark nursery and pupping areas in state waters. The information included in this data set was derived through a variety of collecting methods including longline, gillnet and trawl surveys, and standardized to include information on location, species, length, and data source.

The Southeast Fishery Longline Shark Survey, administered by NOAA Fisheries, Southeast Fisheries Science Center (SEFSC), Pascagoula Laboratory, has been conducting biological surveys to assess the relative abundance and distribution of coastal sharks since 1995. Biological data is collected from all captures and associated environmental data is recorded from each longline location. Most of the sharks captured are tagged and released. The longline surveys provide a useful fisheries independent data base for sharks.

The Pelagic Longline Observer Program, administered by SEFSC in Miami, has been monitoring the commercial pelagic longline fishery since 1992. The program places trained observers aboard commercial fishing boats in the swordfish directed fishery. Although not targeted, sharks are frequently caught as bycatch in the longline fishery. The observers collect information on location, number of fish caught per set, species identification, sex, length, and weight.

Other data sets included in the analysis were the Southern Atlantic SEAMAP Shallow Water Trawl Survey administered by the South Carolina Department of Natural Resources, the Virginia Institute of Marine Sciences Longline Survey, and the Mote Marine Laboratory, Center for Shark Research.

After careful screening to ensure standardization and quality of the data, all of the data sets were combined into a single database for analysis in a Geographic Information System (GIS) program. By combining all of the data sets, the number of observations for an individual life stage for a single species ranged from several hundred to over 18,000. Each observation included the species name, life stage, total length in cm, location in latitude and longitude coordinates, date of collection, and data source.

To visually represent species' distributions, data from all data sets were combined and analyzed by species and life stage in a GIS program. To identify areas with the highest concentration of observations, individual observations were assigned to 10 minute squares (See Figure 10.1). Each square represents 100 square nautical miles. Depending on the species, the number of observations per square ranged from zero to several hundred. The squares were color-coded according to the number of observations per square, with highest concentrations in black and lowest concentrations in white, and a color scale was generated to reflect the frequency of occurrence. This allows the reader to quickly identify areas of highest concentration, which may have been difficult to do by simply plotting observations. Depending on the number of observations in the data set, and the status of the species, a higher or lower number of observations per 10 minute grid was used as a guide for identifying potential EFH areas. For example, for blacktip sharks, a rebuilt species with a large number of observations, a guide of >10 observations per 10 minute square was used to select areas of highest concentrations. For finetooth shark, a species for which there is not as much data and which is currently experiencing overfishing, a more precautionary level of > 1 observation per 10 minute square was used as a guide to help identify potential EFH areas. The number of observations per grid were used as a guide only. In certain instances there may have been outliers that were not included in the EFH area even though they fell within the range being considered. The number of observations per grid that was used as a guide, and the percentage of observed distribution points included in EFH under alternative L4 as a result are provided in Table 10.1.

The average percentage of observed distribution points included in EFH areas was 77 percent (See Table 10.1), and ranged from a high of 97 percent for neonate finetooth and blacktip sharks to a low of 47 percent for adult nurse sharks. The percentages were not used a priori as a guide to include or exclude areas from EFH, but rather were calculated after the EFH boundaries were established and are provided for illustrative purposes only. The percentages indicate that the earliest life stages tend to aggregate more than adults and hence have higher percentages of observed distributions included in EFH. For finetooth sharks, for example, 97 percent of the neonate observed distribution points are included in EFH, whereas the percentages for juveniles and adults are 88 and 74 percent respectively. Although accurate estimates of area could not be calculated, a qualitative examination of the EFH maps (Figures 10.6b,c,d) shows that the EFH area for neonates is considerably smaller than that of juveniles and adults.

Since this Amendment is meant to provide an update to the EFH areas identified in the 1999 HMS FMP, those areas (shapefiles) used to map EFH in the 1999 HMS FMP were used as the starting point, and adjustments were made to those shapefiles based on new or updated information. In areas where there was a readily identifiable geographic or bathymetric feature that coincided with or overlapped areas of aggregations, the feature was used to delineate the boundary, or a portion of the boundary, for the identified EFH. Where expert opinion was available and data points were scarce, areas were identified as EFH based on our best interpretation of life history accounts. EFH boundaries were digitized and processed into maps to supplement the text descriptions and tabular information provided in this FMP Amendment. Only those habitats that occur within the boundaries as they are interpreted through the combined text, maps and tables are considered EFH. If there are differences between the descriptions of EFH in text, maps, and tables, the textual description is ultimately determinative of the limits of EFH (See Section 600.815(a)(1)(IV)(B)).

EFH regulations require identification of EFH for each life stage of the managed species. Accordingly, EFH has been identified for each life stage of sharks. The size ranges of the life stages in the current Amendment as well as size ranges in the 1999 HMS FMP are presented in Table 10.2. The table reflects new information and updates to the 1999 HMS FMP size ranges. Summary tables of life history and habitat associations are included in Section 10.4 and reflect updated information regarding newly identified or existing EFH for several shark species. In the 1999 HMS FMP, the smallest size class was identified as "neonates and early juveniles." This definition has been modified to include primarily neonates and only small young-of-the-year sharks in order to better define and identify nursery areas. The total length cutoff for this size class is determined as the maximum embryo size in term females plus 10 percent of the maximum embryo size. This criteria was used because it helps to eliminate some of the small one-year-old sharks that fall within the young-of the-year size range, making it easier to identify primary nursery areas (where pupping occurs and young-of-the-year are present). This criteria can also be more easily applied to other species given the lack of published data on growth rates for many species, especially during the first year. This modification should also better represent the habitat shift between primary nursery areas and secondary nursery areas (occupied by age 1+ sharks); although many species do overlap habitat use between these two size classes.

The middle size class designated in the 1999 HMS FMP, "late juveniles and subadults," has been renamed as simply "juveniles". This size class includes all immature sharks from young juveniles to older or late juveniles. Some overlap between the "neonate and early juveniles" and the "adult" EFH areas may occur, depending on the species, due to the return to primary nursery areas by many juveniles, age 1+, and the developing conformity to adult migration patterns by late juveniles.

As in the 1999 HMS FMP, the largest size class, "adults," still consists of mature sharks based on the size at first maturity for females of the species. Changes to the size range of the adult size class for some species have been made based on new information on the size at first maturity for females of those particular species.

10.3 LIFE HISTORY ACCOUNTS AND ESSENTIAL FISH HABITAT DESCRIPTIONS

10.3.1 Large Coastal Sharks

10.3.1.1 Requiem Sharks

The requiem sharks comprise one of the largest shark families (*Carcharhinidae*), and are among the most economically valuable of all sharks. They are small to large sharks characterized by a flattened snout, with the fifth gill slit over or behind the origin of the pectoral fin, the first dorsal fin originating well ahead of the pelvic fins, and a caudal fin with an upper lobe that is nearly twice as long as the lower lobe. They include the blacktip, sandbar, tiger, bull, dusky and spinner sharks (Castro, 1993).

10.3.1.1.1 Blacktip shark (*Carcharhinus limbatus*) The blacktip shark is circumtropical in shallow coastal waters and offshore surface waters of the continental shelves. In the southeastern United States it ranges from Virginia to Florida and the Gulf of Mexico. Garrick (1982), on examining a large number of museum specimens, believed it to be a single worldwide species. Dudley and Cliff (1993), working off South Africa, and Castro (1996), working on blacktip sharks off the southeastern United States, showed that there were significant differences among the various populations. For example, the median size for blacktip sharks in the Atlantic is 126.6 cm fork length, whereas the median size in the Gulf region is 117.3 cm fork length. The blacktip shark is a fast moving shark that is often seen at the surface, frequently leaping and spinning out of the water. It often forms large schools that migrate seasonally north-south along the coast. This species is much sought after in the eastern United States because of the quality of its flesh. The blacktip and the sandbar shark are the two primary species in the U.S. commercial fisheries. In the markets of the United States "blacktip" has become synonymous with good quality shark; therefore, many other species are also sold under that name. Habitat associations are summarized in Table 10.3.

Reproductive potential: Off the southeastern United States males mature at between 142 and 145 cm total length and females at about 156 cm total length (Castro 1996). According to Branstetter and McEachran (1986), in the western north Atlantic, males mature at 139 to 145 cm total length at four to five years, and females at 153 cm total length at six to seven years. A similar pattern is evident in the Atlantic and Gulf of Mexico with larger size at maturity in the Atlantic than in the Gulf region. However, these ages are unvalidated and based on a small sample. Branstetter and McEachran (1986) estimated the maximum age at 10 years, and gave the von Bertalanffy parameters for combined sexes as: L_∞ = 171, K= 0.284, t_o= -1.5.

The young are born at 55 to 60 cm total length in late May and early June in shallow coastal nurseries from Georgia to the Carolinas (Castro, 1996), and in Bay systems in the Gulf of Mexico (Carlson, 2002; Parsons, 2002) and the Texas coast (Jones and Grace, 2002) Litters range from one to eight pups (Bigelow and Schroeder, 1948) with a mean of four. The gestation cycle lasts about a year; the reproductive cycle is biennial (Castro, 1996).

According to Castro (1993b), the nurseries are on the seaward side of coastal islands of the Carolinas, at depths of two to four meters. Carlson (2002) found neonates in depths of 2.1 to 6.0 m under a variety of habitat conditions. Castro (1993b) found neonates over muddy bottoms off Georgia and the Carolinas, while Hueter found them over seagrass beds off west Florida (unpublished Mote Laboratory CSR data). Neonates and juveniles were found off west Florida (from the Florida Keys to Tampa Bay) at temperatures of 18.5º to 33.6º C, salinities of 15.8 to 37.0 ppt, and DO of 3.5 to 9.0 mg/l. The neonates were found from April to September, while juveniles were found there nearly year-round.

Impact of fisheries: The blacktip shark is caught in many diverse fisheries throughout the world. Off the southeastern United States, it is caught in commercial longlines set in shallow coastal waters, but it is also pursued as a gamefish. There are localized gillnet fisheries in Federal waters off Florida that target blacktips during their migrations, when the schools are close to shore in clear waters. Aircraft are often used to direct net boats to the migrating schools, often resulting in the trapping of large schools. The species is pursued commercially throughout its range and is targeted because it is often found in shallow coastal waters. Its habit of migrating in large schools along shorelines makes it extremely vulnerable to organized drift gillnet fisheries.

***Essential Fish Habitat for Blacktip Shark (Figures 10.2 a-d)*:**

Neonate (≤ 69 cm total length) : The 1999 HMS FMP identified EFH for neonates/early juveniles (≤ 99 cm) as shallow coastal waters to the 25 m isobath, from Bull's Bay, SC at 33.5° N, south to Cape Canaveral, FL at 28.5° N; also, on the west coast of Florida from Thousand Islands at 26° N to Cedar Key, FL at 29° N, especially Tampa Bay and Charlotte Harbor, FL. Additionally, shallow coastal waters with muddy bottoms less than five meters deep on the seaward side of coastal islands from Apalachee Bay to St. Andrews Bay, FL.

The current Amendment retains the EFH areas identified above with the following modifications. The length of neonates is defined as ≤ 69 cm. EFH includes shallow coastal waters south of the Thousand Islands, FL at 26° N south to Key West, FL at 24.5° N; also the northeastern Gulf of Mexico (Apalachee Bay, Apalachicola Bay, St. Joseph Bay, Crooked Island Sound and St Andrew Bay) at 85° W to the mouth of St. Louis Bay and the Terrebonne Timbalier Bay System, LA at 91.2° W; also, all major bay systems along the Gulf coast of Texas from Sabine Lake to Lower Laguna Madre.

Juvenile (69 to 155 cm total length): The 1999 HMS FMP identified EFH for late juveniles/subadults (90 to 155 cm) as shallow coastal waters from the shoreline to the 25 m isobath: from Cape Hatteras, NC at 35.25° N to 29° N at Ponce de Leon Inlet; the west coast of Florida, including the Florida Keys and Florida Bay, north to Cedar Key at 29° N; from Cape San Blas, FL north of 29.5° N to the east coast of the Mississippi River delta north of 29° N; also, the west coast of Texas from Galveston, west of 94.5° N, to the U.S./Mexico border.

The current Amendment retains the EFH areas identified above with the following modifications. The length of juveniles is defined as 69-155 cm. EFH includes areas from the northeastern Gulf of Mexico (Apalachee Bay, Apalachicola Bay, St. Joseph Bay, Crooked Island Sound and St Andrew Bay) to the mouth of St. Louis Bay and the Terrebonne Timbalier Bay System, LA; also, all major bay systems along the Gulf coast of Texas from Sabine Lake to Lower Laguna Madre.

Adult (≥ 155 cm total length): The 1999 HMS FMP identified EFH for adults (≥156 cm) as shallow coastal waters of the Outer Banks, NC from the shoreline to the 200 m isobath between 36° N and 34.5° N; shallow coastal waters offshore to the 50 m isobath from St. Augustine, FL (30° N) to offshore Cape Canaveral, FL (28.5° N); on the west coast of Florida, shallow coastal waters to the 50 m isobath from 81° W in Florida Bay, to 85° W, east of Cape San Blas, FL.

The current Amendment retains the EFH areas identified above with the following modifications. The length of adults is defined as ≥ 155 cm. EFH includes areas north of St. Augustine, FL at 30° N to Cumberland Island, GA at 30.9°N, but excludes areas south from Apalachicola Bay to Tarpon Springs at 28.2°N.

10.3.1.1.2 <u>Dusky shark (*Carcharhinus obscurus*)</u>. The dusky shark is common in warm and temperate continental waters throughout the world. It is a migratory species which moves north-south with the seasons. This is one of the larger species found from inshore waters to the outer reaches of continental shelves. It used to be important as a commercial species and a game fish, but is currently prohibited. Habitat associations are summarized in Table 10.4.

Reproductive potential: Males mature at 290 cm total length and reach at least 340 cm total length. The females mature at about 300 cm total length and reach up to 365 cm total length. The dusky shark matures at about 17 years and is considered a slow growing species (Natanson, 1990). Litters consist of six to14 pups, which measure 85 to 90 cm total length at birth (Castro, 1983). The gestation period is believed to be about 16 months (Clark and von Schmidt, 1965), but this has not been confirmed. Natanson (1990) gave the following parameters for males L_{max}= 351 cm FL (420 cm total length), K= .047, t_o = −5.83; and females at L_{max}= 316 cm total length (378 cm total length) K= .061, t_o=-4.83. The growth rate is believed to be about 10 cm/yr for the young and five cm/yr for the adults.

The nursery areas are in coastal waters. Castro (1993c) reported that dusky sharks gave birth in Bulls Bay, SC, in April and May. Musick and Colvocoresses (1986) stated that the species gives birth in the Chesapeake Bay, MD in June and July, however Grubbs and Musick (2002) note that they use nearshore waters in VA as nursery areas but rarely enter estuaries.

Impact of fisheries: The dusky shark has played an important role in the coastal shark fisheries for flesh and fins, and is taken as bycatch in the swordfish and tuna fisheries. The dusky shark is one of the slowest growing requiem sharks and is often caught on both bottom and pelagic longlines, making it highly vulnerable to overfishing. Dusky sharks are currently prohibited and are a candidate for listing under the ESA.

***Essential Fish Habitat for Dusky Shark (Figures 10.3 a-d)*:**

Neonate (≤ 110 cm total length): The 1999 HMS FMP identified EFH for neonates/early juveniles (≤ 115 cm total length) as shallow coastal waters, inlets and estuaries to the 25 m isobath from the eastern end of Long Island, NY at 72° W south to Cape Lookout, NC at 34.5° N; from Cape Lookout south to West Palm Beach, FL (27.5° N), shallow coastal waters, inlets and estuaries and offshore areas to the 90 m isobath.

The current Amendment retains the EFH areas identified above with the following modifications. The length of neonates is defined as ≤ 110 cm. EFH includes areas out to the 200 m isobath off the states of Maryland south to North Carolina, and out to the 70 m isobath off New Jersey north to Long Island, NY.

Juvenile (110 to 299 cm total length): The 1999 HMS FMP identified EFH for late juveniles/subadults (116 to 300 cm) as areas off the coast of southern New England from 70° W west and south, coastal and pelagic waters between the 25 and 200 m isobaths; shallow coastal waters, inlets and estuaries to the 200 m isobath from Assateague Island at the Virginia/Maryland border (38° N) to Jacksonville, FL at 30° N; shallow coastal waters, inlets and estuaries to the 500 m isobath continuing south to the Dry Tortugas, FL at 83° W.

The current Amendment retains the EFH areas identified above with the following modifications. The length of juveniles is defined as 110-299 cm total length.

Adult (≥ 299 cm total length): The 1999 HMS FMP identified EFH for adults (≥301 cm) as pelagic waters offshore the Virginia/North Carolina border at 36.5° N south to Ft. Lauderdale, FL at 28° N between the 25 and 200 m isobaths.

The current Amendment retains the EFH areas identified above with the following modifications. The length of adults is defined as ≥299 cm. EFH includes coastal waters offshore from the Virginia/North Carolina border at 36.5° N south to Cape Romain, NC out to the 25 m isobath; also, coastal waters offshore from the Georgia/Florida border at 30.8° N to Cape Canaveral at 28.5° N.

10.3.1.1.3 Sandbar shark (*Carcharhinus plumbeus*). The sandbar shark is cosmopolitan in subtropical and warm temperate waters. It is a common species found in many coastal habitats. It is a bottom-dwelling species most common in 20 to 55 m of water, but occasionally found at depths of about 200 m. Habitat associations are summarized in Table 10.5.

Reproductive potential: The sandbar shark is a slow growing species. Both sexes reach maturity at about 147 cm total length or approximately 5 feet (Merson, 1998). Estimates of age at maturity range from 15 to 16 years (Sminkey and Musick, 1995) to 29 to 30 years (Casey and Natanson, 1992), although 15 to 16 years is the commonly accepted age of maturity. The von Bertalanffy growth parameters were proposed for combined sexes are L_∞= 186 cm FL (224 cm total length; 168 cm PCL), K= 0.046, t_o= -6.45 by Casey and Natanson (1992); and re-evaluated by Sminkey and Musick (1995) as L_∞= 164 cm PCL (219 cm total length; 182 cm Fl), K= 0.089, t_o= -3.8.

Young are born at about 60 cm total length (smaller in the northern parts of the North American range) from March to July. Litters consist of one to14 pups, with nine being the average (Springer, 1960). The gestation period lasts about a year and reproduction is biennial (Musick *et al*,. 1993). Hoff (1990) used an age at maturity of 15 years, a life span of 35 years, and a two-year reproductive cycle, to calculate that each female may reproduce only 10 times. New maturity estimates and the increased mortality in the fishery may reduce that reproductive potential much further.

In the United States the sandbar shark has its nurseries in shallow coastal waters from Cape Canaveral, FL (Springer, 1960), to Great Bay, NJ (Merson and Pratt, 2002). Delaware Bay, DE (McCandless *et al*., 2002), Chesapeake Bay, MD (Grubbs and Musick, 2002), and the waters off Cape Hatteras, NC (Jensen *et al*., 2002) are important primary and secondary nurseries. Juveniles return to Delaware Bay after a winter absence around May 15, and are found as far north as Martha's Vineyard, MA in the summer. Neonates have been captured in Delaware Bay in late June. Young of the year were present in Delaware Bay until early October when the temperature fell below 21˚ C. Another nursery may exist along the west coast of Florida and along the northeast Gulf of Mexico. Hueter and Tyminski (2002) found neonates off Yankeetown, FL, from April to July, in temperatures of 25.0˚ to 29.0˚ C, and salinities of 20.4 to 25.9 ppt. Neonate sandbar sharks were found in an area between Indian Pass and St. Andrew Sound, FL in June when the temperature had reached 25˚ C (Carlson, 2002).

Impact of fisheries: The sandbar shark is one of the most important commercial species in the shark fishery of the southeastern United States, along with blacktip sharks. It is a preferred species because of the high quality of its flesh and large fins. Commercial longline fishermen pursue sandbar stocks in their north-south migrations along the coast; their catches can be as much as 80 to 90 percent sandbar sharks in some areas. Musick *et al.* (1993) have documented a severe decline in CPUE of the sandbar shark in the Chesapeake Bay area. It is considered highly vulnerable to overfishing because of its slow maturation and heavy fishing pressure, as evidenced in the catch per unit effort (CPUE) declines in U.S. fisheries.

***Essential Fish Habitat (EFH) for Sandbar Shark (Figures 10.4 a-d)*:**

Neonate (≤ 71 cm total length): The 1999 HMS FMP identified EFH for neonates/early juveniles (≤ 90 cm total length) as shallow coastal areas to the 25 m isobath from Montauk, NY at 72˚ W, south to Cape Canaveral, FL at 80.5˚ W (all year); nursery areas in shallow coastal waters from Great Bay, NJ to Cape Canaveral, FL, especially Delaware and Chesapeake Bays (seasonal-summer); also shallow coastal waters to up to a depth of 50 m on the west coast of Florida and the Florida Keys from Key Largo at 80.5˚ W north to south of Cape San Blas, FL at 85.25˚ W. Typical parameters: salinity-greater than 22 ppt; temperatures-greater than 21˚ C.

The current Amendment retains the EFH areas identified above with the following modifications. The length of neonates is defined as ≤ 71 cm. EFH identified on the west coast of Florida is reduced from the 50 m isobath to the 30 m isobath and the seaward extent of EFH is reduced to approximately 20 miles offshore from the Virginia/Maryland border at 37.8˚ N south to Pamlico Sound, NC at 35.4˚ N.

Juvenile (71 to 147 cm total length): The 1999 HMS FMP identified EFH for late juveniles/subadults (≤ 90 cm total length) as areas offshore southern New England and Long

Island, NY, all waters, coastal and pelagic, north of 40˚ N and west of 70˚ W; also, south of 40˚ N at Barnegat Inlet, NJ, to Cape Canaveral, FL (27.5˚ N), shallow coastal areas to the 25 m isobath; also, in the winter, from 39˚ N to 36˚ N, in the Mid-Atlantic Bight, at the shelf break, benthic areas between the 90 and 200 m isobaths; also, on the west coast of Florida, from shallow coastal waters to the 50 m isobath, from Florida Bay and the Keys at Key Largo north to Cape San Blas, FL at 85.5˚ W.

The current Amendment retains the EFH areas identified above with the following modifications. The length of juveniles is defined as 71-147 cm. EFH includes Cape Poge Bay, MA around Chappaquiddick Island, MA, and off the south shore of Cape Cod, MA, but excludes an area running from 39.2˚ N off the coast of New Jersey south to 35.2˚ N off Cape Hatteras, NC. This is a long, finger-like projection roughly following the 200 m isobath.

Adult (≥ 147 cm total length): The 1999 HMS FMP identified EFH for adults (≥180 cm total length) as areas on the east coast of the U.S., shallow coastal areas from the coast to the 50 m isobath from Nantucket, MA, south to Miami, FL; also, shallow coastal areas from the coast to the 90 m isobath around peninsular Florida to the Florida panhandle at 85.5˚ W, near Cape San Blas, FL including the Keys and saline portions of Florida Bay.

The current Amendment retains the EFH areas identified above with the following modifications. The length of adults is defined as ≥147 cm. EFH excludes an area running from 39.2˚ N off the coast of New Jersey south to 35.2˚ N off of Cape Hatteras, NC. This is a long, finger-like projection roughly following the 200 m isobath.

Habitat Areas of Particular Concern (HAPC): Important nursery and pupping grounds have been identified in shallow areas and at the mouth of Great Bay, NJ, in lower and middle Delaware Bay, DE, lower Chesapeake Bay, MD, and near the Outer Banks, NC, and in areas of Pamlico Sound and adjacent to Hatteras and Ocracoke Islands, NC, and offshore of those islands. The current Amendment does not propose any changes to sandbar shark HAPC (See Figure 10.4e).

10.3.1.2 Nurse Sharks - Family Ginglymostomatidae

The family Ginglymostomatidae is comprised of nurse sharks and carpet sharks. They are sluggish, bottom-dwelling sharks of shallow tropical waters. They are characterized by the presence of fleshy nasal barbels or feelers just anterior to the mouth and a deep groove connecting the nostril with the mouth. Other characteristics include short snouts with rectangular mouths and small eyes (Castro, 1993).

10.3.1.2.1 Nurse shark (*Ginglymostoma cirratum*). The nurse shark inhabits littoral waters in both sides of the tropical and subtropical Atlantic, ranging from tropical West Africa and the Cape Verde Islands in the east, and from Cape Hatteras, NC to Brazil in the west. It is also found in the east Pacific, ranging from the Gulf of California to Panama and Ecuador (Bigelow and Schroeder, 1948). It is a shallow water species, often found lying motionless on the bottom under coral reefs or rocks. It often congregates in large numbers in shallow water (Castro, 1983; Pratt and Carrier, 2002) Habitat associations are summarized in Table 10.6.

Reproductive potential: The nurse shark matures at about 225 cm total length (Springer, 1938). Litters consist of 20 to 30 pups, the young measuring about 30 cm total length at birth. The gestation period is about five to six months and reproduction is biennial (Castro, 2000). The age at maturity is unknown, but the nurse shark is a long-lived species. Clark (1963) reported an aquarium specimen living up to 24 years in captivity.

Its nurseries are in shallow turtle grass (*Thalassia*) beds and shallow coral reefs (Castro, 2000; Pratt and Carrier, 2002). However, juveniles are also found around mangrove islands in south Florida. Hueter and Tyminski (2002) found numerous juveniles along the west coast of Florida, in temperatures of 17.5˚ to 32.9˚ C, salinities of 28.0 to 38.5 ppt, and DO of 3.1 to 9.7 mg/l. Large numbers of nurse sharks often congregate in shallow waters off the Florida Keys and the Bahamas at mating time in June and July (Fowler, 1906; Gudger, 1912; Pratt and Carrier, 2002). A small area has been set up for protection of mating sharks at Fort Jefferson in the Dry Tortugas. It is not certain, however, whether this area is a primary mating ground or a refuge for mated females.

Impact of fisheries: In North America and the Caribbean the nurse shark has often been pursued for its hide, which is said to be more valuable than that of any other shark (Springer, 1950a). The fins have no value and the meat is of questionable value (Springer, 1979). The U.S. commercial bottom longline fleet catches few nurse sharks.

***Essential Fish Habitat for Nurse Shark (See Figure 10.5 a-d)*:**

Neonate (≤ 36 cm total length): The 1999 HMS FMP identified EFH for neonates (≥ 60 cm total length) as areas of shallow coastal areas from West Palm Beach, FL, south to the Dry Tortugas in waters less than 25 m deep.

The current Amendment retains the EFH areas identified above with the following modifications. The length of neonates is defined as ≤ 36 cm total length. EFH includes Charlotte Harbor, FL at 82˚ W and 26.8˚ N in waters less than 25 m deep.

Juvenile (37 to 221 cm total length): The 1999 HMS FMP identified EFH for late juveniles/subadults (61 to 225 cm total length) as shallow coastal waters from the shoreline to the 25 m isobath off the east coast of Florida from south of Cumberland Island, GA (at 30.5˚ N) to the Dry Tortugas; also shallow coastal waters from Charlotte Harbor, FL (at 26˚ N) to the north end of Tampa Bay, FL (at 28˚ N); also, off southern Puerto Rico, shallow coastal waters out to the 25 m isobath from 66.5˚ W to the southwest tip of the island.

The current Amendment retains the EFH areas identified above with the following modifications. The length of juveniles is defined as 37 to 221 cm total length. EFH includes areas in the northeast Gulf of Mexico (Apalachee Bay, Apalachicola Bay, and Crooked Island Sound, FL).

Adults (≥ 221 cm total length): The 1999 HMS FMP identified EFH for adults (≥226 cm total length) as shallow coastal waters from the shoreline to the 25 m isobath off the east coast of Florida from south of Cumberland Island, GA (at 30.5° N) to the Dry Tortugas; also, shallow coastal waters from Charlotte Harbor, FL (at 26° N) to the north end of Tampa Bay, FL (at 28° N); also, off southern Puerto Rico, shallow coastal waters out to the 25 m isobath from 66.5° W to the southwest tip of the island.

The current Amendment retains the EFH areas identified above with the following modifications. The length of adults is defined as 37 to 221 cm total length. No other changes to the 1999 EFH areas are proposed.

10.3.2 Small Coastal Sharks

10.3.2.1 Finetooth shark (*Carcharhinus isodon*). This is a common inshore species of the west Atlantic. It ranges from North Carolina to Brazil. It is abundant along the southeastern United States and the Gulf of Mexico (Castro, 1983). Sharks captured in the northeastern Gulf of Mexico ranged in size from 48 to 150 cm total length, were generally found in water temperatures averaging 27.3°C, and depths of 4.2 m (Carlson, 2002). Important nursery habitat is also located in South Carolina (Ulrich and Riley, 2002), Louisiana (Neer *et al*., 2002), and the coast of Texas (Jones and Grace, 2002). Habitat associations are summarized in Table 10.7.

Reproductive potential: Males mature at about 130 cm total length and females mature at about 135 cm total length. The young measure 48 to 58 cm total length at birth. Litters range from two to six embryos, with an average of four. The gestation period lasts about a year, and the reproductive cycle is biennial. Some of the nurseries are in shallow coastal waters of South Carolina (Castro, 1993b).

Impact of fisheries: According to the SCS stock assessment, finetooth sharks are caught commercially almost exclusively in the South Atlantic region and mostly with gillnets (approximately 80 percent of finetooth landings) and longlines (approximately 20 percent). The SCS stock assessment estimates 16,658 finetooth sharks were landed commercially in 2000, and of these, only 8 percent were from HMS fisheries. The majority of the catch thus appears to come from fishermen in non-HMS fisheries. The species is vulnerable to overfishing because of its biennial reproductive cycle and small brood size.

***Essential Fish Habitat for Finetooth Shark (See Figure 10.6 a-d)*:**

Neonate (≤ 65 cm total length): The 1999 HMS FMP identified EFH for neonates (≤90 cm total length) as shallow coastal waters of South Carolina, Georgia, and Florida out to the 25 m isobath from 33° N to 30° N. Additionally, shallow coastal waters less than five meters deep with muddy bottoms, and on the seaward side of coastal islands from Apalachee Bay to St. Andrews Bay, FL, especially around the mouth of the Apalachicola River.

The current Amendment retains the EFH areas identified above with the following modifications. The length of neonates is defined as ≤ 65 cm total length. EFH includes coastal waters out to the 25 m isobath from Mobile Bay, AL to Bay St. Louis, MS from 88° W to 89.5° W, and from near Sabine Pass, TX to Laguna Madre, TX.

Juvenile (65 to 135 cm total length): The 1999 HMS FMP identified EFH for juveniles (91 to 135 cm total length) as identical to neonate EFH: shallow coastal waters of South Carolina, Georgia, and Florida out to the 25 m isobath from 33° N to 30° N. Additionally, shallow coastal waters less than five meters deep with muddy bottoms, and on the seaward side of coastal islands from Apalachee Bay to St. Andrews Bay, FL, especially around the mouth of the Apalachicola River.

The current Amendment retains the EFH areas identified above with the following modifications. The length of juveniles is defined as 65 to 135 cm total length. EFH includes coastal waters out to the 25 m isobath from Mobile Bay, AL to Atchafalaya Bay, LA from 88° W to 91.4° W, and from near Sabine Pass, TX at 94.2° W to Laguna Madre, TX at 26° N; also, coastal waters out to the 25 m isobath from South Carolina north to Cape Hatteras, NC at 35.5° N.

Adult (≥ 135 cm total length): The 1999 HMS FMP identified EFH for adults (≥136 cm total length) as identical to neonate EFH: shallow coastal waters of South Carolina, Georgia, and Florida out to the 25 m isobath from 33°N to 30° N. Additionally, shallow coastal waters less than five meters deep with muddy bottoms, and on the seaward side of coastal islands from Apalachee Bay to St. Andrews Bay, FL, especially around the mouth of the Apalachicola River.

The current Amendment retains the EFH areas identified above with the following modifications. The length of adults is defined as 135 cm total length. EFH includes areas identical to those for juveniles: coastal waters out to the 25 m isobath from Mobile Bay, AL to Atchafalaya Bay, LA from 88° W to 91.4° W, and from near Sabine Pass, TX at 94.2° W to Laguna Madre, TX at 26° N; also, coastal waters out to the 25 m isobath from South Carolina north to Cape Hatteras, NC at 35.5° N.

10.4 THREATS TO ESSENTIAL FISH HABITAT

This section identifies the principal fishing and non-fishing related threats to shark EFH, as identified and described in Section 10.2 of this chapter. It also provides examples and information concerning the relationship between those threats and EFH, and describes actions to conserve and enhance EFH that may minimize adverse impacts on shark EFH.

Many shark species use bays, estuaries, and shallow coastal waters as pupping and nursery areas. In only a few cases are there specific bottom habitats that can be attributed to influencing the choice of habitats, e.g., young-of-the-year bonnethead sharks are associated with sea grass beds while adults prefer deeper areas with sand or clay bottoms (Carlson, 2002). Pelagic species (or life stages), are most often associated with areas of convergence or oceanographic fronts such those found over submarine canyons, the edge of the continental shelf, or the boundary currents (edge) of the Gulf Stream. Although there is no substrate or hard structure in the traditional sense, these water column habitats can be characterized by their physical, chemical and biological parameters.

10.4.1 Fishing Activities That May Adversely Affect EFH

The Magnuson-Stevens Act requires NOAA Fisheries to identify adverse effects on EFH caused by fishing activities, and further requires that the fisheries are managed so as to minimize such impacts. The EFH regulations explain that "adverse effects from fishing may include physical, chemical, or biological alterations of the substrate, and loss of, or injury to, benthic organisms, prey species and their habitat, and other components of the ecosystem." The regulations require that FMPs or FMP amendments contain an assessment of the potential adverse effects of all fishing gears and practices used in waters described as EFH. The assessment must consider the relative impacts of gears on all different types of EFH identified. Special consideration is to be given to the analysis of impacts from gears that will affect Habitat Areas of Particular Concern (HAPC).

The EFH regulations also require that FMPs or FMP amendments include management measures that minimize adverse effects on EFH from fishing, to the extent practicable. To decide if minimization of an adverse effect from fishing is practicable, NOAA Fisheries must consider: (1) whether, and to what extent, the fishing activity is adversely impacting EFH, including the fishery; (2) the nature and extent of the adverse effect on EFH; and, (3) whether the management measures are practicable, taking into consideration the long and short-term costs as well as the benefits to the fishery and its EFH, along with other appropriate factors consistent with National Standard 7. The best scientific information available must be used, as well as other appropriate information sources, as available. Where information gaps are identified through the assessment process, the establishment of research closure areas and other measures should be considered to evaluate the impact of any fishing activity that physically alters EFH.

This section includes an assessment of fishing gears and practices that are used in the shark fisheries, accompanied by conservation recommendations to minimize the potential impacts. Also included is a brief discussion of the scientific review of information relating to fishing impacts on habitat. In recent reviews of fishing impacts on habitat, Jennings and Kaiser (1998) and Auster and Langton (1998) characterize fishing impacts hierarchically: impacts on structural components of the habitat, effects on community structure, and effects on ecosystem processes. In this section the impacts of shark fishing activities will be addressed in the same format, followed by comments on non-shark fishing impacts on shark EFH, and also the identification of research priorities to provide additional information that can be used to improve future amendments to the FMP EFH provisions.

Physical Impacts of HMS Fishing Gears on EFH

The following is a comprehensive list of all gear types used in HMS fisheries:

Atlantic Highly Migratory Species

Directed Fishery	**Approved Gear**
Atlantic Swordfish:	
A. Handgear fishery	A. Rod and reel, harpoon, handline, bandit gear
B. Longline fishery	B. Longline
Atlantic Sharks[1]:	
A. Hook and line fishery	A. Rod and reel, handline
B. Handgear fishery	B. Rod and reel, handline, bandit gear
C. Longline fishery	C. Longline
D. Gillnet fishery	D. Gillnet
Atlantic Tuna:	
A. Handgear fishery	A. Rod and reel, handline, harpoon, bandit gear
B. Purse seine fishery	B. Purse seine
C. Longline fishery	C. Longline
D. Harpoon fishery	D. Harpoon
E. Recreational fishery	E. Rod and reel, handline

None of the proposed gear modifications are expected to have an impact on shark EFH.

Of the approved gears that are used in the HMS fisheries, only bottom longlines, principally targeting large coastal sharks, make contact with the bottom. If bottom longline gear becomes hung or entangled on bottom substrates such as rock, and hard and soft corals, it could have some adverse impacts. However, the nature of these impacts to shark EFH overall is considered to be minimal. As noted in Section 10.1, EFH for sharks may encompass a wide range of habitats from coastal waters to deep offshore pelagic waters along the U.S. Atlantic and Gulf of Mexico coasts. Currently, little information exists on the effects of bottom longlining on benthic habitat. The principal components of the longline that can produce seabed effects are the anchors or weights, hooks, and mainline (Johnson, 2002). The only data currently available regarding bottom longline impacts is from submersible observations of halibut longline gear off southeast

[1] This FMP Amendment proposes to modify the list of approved recreational gear types to allow only handline and rod and reel. Currently, fishermen may use gears traditionally considered to be commercial gears.

Alaska in 1992 (NPFMC 1992). The 1999 NOAA Fisheries EFH Workshop categorized the impact of bottom longline gear on mud, sand, and hard-bottom as low (Barnett, 2001).

The Gulf of Mexico and Caribbean Fishery Management Councils are evaluating the impacts of several gear types, including bottom longline, on EFH areas identified under their respective reef fish and coral reef fisheries (Gulf of Mexico DEIS, 2003; Caribbean Fishery Management Council DEIS, 2003). Specifically, both Councils are evaluating measures to minimize the impacts of bottom longline gear on coral reef habitat identified as EFH for several of their managed species. If those measures are finalized, NOAA Fisheries will consider further rulemaking, as necessary, for the Atlantic shark fisheries, because there may be overlap in fishery participants.

As a precautionary measure, NOAA Fisheries recommends that fishermen take appropriate steps to identify bottom obstructions and "hangs" and avoid setting gear in areas where it may become entangled and potentially disrupt benthic habitats. If gear is lost, diligent efforts should be made to recover the lost gear to avoid further fouling (disturbance) of the underwater habitat through ghost fishing.

Impacts on HMS EFH from non-HMS Fishing Gears and Practices

Because sharks use both estuarine and coastal inshore habitats, their EFH may be negatively impacted by fisheries that target species other than sharks. These fisheries may be either state or Federally managed. Trawl fisheries that scrape the substrate, disturb boulders and their associated epiphytes or epifauna, resuspend sediments, flatten burrows and disrupt seagrass beds have the potential to alter the habitat characteristics that are important for survival of early life stages of many targeted and non-targeted species. In particular, shark pupping and nursery habitats may be subjected to fishing impacts from gears of other fisheries, e.g., shrimp trawling, but the degree of overlap between the various trawl fisheries and shark EFH, the extent to which habitat is altered by these gears, and the resulting impact on EFH are currently not known. Further research would be required to determine habitat-related production rates for sharks (the highest, most refined level of information available with which to identify EFH, and which is currently not available for sharks) and the potential impact of other fisheries on these production rates.

NOAA Fisheries is aware of shark bycatch occurring in other fisheries such as the shrimp trawl fishery which catches large numbers of SCS, and the menhaden fishery which catches LCS. Both of these sources of mortality have been taken into account in the most recent 2002 LCS and SCS stock assessments. It is unclear which species comprise the bulk of the SCS bycatch in the shrimp trawl fishery, however, the SCS stock assessment indicated that despite this bycatch, SCS is not overfished and overfishing is not occurring. The LCS bycatch in the menhaden fishery is comprised mainly of blacktip sharks which are also not overfished and overfishing is not occurring. Other than these direct sources of mortality, there is currently no information to indicate that either of these fisheries or any other non-HMS fisheries are having a negative impact on shark EFH.

The degree of impact and long term habitat modification depends on the severity and frequency of the impacts as well as the amount of recovery time between impacts (Barnette, 2001, Auster and Langton, 1998). The extent to which particular parameters are altered by trawl gear is somewhat dependent on the configuration of the gear and the manner in which the gear is fished. Additional efforts are required to study shark EFH areas that are fished for non-HMS species and identify fishing gears that impact these habitats. Research into the spatial distribution of these activities, the frequency of disturbance, and the short and long-term changes induced in the habitat are of primary importance. A better understanding of the habitat characteristics that influence the abundance of managed species within those habitats is also needed in order to better understand the effects of fishing activities on habitat suitability for sharks.

Besides altering the physical characteristics of EFH, other fisheries may potentially remove prey species that make up the necessary biological components of shark EFH. However, currently, there is no evidence that other fisheries are having such an impact on shark EFH.

EFH Conservation Recommendations

The EFH regulations require actions to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing practice is having an identifiable adverse effect on EFH, based on the assessment of fishing gears on EFH. At this time, there is no evidence that physical effects caused by fishing under this Amendment, or under other fisheries, are adversely affecting shark EFH to the extent that detrimental effects can be identified on the habitat or the fisheries. However, the following two conservation recommendations, discussed above as a precautionary measure, should be used whenever possible in the event that impacts to coral reef or other hard bottom EFH habitat may be occurring but unverified: (1) fishers should take appropriate measures to identify bottom obstructions and avoid setting gear in areas where it may become entangled; and (2) if gear is lost, diligent efforts should be undertaken to recover the lost gear.

Other Actions related to EFH

In addition, this FMP Amendment is considering the use of a time/area closure as a possible management option to reduce the incidental bycatch of prohibited species such as the dusky shark, as well as juvenile sandbar sharks (See Chapter 4) in EFH and HAPC areas off of North Carolina. Specifically, a time/area closure is being proposed under this FMP Amendment in order to reduce dusky and sandbar shark bycatch from January through July of each year. Besides serving as a tool to reduce bycatch and rebuild stocks, seasonal closures could also help maintain the biological integrity of EFH and reduce the chance of altering the biological characteristics of EFH. From an EFH perspective, the alternative of time/area closures is seen as a desirable step toward not only reducing bycatch, but potentially conserving and enhancing

EFH. As such, NOAA Fisheries recommends time/area closures as a conservation measure for the protection of adult and juvenile shark EFH.

Proposed quota reductions in this FMP are one measure being adopted that may have a positive impact on shark EFH. By preserving more of the age structure in the population and a diversity of trophic levels, this measure could lend added stability to the ecosystem upon which the HMS fisheries depend. A reduction in overall catch may be a means to conserve sharks as well as shark EFH.

Limited access is another means of conserving EFH. Under the 1999 FMP, a limited access permitting program was implemented which helped to reduce overall impacts on EFH by reducing fishing effort. Limited access may prevent fishing by individuals unfamiliar with the gear and bottom habitat and who may be more likely to damage EFH through improper setting of gear.

10.4.2 Non-fishing Threats to EFH

Section 600.815 (a)(4) of the EFH regulations requires that FMPs identify non-fishing related activities that may adversely affect EFH of managed species, either quantitatively or qualitatively, or both. In addition, Section 600.815 (a)(6) of the regulations requires that FMPs recommend conservation measures describing options to avoid, minimize, or compensate for the adverse effects identified. As the jurisdiction and the EFH of this FMP Amendment overlaps with the EFH identified by the respective Councils of the eastern United States, the threats to EFH and conservation measures compiled for this document are a synthesis of those listed in the Councils' EFH amendments. The information in this section has been adapted, with permission, from EFH amendments prepared by the Mid-Atlantic Fishery Management Council, the South Atlantic Fishery Management Council (1998), and the Gulf of Mexico Fishery Management Council. Original sources of information are cited in those documents.

Broad categories of activities that may adversely affect HMS EFH include, but are not limited to: (1) actions that physically alter structural components or substrate, e.g., dredging, filling, excavations, water diversions, impoundments and other hydrologic modifications; (2) actions that result in changes in habitat quality, e.g., point source discharges, activities that contribute to non-point source pollution and increased sedimentation, introduction of potentially hazardous materials, or activities that diminish or disrupt the functions of EFH. If these actions are persistent or intense enough, they can result in major changes in habitat quantity as well as quality, conversion of habitats, or in complete abandonment of habitats by some species.

In addition to identifying activities with the potential to adversely affect EFH, the Magnuson-Stevens Act and the EFH regulations require the inclusion of actions to encourage the conservation and enhancement of EFH. Each activity discussed below is followed by actions to encourage the conservation and enhancement of EFH to avoid, minimize or mitigate adverse effects on EFH.

10.4.2.1 Marine Sand and Minerals Mining

Mining for sand (e.g., for beach nourishment projects), gravel, and shell stock in estuarine and coastal waters can result in water column effects by changing circulation patterns, increasing turbidity, and decreasing oxygen concentrations at deeply excavated sites where flushing is minimal. Ocean extraction of mineral nodules is a possibility for some non-renewable minerals now facing depletion on land. Such operations are proposed for the continental shelf and the deep ocean proper. Deep borrow pits created by mining may become seasonally or permanently anaerobic. Marine mining also elevates suspended materials at mining sites, creating turbidity plumes that may move several kilometers from these sites. Resuspension of sediments can affect water clarity over wide areas, and could also potentially affect pelagic eggs and larvae. In addition, resuspended sediments may contain contaminants such as heavy metals, pesticides, herbicides, and other toxins.

Actions to Encourage Conservation and Enhancement of EFH:

- Sand mining and beach nourishment should not be allowed in HMS EFH during seasons when HMS are utilizing the area, particularly during spawning seasons.
- Gravel extraction operations should be managed to avoid or minimize impacts to the bathymetric structure in estuarine and nearshore areas.
- An integrated environmental assessment, management, and monitoring program should be a part of any gravel or sand extraction operation, and encouraged at Federal and state levels.
- Planning and design of mining activities should avoid significant resource areas important as HMS EFH.
- Mitigation and restoration should be an integral part of the management of gravel and sand extraction policies.

10.4.2.2 Offshore Oil and Gas Operations

Offshore oil and gas operations (exploration, development, production, transportation and decommissioning) pose a significant level of potential threat to marine, coastal and estuarine ecosystems. Exploration and recovery operations may cause substantial localized bottom disturbance. However, more pertinent to HMS is the threat of contaminating operational wastes associated with offshore exploration and development, the major operational wastes being drilling muds and cuttings and formation waters.

Actions to Encourage Conservation and Enhancement of EFH:

- A plan should be in place to avoid the release of hydrocarbons, hydrocarbon-containing substances, drilling muds, or any other potentially toxic substance into the aquatic environment. Storage of these materials should be in enclosed tanks whenever feasible or, if not, in lined mud pits or other approved sites. Equipment should be maintained to prevent leakage. Catchment basins for collecting and storing surface runoff should be included in the project design.

- Exploration/production activities and facilities should be designed and maintained in a manner that will maintain natural water flow regimes, avoid blocking surface drainage, and avoid erosion in adjacent coastal areas.

- Activities should avoid wetlands. Drilling should be conducted from uplands, existing drill sites, canals, bayous or deep bay waters (greater than six feet), wherever possible, rather than dredging canals or constructing board roads. When wetland use is unavoidable, work in previously disturbed wetlands is preferable to work in high quality or undisturbed wetlands. If this is not possible, temporary roads (preferably board roads) to provide access are more desirable than dredging canals because roads generally impact less acreage and are easier to restore than canals. If the well is a producer, the drill pad should be reduced to the minimum size necessary to conduct production activities and the disturbed area should be restored to pre-project conditions.

- Upon completion or abandonment of wells in wetlands, all unnecessary equipment should be removed and the area restored to pre-project elevations. The well site, various pits, levees, roads and other work areas should be graded to pre-project marsh elevations and then restored with indigenous wetland vegetation. Abandoned canals frequently need plugging and capping with erosion-resistant material at their origin to minimize bank erosion and to prevent saltwater intrusion. In addition, abandoned canals will frequently need to be backfilled to maximize fish and wildlife production in the area and to restore natural sheet flows. Spoil banks containing uncontaminated materials should be backfilled into borrow areas or breached at regular intervals to re-establish hydrological connections.

- In open bays maximum use should be made of existing navigable waters already having sufficient width and depth for access to the drill sites.

- An oil spill response plan should be developed and coordinated with Federal and state resource agencies.

- Activities on the OCS should be conducted so that petroleum-based substances such as drilling muds, oil residues, produced waters, or other toxic substances are not released into the water or onto the sea floor: drill cuttings should be shunted through a conduit and discharged near the sea floor, or transported ashore or to less sensitive, NMFS-approved offshore locations; drilling and production structures, including pipelines, generally should not be located within one mile of the base of a live reef.

- Prior to pipeline construction, less damaging, alternative modes of oil and gas transportation should be explored.

- State natural resource agencies should be involved in the preliminary pipeline planning process to prevent violations of water quality and habitat protection laws and to minimize impact of pipeline construction and operation on aquatic resources.

- Pipeline alignments should be located along routes that minimize damage to marine and estuarine habitats. Buried pipelines should be examined periodically for maintenance of adequate earthen cover.

- All vessels transporting fuels and other hazardous materials should be required to carry equipment to contain and retrieve the spill. Dispersants shall not be used to clean up fuels and hazardous materials unless approved by the EPA/Coast Guard and fishery agencies.

- NPDES permit conditions such as those relating to dissolved oxygen, temperature, impingement and entrainment, under the Clean Water Act should be monitored and strictly enforced in areas that could affect HMS EFH.

- NPDES permits should be reviewed every five years for all energy production facilities.

10.4.2.3 Coastal Development

Coastal development activities include urban, suburban, commercial, and industrial construction, along with development of corresponding infrastructure. These activities may result in erosion and sedimentation, dredging and filling (see following sub-section), point and non-point source discharges of nutrients, chemicals, and cooling water into streams, rivers, estuaries and ocean waters. Coastal development can also lead to the destruction of coastal wetlands, resulting in the elimination of protective buffer zones that serve to filter sediments, nutrients, and contaminants.

Actions to Encourage Conservation and Enhancement of EFH:

- Adverse impacts resulting from construction should be avoided whenever practicable alternatives are identified. For those impacts that cannot be avoided, minimization through implementation of Best Management Practices (BMPs) should be employed. For those impacts that can neither be avoided nor minimized, compensation through replacement of equivalent functions and values should be required.

- Coastal development traditionally has involved dredging and filling of shallows and wetlands, hardening of shorelines, clearing of riparian vegetation, and other activities that adversely affect the habitats of living marine resources. Mitigative measures should be required for all development activities with the potential to degrade HMS EFH, whether conducted within the EFH or in adjacent areas that influence HMS EFH.

- Destruction of wetlands and shallow coastal water habitats should not be permitted in areas adjacent to HMS EFH. Mitigating or compensating measures should be employed where destruction is unavoidable. Project proponents should demonstrate that project implementation will not negatively affect HMS, their habitat, or their food sources.

- Flood control projects in waterways draining into EFH should be designed to include mitigative measures and constructed using BMPs. For example, stream relocation and channelization should be avoided whenever practicable. However, should no practicable alternatives exist, relocated channels should be of comparable length and sinuosity as the natural channels they replace to maintain the quality of water entering receiving waters (i.e., HMS EFH).

- Watershed protection/site development should be encouraged. Comprehensive planning for development on a watershed scale (and for small-scale site development as well) should be undertaken, including planning and designing to protect sensitive ecological areas, minimizing land disturbances and retaining natural drainage and vegetation whenever possible. To be truly effective, watershed planning efforts should include existing facilities even though they are not subject to EFH consultation.

- Pollution prevention activities, including techniques and activities to prevent non-point source pollutants from entering surface waters, should be implemented. Primary emphasis should be placed on public education to promote methods for proper disposal and/or recycling of hazardous chemicals, management practices for lawns and gardens, onsite disposal systems (OSDSs), and commercial enterprises such as service stations and parking lots.

- Construction erosion/sediment control measures should be used to reduce erosion and transport of sediment from construction sites to surface waters. A sediment and erosion control plan should be developed and approved prior to land disturbance.

- Runoff from new development should be managed so as to meet two conditions: 1) the average annual total suspended solids loadings after construction is completed are no greater than pre-development loadings; and 2) to the extent practicable, post-development peak runoff rate and average volume are maintained at levels that are similar to pre-development levels.

- Construction site chemical control measures should address the transport of toxic chemicals to surface water by limiting the application, generation, and migration of chemical contaminants (i.e., petrochemicals, pesticides) and providing proper storage and disposal.

- New OSDSs should be built to reduce nutrient/pathogen loadings to surface waters. OSDSs should be designed, installed and operated properly and to be situated away from open waterbodies and sensitive resources such as wetlands, and floodplains. Protective separation between the OSDS and the groundwater table should be established. The OSDS unit should be designed to reduce nitrogen loadings in areas where surface waters may be adversely affected. Operating OSDSs should prevent surface water discharges and reduce pollutant loadings to ground water. Inspection at regular intervals and repair or replacement of faulty systems should occur.

- Roads, highways, bridges and airports should be situated away from areas that are sensitive ecosystems and susceptible to erosion and sediment loss. The siting of such structures should not adversely impact water quality, should minimize land disturbances, and should retain natural vegetation and drainage features.

- Construction projects of roads, highways, bridges and airports should implement approved erosion and sediment control plans prior to construction to reduce erosion and improve retention of sediments onsite during and after construction.

- Construction site chemical control measures for roads, highways, and bridges should limit toxic and nutrient loadings at construction sites by ensuring the proper use, storage, and disposal of toxic materials to prevent significant chemical and nutrient runoff to surface waters.

- Operation and maintenance activities for roads, highways, bridges, and airports should be developed so as to reduce pollutant loadings to receiving waters during operation and maintenance.

- Runoff systems should be developed for roads, highways, bridges, and airports to reduce pollutant concentrations in runoff from existing roads, highways, and bridges. Runoff management systems should identify priority pollutant reduction opportunities and schedule implementation of retrofit projects to protect impacted areas and threatened surface waters.

- The planning process for new and maintenance channel dredging projects should include an evaluation of the potential effects on the physical and chemical characteristics of surface waters that may occur as a result of the proposed work, and should reduce undesirable impacts. When the operation and maintenance programs for existing modified channels are reviewed, they should identify and implement any available opportunities to improve the physical and chemical characteristics of surface waters in those channels.

- Bridges should be designed to include collection systems which convey surface water runoff to land-based sedimentation basins.

- Sewage treatment discharges should be treated to meet state water quality standards. Implementation of up-to-date methodologies for reducing discharges of biocides (e.g., chlorine) and other toxic substances is encouraged.

- Use of land treatment and upland disposal/storage techniques of solid waste from sewage treatment should be implemented where possible. Use of vegetated wetlands as natural filters and pollutant assimilators for large scale wastewater discharges should be limited to those instances where wetlands have been specifically created for this purpose. The use of such constructed wetlands for water treatment should be encouraged wherever the overall environmental and ecological suitability of such an action can been demonstrated.

- Sewage discharge points in coastal waters should be located well away from critical habitats. Proposals to locate outfalls in coastal waters must be accompanied by hydrographic studies that demonstrate year round dispersal characteristics and provide proof that effluents will not reach or affect fragile and productive habitats.

- Dechlorination facilities or lagoon effluent holding facilities should be used to destroy chlorine at sewage treatment plants.

- No toxic substances in concentrations harmful (synergistically or otherwise) to humans, fish, wildlife, and aquatic life should be discharged. The EPA's Water Quality Criteria Series should be used as a guideline for determining harmful concentration levels. Use of the best available technology to control industrial waste water discharges should be required in areas adjacent to habitats essential to HMS. Any new potential discharge that will influence HMS EFH must be shown not to have a harmful effect on HMS or their habitat.

- The siting of industries requiring water diversions and large-volume water withdrawals should be avoided in areas influencing HMS EFH. Project proponents should demonstrate that project implementation will not negatively affect HMS, their EFH, or their food supply. Where such facilities currently exist, best management practices should be employed to minimize adverse effects on the aquatic environment.

- All NPDES permits should be reviewed and strictly enforced in areas affecting HMS EFH.

- Hazardous waste sites should be cleaned up (i.e., remediated) to prevent contaminants from entering aquatic food chains. Remedial actions affecting aquatic and wetland habitats should be designed to facilitate restoration of ecological functions and values.

10.4.2.4 Dredging and Disposal of Dredge Material

Dredging operations occur in estuaries, nearshore areas, and offshore in order to maintain certain areas for activities such as shipping, boating, construction of infrastructure (e.g., offshore oil and gas pipelines), and marine mining. Disposal of the dredged material takes place in designated open water disposal areas, often near the dredge site. These operations result in negative impacts on the marine environment. Of particular concern regarding HMS EFH is the temporary degradation of water quality due to the resuspension of bottom materials, resulting in water column turbidity, potential contamination due to the release of toxic substances (metals and organics), and reduced oxygen levels due to the release of oxygen-consuming substances (e.g., nutrients, sulfides). Even with the use of approved practices and disposal sites, ocean disposal of dredged materials is expected to cause environmental harm since contaminants will continue to be released, and localized turbidity plumes and reduced oxygen zones may persist.

Actions to Encourage Conservation and Enhancement of EFH:

- Best engineering and management practices (e.g., seasonal restrictions, modified dredging methods, and/or disposal options) should be employed for all dredging and in-water construction projects. Such projects should be permitted only for water dependent purposes when no feasible alternatives are available. Mitigating or compensating measures should be employed where significant adverse impacts are unavoidable. Project proponents should demonstrate that project implementation will not negatively affect HMS, their EFH, or their food sources.

- Project guidelines should make allowances to cease operations or take additional precautions to avoid adversely affecting HMS EFH during seasons when sensitive HMS life stages might be most susceptible to disruption (e.g., seasons when spawning is occurring).

- When projects are considered and in review for open water disposal permits for dredged material, Federal permitting agencies should identify the direct and indirect impacts such projects may have on HMS EFH.

- Uncontaminated dredged material may be viewed as a potentially reusable resource if properly placed and beneficial uses of these materials should be investigated. Materials that are suitable for beach nourishment, marsh construction or other beneficial purposes should be utilized for these purposes as long as the design of the project minimizes impacts on HMS EFH.

- “Beneficial Use” proposals in areas of HMS EFH should be compatible with existing uses by HMS. If no beneficial uses are identified, dredged material should be placed in contained upland sites. The capacity of these disposal areas should be used to the fullest extent possible. This may necessitate dewatering of the material or increasing the elevation of embankments to augment the holding capacity of the site. Techniques could be applied that render dredged material suitable for export or for use in re-establishing wetland vegetation.

- No unconfined disposal of contaminated dredge material should be allowed in HMS EFH.

- Disposal sites should be located in uplands when possible.

10.4.2.5 Agriculture (and Silviculture)

Agricultural and silvicultural practices can affect estuarine, coastal and marine water quality through nutrient enrichment and chemical contamination from animal wastes, fertilizers, pesticides and other chemicals via non-point source runoff or via drainage systems that serve as conduits for contaminant discharge into natural waterways. In addition, uncontrolled or improper irrigation practices can contribute to non-point source pollution, and may exacerbate contaminant flushing into coastal waters. Major impacts also include nutrient over-enrichment with subsequent deoxygenation of surface waters, algal blooms - which can also produce hypoxic or anoxic conditions - and stimulation of toxic dinoflagellate growth. Excessively enriched waters often will not support fish, and also may not support food web assemblages and other ecological assemblages needed to sustain desirable species and populations. Agricultural activities also increase sediment transport in adjacent water bodies, resulting in high turbidity. Many of these same concerns may apply to silviculture, as well.

Actions to Encourage Conservation and Enhancement of EFH:

- Federal agencies, in conjunction with state agencies, should establish and approve criteria for vegetated buffer strips in agricultural areas adjacent to estuarine and coastal HMS EFH in order to minimize pesticide, fertilizer, and sediment loads to these areas critical for HMS survival. The effective width of these vegetated buffer strips should vary with the slope of the terrain and soil permeability.

- Concerned Federal agencies (e.g., Natural Resources Conservation Service) should conduct or contribute to programs and demonstration projects to educate farmers on improved agricultural practices that would minimize the use and wastage of pesticides, fertilizers, and top soil, and reduce the adverse effects of these materials on HMS EFH.

- Delivery of sediment from agricultural lands to receiving waters should be minimized. Land owners have a choice of one of two approaches: 1) apply the erosion component of the U.S. Department of Agriculture's Conservation Management System through such practices as conservation tillage, strip cropping, contour farming, and terracing; or 2) design and install a combination of practices to remove settleable solids and associated pollutants in runoff for all but the largest storms.

- New and existing confined animal facilities should be designed to limit discharges to waters of the United States by storing wastewater and runoff caused by all storms up to and including the 25-year frequency storms. For smaller existing facilities, the management systems that collect solids, reduce contaminant concentrations, and reduce runoff should be designed and implemented to minimize the discharge of contaminants in both facility wastewater and runoff caused by all storms up to and including 25-year frequency storms.

- Stored runoff and solids should be managed through proper waste utilization and the use of disposal methods which minimize impacts to surface and ground water.

- Development and implementation of comprehensive nutrient management plans should be undertaken, including development of a nutrient budget for the crop, identification of the types and amounts of nutrients necessary to produce a crop based on realistic crop yield expectations, and an identification of the environmental hazards of the site.

- Pesticide and herbicide management should minimize water quality problems by reducing pesticide use, improving the timing and efficiency of application (not within 24 hours of expected rain or irrigation), preventing backflow of pesticides into water supplies, and improving calibration of pesticide spray equipment. Improved methods should be used such as integrated pest management (IPM) strategies. IPM strategies include evaluating current pest problems in relation to the cropping history, previous pest control measures, and applying pesticides only when an economic benefit to the producer will be achieved (i.e., application based on economic thresholds). If pesticide applications are necessary, pesticides should be selected to minimize environmental impacts such as persistence, toxicity, and leaching potential.

- Livestock grazing should protect sensitive areas, including streambanks, wetlands, estuaries, ponds, lake shores, and riparian zones. Protection is to be achieved with improved grazing management that reduces the physical damage and direct loading of animal waste and sediment to sensitive areas, i.e., by restricting livestock access or providing stream crossings.

- Upland erosion should be reduced by either applying the range and pasture components of a Conservation Management System, or maintaining the land in accordance with the activity plans established by either the Bureau of Land Management or the Forest Service. Such techniques include the restriction of livestock from sensitive areas through locating salt, shade, and alternative drinking sources away from sensitive areas, and providing livestock stream crossings.

- Irrigation systems that deliver necessary quantities of water yet reduce non-point pollution to surface waters and groundwater should be developed and implemented.

- BMPs should be implemented to minimize habitat impacts when agricultural ditches are excavated through wetlands that drain to HMS EFH.

- NPDES/SPDES permits, in consultation with state fishery agencies, should be required for agricultural ditch systems that discharge into areas adjacent to HMS EFH.

10.4.2.6 Aquaculture and Mariculture

Aquaculture is an expanding industry in the United States, with most facilities located in farmland, tidal, intertidal and coastal areas. Aquaculture related impacts that adversely affect the chemical and biological nature of coastal ecosystems include the discharge of excessive waste products and the release of exotic organisms and toxic substances. Problems resulting from the introduction of food and fecal wastes may be similar to those resulting from certain agricultural activities.

Actions to Encourage Conservation and Enhancement of EFH:

- Mariculture operations should be located, designed and operated to avoid or minimize adverse impacts on estuarine and marine habitats and native fishery stocks. Those impacts that cannot be eliminated should be fully mitigated.

- Mariculture facilities should be operated in a manner that minimizes impacts on the local environment by utilizing water conservation practices and effluent discharge standards that protect existing designated uses of receiving waters.

- Federal and state agencies should cooperatively promulgate and enforce measures to ensure that diseases from culture operations do not adversely affect wild stocks. Animals that are to be moved from one biogeographic area to another or to natural waters should be quarantined to prevent disease transmission.

- To prevent disruption of natural aquatic communities, cultured organisms should not be allowed to escape; the use of organisms native to each facility's region is strongly encouraged.

- Commercial aquaculture facilities and enhancement programs should consider the genetic make-up of the cultured organisms in order to protect the genetic integrity of native fishes.

- Aquaculture facilities should meet prevailing environmental standards for wastewater treatment and sludge control.

10.4.2.7 Navigation

Navigation-related threats to estuarine, coastal, and offshore environments that have the potential to affect HMS EFH include navigation support activities such as excavation and maintenance of channels (including disposal of excavated sediments) which result in the elevation of turbidity and resuspension of contaminants; construction and operation of ports, mooring and cargo facilities; construction of ship repair facilities; and construction of channel stabilization structures such as jetties and revetments. In offshore locations the disposal of dredged material is the most significant navigation related threat, resulting in localized burial of benthic communities and degradation of water quality. In addition, threats to both nearshore and offshore waters are posed by vessel operation activities such as the discharge and spillage of oil, other hazardous materials, trash and cargo, all of which may result in localized water quality degradation and direct effects on HMS, especially eggs, larvae and neonates that may be present. Wakes from vessel operation may also exacerbate shoreline erosion, effecting habitat modification and potential degradation.

Actions to Encourage Conservation and Enhancement of EFH:

- Permanent dredged material disposal sites should be located in upland areas. Where long-term maintenance is anticipated, upland disposal sites should be acquired and maintained for the entire project life.

- Construction techniques (e.g., silt curtains) should minimize turbidity and dispersal of dredged materials into HMS EFH.

- Propwashing should not be used as a dredging method.

- Channels and access canals should not be constructed in areas known to have high sediment contamination levels. If construction must occur in these areas, specific techniques, including the use of silt curtains, are needed to contain suspended contaminants.

- Alignments of channels and access canals should utilize existing channels, canals and other deep water areas to minimize initial and maintenance dredging requirements. All canals and channels should be clearly marked to avoid damage to adjacent bottoms from propwashing.

- Access channels and canals should be designed to ensure adequate flushing to avoid creating low dissolved oxygen conditions or sumps for heavy metals and other contaminants. Widths of access channels in open water should be minimized to avoid impacts to aquatic substrates. In canal subdivisions channels and canals within the development should be no deeper than the parent body of water and should be a uniform depth or become gradually shallower inland.

- To ensure adequate circulation confined and dead-end canals should be avoided by utilizing bridges or culverts that ensure exchange of the entire water column. In general, depths of canals should be minimized, widths maximized, and canals oriented towards the prevailing summer winds in order to enhance water exchange.

- Consideration should be given to the use of locks in navigation channels and access canals which connect more saline areas to fresher areas.

- To the maximum extent practicable, all navigation channels and access canals should be backfilled upon abandonment and restored to as near pre-project condition as possible. Plugs, weirs or other water control structures may also be necessary as determined on a case-by-case basis.

- All vessels transporting fuels and other hazardous materials should be required to carry equipment to contain and retrieve the spill.

- Dispersants should not be used to clean up fuels and hazardous materials unless approved by the EPA/Coast Guard after consultation with fisheries agencies.

10.4.2.8 Marinas and Recreational Boating

Marinas and recreational boating are increasingly popular uses of coastal areas. As marinas are located at the water's edge, there is often no buffering of associated pollutants released into the water column. Impacts caused by marinas include lowered dissolved oxygen, increased temperatures, bioaccumulation of pollutants by organisms, toxic contamination of water and sediments, resuspension of sediments and toxics during construction, eutrophication, change in circulation patterns, shoaling, and shoreline erosion. Pollutants that result from marina activities include nutrients, metals including copper released from antifouling paints, petroleum hydrocarbons, pathogens, and polychlorinated biphenyls. Also, chemicals commonly used to treat timber used for piers and bulkheads - creosote, copper, chromium, and arsenic salts - are introduced into the water. Other potential impacts associated with recreational boating are the result of improper sewage disposal, fuel and oil spillage, cleaning operations, and disposal of fish waste. Propellers from boats can also cause direct damage to multiple life stages of organisms, including eggs, larvae/neonates, juveniles and adults; destratification; elevated temperatures, and increased turbidity and contaminants by resuspending bottom materials.

Actions to Encourage Conservation and Enhancement of EFH:

- Water quality must be considered in the siting and design of both new and expanding marinas.

- Marinas are best created from excavated uplands that are designed so that water quality degradation does not occur. Applicants should consider basin flushing characteristics and other design features such as surface and waste water collection and treatment facilities. Marina siting and design should allow for maximum flushing of the site. Adequate flushing reduces the potential for the stagnation of water in a marina and helps to maintain the biological productivity as well as reduce the potential for toxic accumulation in bottom sediments. Catchment basins for collecting and storing runoff should be included as components of the site development plan.

- Marinas should be designed and located so as to protect against adverse impacts on important habitat areas as designated by local, state, or federal governments.

- Where shoreline erosion is a non-point source pollution problem, shorelines should be stabilized. Vegetative methods are strongly preferred.

- Runoff control strategies, which include the use of pollution prevention activities and the proper design of hull maintenance areas, should be implemented at marina sites.

- Marinas with fueling facilities should be designed to include measures for reducing oil and gas spillage into the aquatic environment. Fueling stations should be located and designed so that in the case of an accident spill contaminants can be contained in a limited area. Fueling stations should have fuel containment equipment as well as a spill contingency plan.

- To prevent the discharge of sewage directly to coastal waters new and expanding marinas should install pumpout, pump station, and restroom facilities where needed. Pumpout facilities should be maintained in operational condition and their use should be encouraged to reduce untreated sewage discharges to surface waters.

- Solid wastes produced by the operation, cleaning, maintenance, and repair of boats should be properly disposed of in order to limit their entry to surface waters.

- Sound fish waste management should be part of the project design, including a combination of fish cleaning restrictions, public education, and proper disposal facilities.

- Appropriate storage, transfer, containment, and disposal facilities for liquid materials commonly used in boat maintenance, along with the encouragement of recycling of these materials, should be required.

- The amount of fuel and oil leakage from fuel tank air vents should be reduced.
- Potentially harmful hull cleaners and bottom paints (and their release into marinas and coastal waters) should be minimized.
- Public education/outreach/training programs should be instituted for boaters, as well as marina operators, to prevent improper disposal of polluting materials.

10.4.2.9 Ocean Dumping

The disposal of dredged sediments and hazardous and/or toxic materials (e.g., industrial wastes) containing concentrations of heavy metals, pesticides, petroleum products, radioactive wastes, pathogens, etc., in the ocean degrades water quality and benthic habitats. These effects may be evident not only within the immediate vicinity of the dumping activity, but also at farther locations, as well, due to current transport and the potential influence of other hydrographic features. The disposal of uncontaminated dredged material, including adverse effects on EFH and appropriate conservation measures are addressed in Section 10.4.2.4 of this chapter. Disposal of hazardous and toxic materials by U.S. flag vessels and vessels operating in the U.S. territorial sea and contiguous zone is currently prohibited under the Marine Protection Research and Sanctuaries Act (MPRSA), although under certain circumstances the Environmental Protection Agency may issue emergency permits for dumping industrial wastes into the ocean. Major dumping threats to the marine environment are therefore limited mostly to illegal dumping and accidental disposal of material in unauthorized locations. However, given the amount of debris that is deposited along the Nation's beaches every year, including hazardous materials such as medical wastes, it is evident that effects from such dumping may be substantial.

Actions to Encourage Conservation and Enhancement of EFH:

- Federal and state agencies mandated with ocean dumping enforcement responsibilities should continue to implement and enforce all legislation, rules and regulations, and consider increasing monitoring efforts where warranted.
- Disposal of hazardous materials within areas designated as EFH for HMS should not be allowed under any circumstances, including emergency permit situations.

10.4.3 Cumulative Impacts

The EFH regulations suggest that cumulative impacts should be analyzed for adverse effects on EFH. Cumulative impact analysis is a locale-specific activity that will be undertaken as additional information on specific habitat locations and threats to that habitat can be accessed, and as additional spatial techniques are developed to properly analyze that information. For this FMP cumulative impacts will be addressed by describing the types of threats and effects that have been documented to have adverse effects on fish habitat, cumulatively.

Cumulative impacts on the environment are those that result from the incremental impact of actions added to other past, present and reasonably foreseeable future actions. Such cumulative impacts generally occur in inshore and estuarine areas, and can result from individually minor, but collectively significant, actions taking place over a period of time. These impacts include water quality degradation due to nutrient enrichment, other organic and inorganic contaminants associated with coastal development, activities related to marine transportation, and loss of coastal habitats, including wetlands and sea grasses. The rate and magnitude of these human-induced changes on EFH, whether cumulative, synergistic, or individually large, is influenced by natural parameters such as temperature, wind, currents, rainfall, salinity, etc. Consequently, the level of threat posed by a particular activity or group of activities may vary considerably from location to location. These multiple effects can, however, result in adverse impacts on HMS EFH.

Wetland loss is a cumulative impact that results from activities related to coastal development: residential and industrial construction, dredging and dredge spoil placement, port development, marinas and recreational boating, sewage treatment and disposal, industrial wastewater and solid waste disposal, ocean disposal, marine mining, and aquaculture. In the late 1970s and early 1980s the country was losing wetlands at an estimated rate of 300,000 acres per year. The Clean Water Act and state wetland protection programs have helped to decrease wetland losses to 117,000 acres per year, between 1985 and 1995. Estimates of wetlands loss differ according to agency. The USDA estimates attributes 57 percent wetland loss to development, 20 percent to agriculture, 13 percent to deepwater habitat, and 10 percent to forest land, rangeland, and other uses. Of the wetlands lost to uplands between 1985 and 1995, the U.S. Fish and Wildlife Service estimates that 79 percent of wetlands were lost to upland agriculture. Urban development, and "other" types of land use activities were responsible for six percent and 15 percent, respectively.

Nutrient enrichment has become a major cumulative problem for many coastal waters. Nutrient loading results from the individual activities of coastal development, non-point source pollution, marinas and recreational boating, sewage treatment and disposal, industrial wastewater and solid waste disposal, ocean disposal, agriculture, and aquaculture. Excess nutrients from land based activities accumulate in the soil, pollute the atmosphere, pollute ground water, or move into streams and coastal waters. Nutrient inputs are known to have a direct effect on water quality. For example, in extreme conditions excess nutrients can stimulate excessive algal blooms or dinoflagellate growth that can lead to increased turbidity, decreased dissolved oxygen, and changes in community structure, a condition known as eutrophication. Examples of such dinoflagellates or algae include *Gymnodinium breve* the dinoflagellate that causes neurotoxic shellfish poisoning, dinoflagellates of the genus *Alexandrium* which causes paralytic shellfish poisoning, *Aureococcus anophagefferens* the algae which causes "brown tides", and diatoms of the genus *Pseudo-nitzschia* which cause amnesic shellfish poisoning. *Pfiesteria piscicida* is a recently-described toxic dinoflagellate that has been documented in the water column in coastal areas of Delaware, Maryland, and North Carolina. Another *Pfiesteria*-like organism has been documented in St. John's River, FL. This organism has been associated with fish kills in some areas.

In addition to the direct cumulative effects incurred by development activities, inshore and coastal habitats are also jeopardized by persistent increases in certain chemical discharges. The combination of incremental losses of wetland habitat, changes in hydrology, and nutrient and chemical inputs produced over time, can be extremely harmful to marine and estuarine biota, resulting in diseases and declines in the abundance and quality of the affected resources.

Future investigations will seek to analyze cumulative impacts within specific geographic locations (certain estuarine, coastal and offshore habitats) in order to evaluate the cumulative impacts on HMS EFH. Information and techniques that are developed for this process will be used to supplement future revisions of these EFH provisions as the information becomes available.

Actions to Encourage Conservation and Enhancement of EFH:

- Conservation measures for individual activities that contribute to cumulative impacts are covered in the previous sections. Participation in watershed scale planning efforts should be encouraged.

10.5 RESEARCH AND INFORMATION NEEDS

Based on the present state of information concerning the habitat associations of HMS, the following research and information needs have been identified:

Ecosystem Structure and Function

- Continue the delineation of shark nurseries; establish the geographic boundaries of the summer nurseries of commercially important species.
- Continue to study and refine locations of the winter nurseries of commercially important species.
- Expand the use of archival tagging and satellite telemetry in shark species, particularly of juvenile sharks in seasonal migrations, to better define locations, distributions, and environmental tolerances.
- Determine if sharks return to their natal nurseries; determine if females return to the same nursery each time they give birth.
- Determine growth and survival rates of each life stage; develop age determination validations.
- Determine habitat relationships such as temperature (e.g., the relation to thermal fronts) and salinity, spatially as well as seasonally; determine the significance of

areas of aggregation; determine the role of coastal/inshore habitats in supporting neonates and juveniles.

Effects of Habitat Alteration

- Document the effects of habitat alteration, including the inflow of organic and inorganic pollutants, increased turbidity, loss of coastal marshes and sea grasses, and changes in freshwater inflow, on the survival of neonate and juvenile sharks in inshore and estuarine areas.
- Identify fisheries that operate in shark EFH and characterize threats from fishery practices to shark EFH, particularly nursery areas.
- Determine impacts from fishing activities on shark EFH; document the degree of overlap between fishing effort in HMS and non-HMS fisheries and shark EFH.

Impact and Recovery Indicators

- Analyze historical changes that have occurred in locations such as Tampa Bay, FL where trends in environmental degradation appear to have been reversed in recent years, resulting in rebounds of depressed shark (blacktip) populations.

Synthesis and Information Transfer

- Incorporate/develop spatially consistent databases of environmental conditions throughout the sharks' ranges (e.g., temperature, salinity, currents).
- Further analyze fishery dependent data to construct a clearer view of relative abundances.
- Contour abundance information to better visualize areas where sharks are most commonly encountered.
- Construct spatial databases for early life history stages (neonates and early juveniles), incorporating seasonal changes.
- Derive objective criteria to model areas of likelihood for relative abundances of sharks based on environmental parameters.
- Define and model habitat suitability based on seasonal analyses of species tolerances of environmental conditions.

Table 10.1 Percentage of observed distribution points included in EFH identified areas under alternative L4 by species and life stage.

Species	Life Stage	Number of Observations per 100 Square Miles Used as a Guide	Number of Observations in EFH Identified Area	Total Number of Observations	Percent of Observations in EFH Area
Blacktip	Neonate	>10	3,550	3,666	97%
	Juvenile	>10	7,375	10,085	73%
	Adult	>10	1,340	2,195	61%
Dusky	Neonate	>6	2,072	2,636	79%
	Juvenile	>6	5,016	6,331	79%
	Adult	>6	150	244	61%
Sandbar	Neonate	>10	5,492	5,804	95%
	Juvenile	>10	13,921	18,186	77%
	Adult	>10	13,126	18,442	71%
Nurse	Neonate	>10	No Data	No Data	-
	Juvenile	>10	1,331	1,795	74%
	Adult	>10	215	457	47%
Finetooth	Neonate	>1	592	612	97%
	Juvenile	>1	1,895	2,142	88%
	Adult	>1	64	87	74%
			Total: 56,139	Total: 72,682	Average: 77%

Table 10.2 Size ranges for different shark life stages from the 1999 HMS FMP and current Amendment.

1999 HMS FMP Large Coastal Sharks	Map Neonates/ early juveniles TL (cm) ≤ or range	Text Pup size TL (cm)	Map Late Juveniles/ subadults TL (cm)	Text: M maturity TL (cm) ≥ or range	Text: F maturity TL (cm) ≥ or range	Map Adults TL (cm) ≥ or range
Ginglymostomatidae Ginglymostoma cirratum	13-60	30	61-225	225		226
Carcharhinidae Carcharhinus limbatus	99	55-60	100-155	142-145 139-145	156 153	156
C. obscurus	115	85-100	116-300	290	300	301
C. plumbeus	90	60	90-179	180		180
Small Coastal Sharks **Carcharhinidae** C. isodon	90	48-58	91-135	130	135	136

HMS FMP Amendment 1 Large Coastal Sharks	Neonates TL (cm) <	Literature embryo size range in term females TL (cm)	Juveniles TL (cm)	Literature M maturity TL (cm) ≥ or range	Literature F maturity TL (cm) ≥ or range	Adults TL (cm) >
Ginglymostomatidae Ginglymostoma cirratum	N/A*	28-30.5 Castro 00	37-221	214-214.6 Castro 00	222-232 Castro 00	221
Carcharhinidae Carcharhinus limbatus	69	58-62.5 Castro 93b & 96	69-155	142.5-145 Castro 96	156 Castro 96	155
C. obscurus	110	85-100 Castro 83	111-299	290 Castro 83	300 Castro 83	299
C. plumbeus	71	44.2-64 Castro 93b	71-147	139-153 Merson 98	148-175 Merson 98	147
Small Coastal Sharks **Carcharhinidae** C. isodon	65	43.7-58 Castro 93a & 93b	65-135	133 Castro 93	136 Castro 93	135

Table 10.3 Blacktip shark (*Carcharinus limbatus*) Life History and Habitat Characteristics

Life Stage	Species Distributions		Habitat Characteristics				Source*
	Location	Season	Temp (˚C)	DO (mg/l)	Sal (ppt)	Depth (m)	
			B = bottom and S = surface				
Neonate and young of the year (YOY)	Off Yaupon and Holden Beaches, NC	summer primary nursery	no data	no data	no data	no data	Jensen et al (2002)
	SC estuarine and nearshore waters	summer primary nursery, pupping late May/early June to early July	no data	no data	no data	no data	Ulrich and Riley, SEAMAP (2002)
	GA estuarine waters	summer primary nursery (June-Sept)	21-30.4	4.35-6.08	22-36.1	0.5-11.6	Belcher and Shierling Gurshin
	Yankeetown to 10,000 Islands on the west coast of Florida, Cape Canaveral on the east coast of FL and the Florida Keys. Also found in the Marquesas Islands west of the Florida Keys	summer primary nursery (June-Oct); FL Keys – found year round; Marquesas Islands – overwintering grounds	19.1-33.6	3.28-9.26	15.8-41.1	0.9-12.5	Hueter and Tyminski, Michel and Steiner
	Northeast Gulf of Mexico (Apalachee Bay, Apalachicola Bay, St. Joseph Bay, Crooked Island Sound and St Andrew Bay)	summer primary nursery	22.5-31.4	3.6-7	19-38	2.1-6	Carlson
	From the mouth of St Louis Bay, MS to the tip of Fort Morgan, AL	summer primary nursery	B 29.3 S 30.6	B 6.6 S 6.6	B 20.3 S 17.8	3.4	Parsons (env. parameters are average values
	Terrebonne/Timbalier Bay System, LA	summer primary nursery (May-Sept)	22.6-32.4	no data	18-34.7	1.2-5.2	Neer et al
	All major bay systems along the Gulf coast of Texas from Sabine Lake to Lower Laguna Madre	summer primary nursery (May-Sept)	16.7-34	no data	0-54	no data	Jones and Grace
Juvenile	Nearshore and inshore waters from Cape Hatteras and Core Sound to Holden Beach, NC	summer secondary nursery	no data	no data	no data	no data	Jensen et al.
	SC estuarine and nearshore waters	secondary summer and overwintering nursery (May-Dec)	18-24	no data	no data	no data	Ulrich and Riley, SEAMAP, Hueter and Tyminski
	GA estuarine waters	summer secondary nursery (June-Sept)	21-30.4	4.35-6.08	22-36.1	0.5-11.6	Belcher and Shierling, Gurshin
	Yankeetown to 10,000 Islands on the west coast of Florida, Cape Canaveral on the east coast of FL and the Florida Keys	summer secondary nursery (March-Nov); warm water effluents of Tampa Bay and Yankeetown power plants during winter months	20.8-33.6	2-8.3	27-38	0.7-5	Hueter and Tyminski, Michel and Steiner
	Northeast Gulf of Mexico (Apalachee Bay, Apalachicola Bay, St. Joseph Bay, Crooked Island Sound and St Andrew Bay) north central Gulf of Mexico	summer secondary nursery	16-32.5	1.9-8.3	19-38	0.7-6.4	Carlson
	Coastal Alabama off Dauphin Island and Mobile Point	summer secondary nursery	B 27.3-28.1	B 3.2-6.2	B 34.3-37	5.8-7.6	Gurshin
	From the mouth of St Louis Bay, MS to the tip of Fort Morgan, AL	summer secondary nursery	B 28 S 28.8	B 6.3 S 6.9	B 19.4 S 17.7	3.1	Parsons (env. parameters are average values)
	Terrebonne/Timbalier Bay System, LA	summer secondary nursery (April-Nov)	22.6-32.4	no data	18-34.7	1.2-5.2	Neer et al
	All major bay systems along the Gulf coast of Texas from Galveston Bay to Lower Laguna Madre, except Corpus Christi Bay	summer secondary nursery					Jones and Grace
Adult	Outer Banks of NC, St Augustine to Cape Canaveral, FL,		Unk	Unk	Unk	Unk	

* Contributing authors in: McCandless, C.T., H.L. Pratt Jr., and N.E. Kohler. 2002. Shark nursery grounds of the Gulf of Mexico and the East Coast waters of the United States: an overview. Authors and papers are cited separately in References section.

Table 10.4 Dusky shark (*Carcharinus obscurus*) Life History and Habitat Characteristics

Life Stage	Species Distributions		Habitat Characteristics				Source*
	Location	Season	Temp (˚C)	DO (mg/l)	Sal (ppt)	Depth (m)	
			B = bottom and S = surface				
Neonate and young of the year (YOY)	Nearshore waters from Cape Hatteras to Bogue Banks and off Holden Beach, NC	Oct and Nov; pupping April and May off Holden beach	no data	no data	no data	no data	Jensen et al, SEAMAP
	SC coastal waters	transient or overwintering nursery (Nov)	18	no data	no data	no data	Ulrich and Riley
Juvenile	In the coastal waters of Martha's Vineyard, MA (off East and South Beaches of Chappaquiddick Island)	summer secondary nursery	17-24	no data	no data	4.8-19.2	Skomal
	Exposed nearshore waters in Virginia, rarely enter the estuaries (one juvenile female (79cm PCL) caught in lower Chesapeake Bay in August of 1990	summer secondary nursery	no data	no data	no data	no data	Grubbs and Musick
	Nearshore waters from Cape Hatteras to Holden Beach, NC	summer secondary and overwintering nursery grounds	18.1-22.2	no data	no data	4.3-15.5	Jensen et al, SEAMAP
	SC coastal waters	transient or overwintering nursery (Nov)	18	no data	no data	no data	Ulrich and Riley
Adult	Pelagic waters offshore the Virginia/North Carolina border and south to Fort Lauderdale, FL Nearshore waters beginning at the border of Georgia and Florida south to Fort Lauderdale	Migrations moving north-south with the seasons	Unk	Unk	Unk	Unk	

* Contributing authors in: McCandless, C.T., H.L. Pratt Jr., and N.E. Kohler. 2002. Shark nursery grounds of the Gulf of Mexico and the East Coast waters of the United States: an overview. Authors and papers are cited separately in References section.

Table 10.5 Sandbar shark (*Carcharinus plumbeus*) Life History and Habitat Characteristics

Life Stage	Species Distributions		Habitat Characteristics				Source*
	Location	Season	Temp (˚C)	DO (mg/l)	Sal (ppt)	Depth (m)	
			B = bottom and S = surface				
Neonate and young of the year (YOY)	Great Bay, NJ	summer primary nursery (pupping early July)	23.8	7.01	26.5	2.4	Merson and Pratt
	Delaware Bay (DE & NJ waters)	summer primary nursery (June-Oct with majority of pupping from late June to early July)	18-29.9	no data	18.3-30.4	0.9-16.6	McCandless et al
	Lower Chesapeake Bay, VA and the tidal creeks and lagoons along Virginia's Eastern Shore	summer primary nursery	17-28	no data	no data	no data	Grubbs and Musick
	In coastal waters from Cape Hatteras to Bogue Banks, off Holden Beach and in Pamlico Sound, NC	summer primary nursery (May-July); overwintering grounds off Cape Hatteras, NC (catches increase greatly in Oct and Nov)	no data	no data	no data	no data	Jensen et al, SEAMAP
	SC estuarine and nearshore coastal waters	summer primary nursery (May-Sept), with coastal waters also serving as overwintering grounds	no data	no data	no data	no data	Ulrich and Riley
	GA estuarine waters	summer primary nursery (June-Sept)	26.9-30.1	4-5.9	29.6-30.1	3.7-13.1	Belcher and Shierling
	Off Yankeetown, FL (N=3)	summer primary nursery	25-29	no data	20.4-25.4	2.4-3.7	Hueter and Tyminski
	Northeast Gulf of Mexico (Apalachicola Bay and Crooked Island	summer primary nursery	26.6-30.8	5-7.3	19-39	3-5.2	Carlson
Juvenile	Cape Poge Bay, MA, around Chappaquiddick Island, MA (East and South Beaches), and off the south shore of Cape Cod, MA	summer secondary nursery (June -Oct)	20-24	no data	no data	2.4-6.4	Skomal
	Delaware Bay (DE & NJ waters)	summer secondary nursery (May-Oct)	15.5-30	no data	18.3-31.4	0.8-23	McCandless et al
	Lower Chesapeake Bay, VA and the tidal creeks and lagoons along Virginia's Eastern Shore	summer secondary nursery (May-Oct)	17-28	no data	no data	no data	Grubbs and Musick
	Coastal NC waters	summer secondary nursery; overwintering grounds off Cape Hatteras, NC	22.6-28.1	no data	no data	no data	Jensen et al, SEAMAP
	SC estuarine and coastal waters	summer secondary (April - Sept) and overwintering grounds (Dec)	15-28	no data	no data	no data	Ulrich and Riley, SEAMAP
	GA estuarine waters	summer secondary nursery (June-Sept)	26.9-30.1	4-5.9	29.6-30.1	3.7-13.1	Belcher and Shierling
	Northeast Gulf of Mexico (Apalachicola Bay and Crooked Island Sound)	summer secondary nursery	19.8-30.8	5-7.3	19-36	2.1-5.2	Carlson
	North central Gulf of Mexico (just north of Cat and Horn Islands, MS) (N=4)	summer secondary nursery	23.3-24.4	8-8.3	13.4-14.8	2.1	Parsons
	Upper Texas coast, LA coast, and Bulls Bay, SC	spring/summer secondary nursery	no data	no data	no data	no data	Hueter and Tyminski
Adult	Unk	Unk	Unk	Unk	Unk	Unk	

* Contributing authors in: McCandless, C.T., H.L. Pratt Jr., and N.E. Kohler. 2002. Shark nursery grounds of the Gulf of Mexico and the East Coast waters of the United States: an overview. Authors and papers are cited separately in References section.

Table 10.6 Nurse shark (*Ginglymostoma cirratum*) Life History and Habitat Characteristics

Life Stage	Species Distributions		Habitat Characteristics				Source*
	Location	Season	Temp (˚C)	DO (mg/l)	Sal (ppt)	Depth (m)	
			B = bottom and S = surface				
Neonate and young of the year (YOY)	Charlotte Harbor, FL and the Florida Keys	primary nursery	31.7	7.01	33.9	2.1	Hueter and Tyminski
Juvenile	Tampa Bay, Charlotte Harbor, 10,000 Islands Estuary and the Florida Keys	secondary nursery (April-Nov)	17.5-32.9	3.1-9.7	28-38.5	0.6-2.9	Hueter and Tyminski, Michel and Steiner
	Dry Tortugas, FL	summer secondary nursery	no data	no data	no data	no data	Pratt and Carrier
	Northeast Gulf of Mexico (Apalachee Bay, Apalachicola Bay, and Crooked Island Sound)	summer secondary nursery	22.6-28.1	5-8.3	27-37	3.5-6	Carlson
Adult	From tropical West Africa and the Cape Verde Islands in the east, and from Cape Hatteras to Brazil in the west. Littoral waters of the tropical and subtropical Atlantic, shallow water, often under coral reefs or rocks	Unk	Unk	Unk	Unk	Unk	

* Contributing authors in: McCandless, C.T., H.L. Pratt Jr., and N.E. Kohler. 2002. Shark nursery grounds of the Gulf of Mexico and the East Coast waters of the United States: an overview. Authors and papers are cited separately in References section.

Table 10.7 Finetooth shark (*Carcharinus isodon*) Life History and Habitat Characteristics

Life Stage	Species Distributions		Habitat Characteristics				Source*
	Location	Season	Temp (˚C)	DO (mg/l)	Sal (ppt)	Depth (m)	
			B = bottom and S = surface				
Neonate and young of the year (YOY)	SC estuarine waters	summer primary nursery (June - Sept), pupping early to mid June	no data	no data	no data	no data	Ulrich and Riley
	GA estuarine and coastal waters	transient or overwintering nursery (Nov)	above 25	no data	23-26	0.5-5	Belcher and Shierling, Gurshin, SEAMAP
	Northeast Gulf of Mexico (Apalachicola Bay and Crooked Island Sound)	summer primary nursery	26.4-31.4	4.5-5.6	25-36	3.3-5	Carlson
	Terrebonne/Timbalier Bay System, LA	summer primary nursery (May-Aug)	25.3-32.1	no data	19-34.3	0.6-4.9	Neer et al
	Galveston, Matagorda, Aransas, Corpus Christi and the Lower Laguna Madre major bay systems of Texas	summer primary nursery (April-Nov)	19.2-30.6	no data	no data	16-36	Jones and Grace
Juvenile	Cape Hatteras to Holden Beach, NC	secondary summer nursery for older juveniles	22-30.6	no data	no data	3.1-10.7	Jensen et al
	SC estuarine (primarily early juveniles) and nearshore coastal waters (primarily late juveniles)	summer secondary nursery (May-Oct)	20-28	no data	no data	no data	Ulrich and Riley
	GA estuarine waters	summer secondary nursery	25-28.2	6.21	23-32.1	0.5-4.3	Gurshin
	Northeast Gulf of Mexico (Apalachicola Bay, Crooked Island Sound and St Andrew Bay)	summer secondary nursery	19.5-31.4	3.6-6.8	19-38	2.3-5.3	Carlson
	Coastal Alabama off Dauphin Island and Mobile Point (N=3)	summer secondary nursery	B 26.1-27.5 S 28.8-31.5	B 0.3-2.4 S 5.3-7.3	B 33.3-36.3 S 23.5-32.4	4.9-7.6	Gurshin
	Terrebonne/Timbalier Bay System, LA	summer secondary nursery	25.3-32.1	no data	19-34.3	0.6-4.9	Neer et al
	All major bay systems along the Gulf coast of Texas from Galveston Bay to Lower Laguna Madre, except Upper Laguna Madre	summer secondary nursery	no data	no data	no data	no data	Jones and Grace
	Along the beaches of the lower TX coast	spring and fall migrations	33.8	8.5	11.5	2.1-5.5	Hueter and Tyminski
Adult	Western Atlantic, from NC to Brazil, SE U.S. and Gulf of Mexico	Unk					
	Northeast Gulf of Mexico especially around the mouth of the Apalachicola River	April-Oct	22-32	5.0-8.0	28-35	<5	Castro, J.I. 1983 Carlson

* Contributing authors in: McCandless, C.T., H.L. Pratt Jr., and N.E. Kohler. 2002. Shark nursery grounds of the Gulf of Mexico and the East Coast waters of the United States: an overview. Authors and papers are cited separately in References section.

Figure 10.1 Ten minute square grid used for distribution analysis.

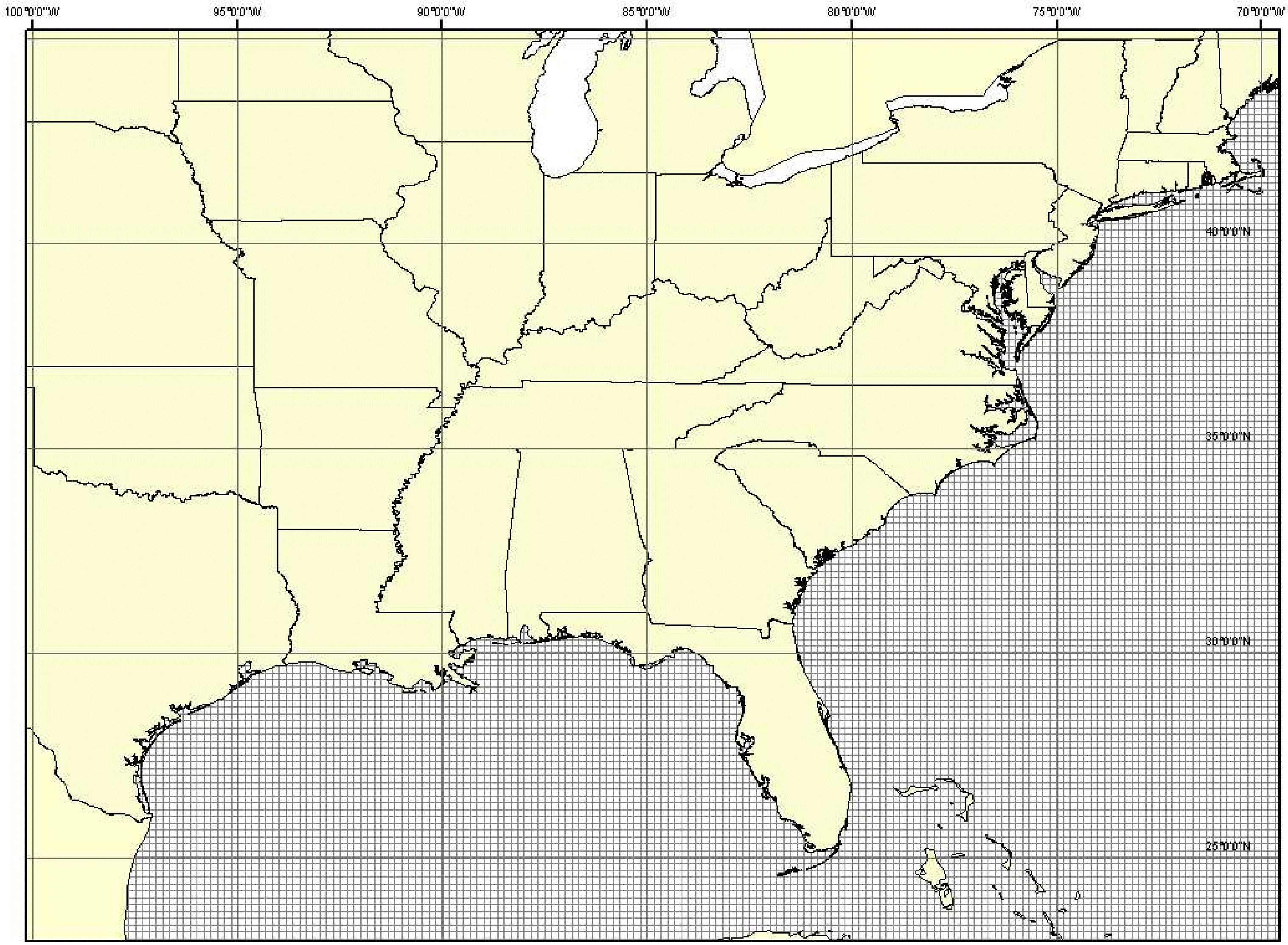

Figure 10.2a Essential Fish Habitat - Blacktip Shark, All Life Stages Combined

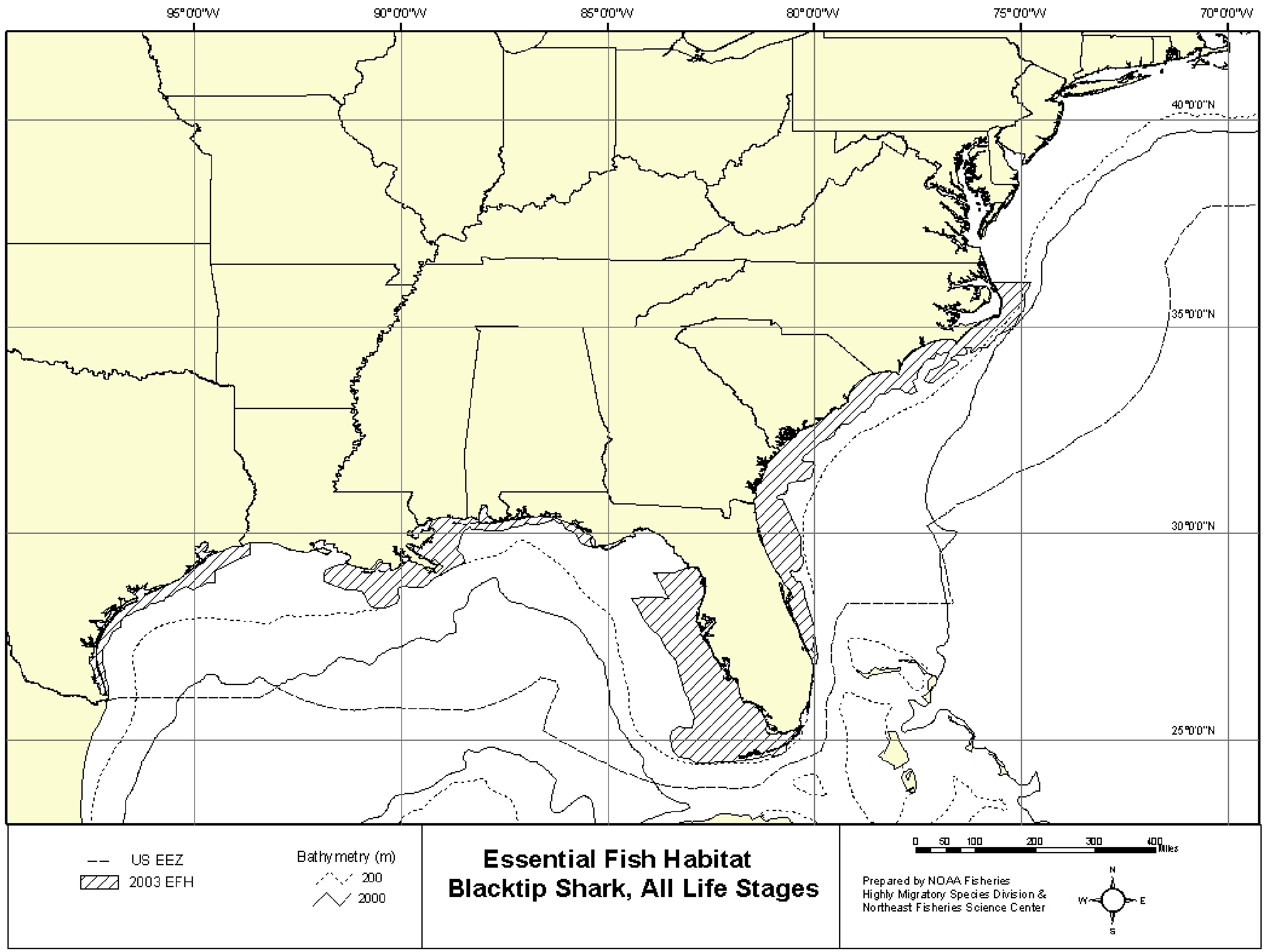

Figure 10.2b Essential Fish Habitat - Blacktip Shark, Neonate

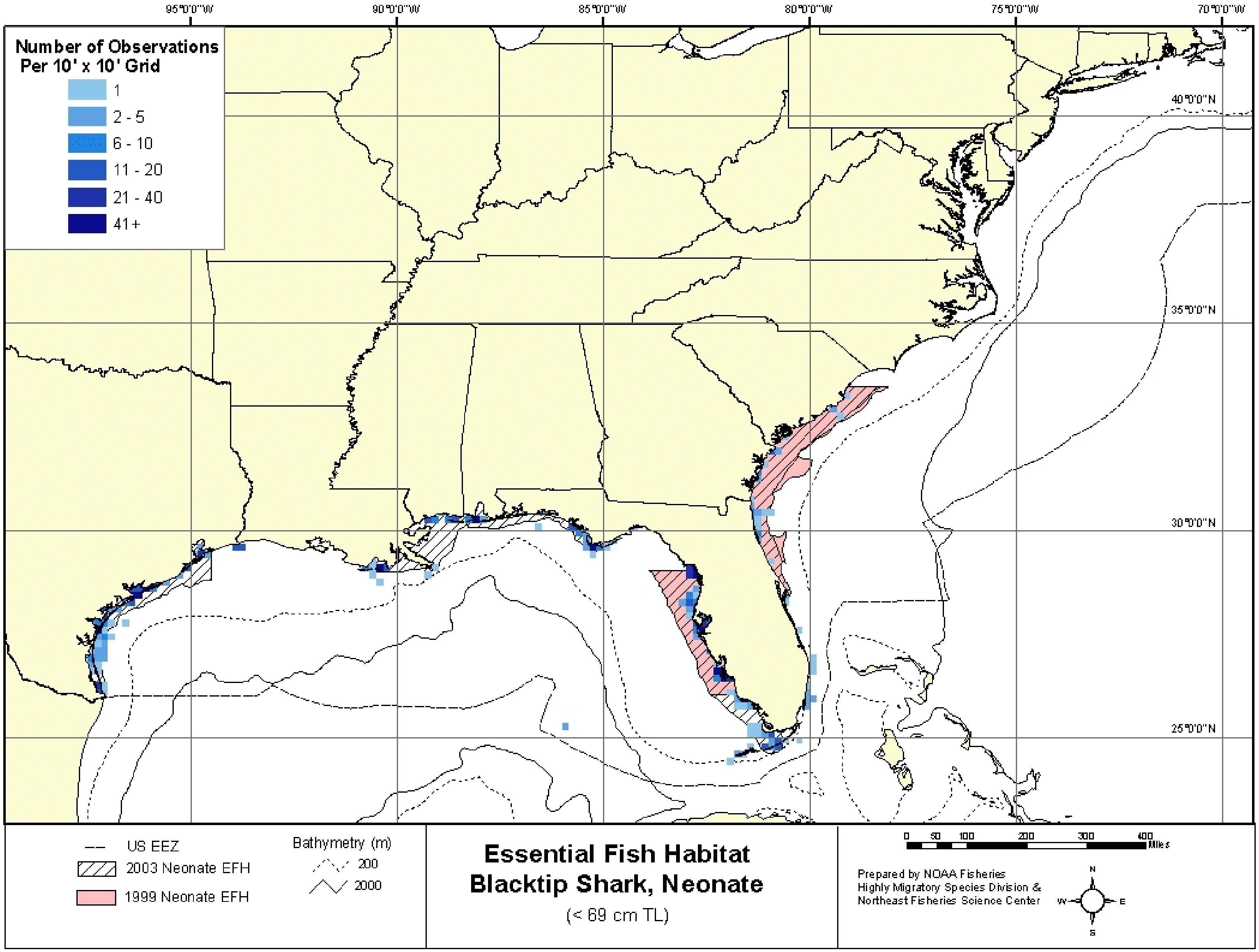

Figure 10.2c Essential Fish Habitat - Blacktip Shark, Juvenile

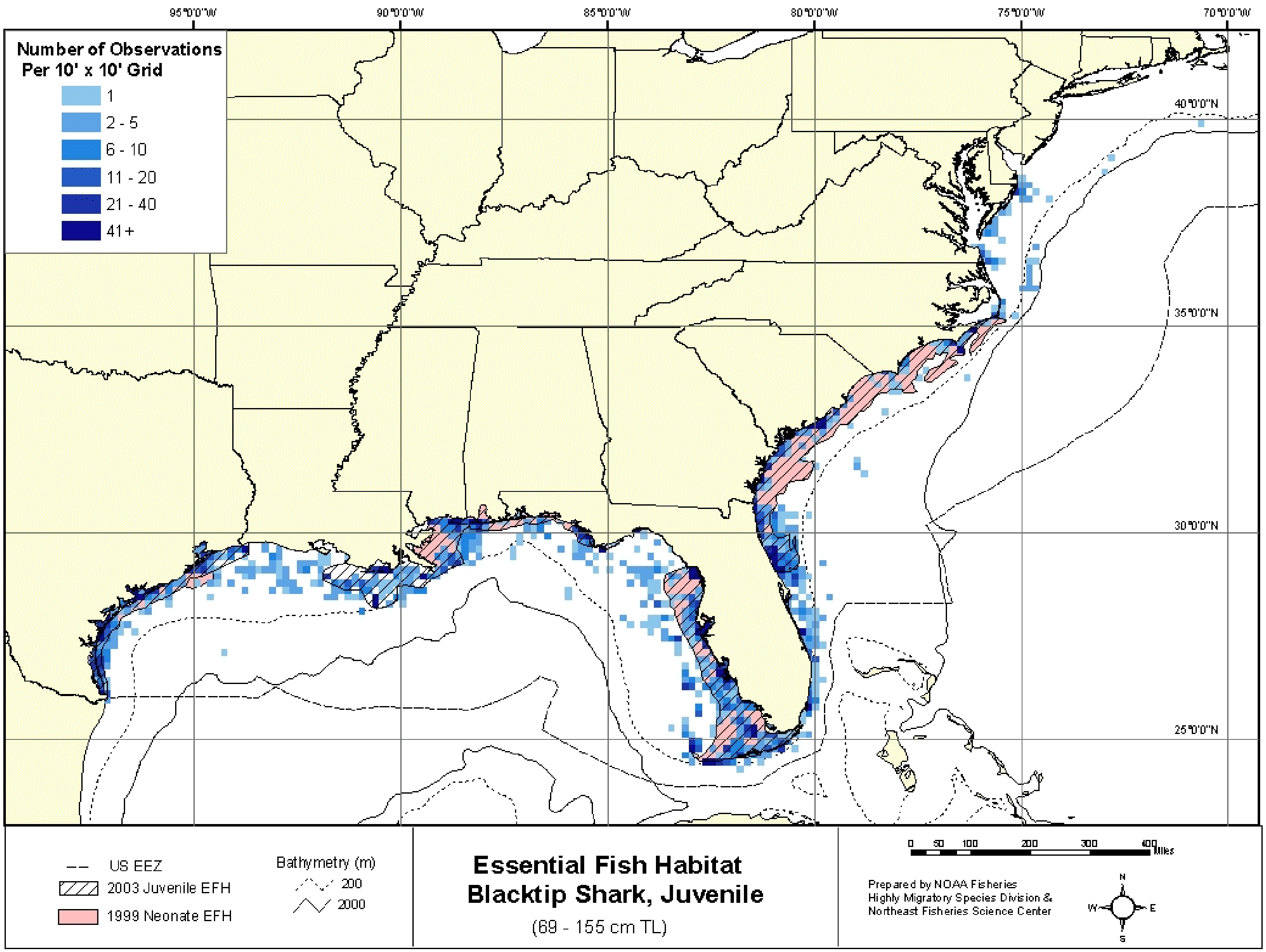

Figure 10.2d Essential Fish Habitat - Blacktip Shark, Adult

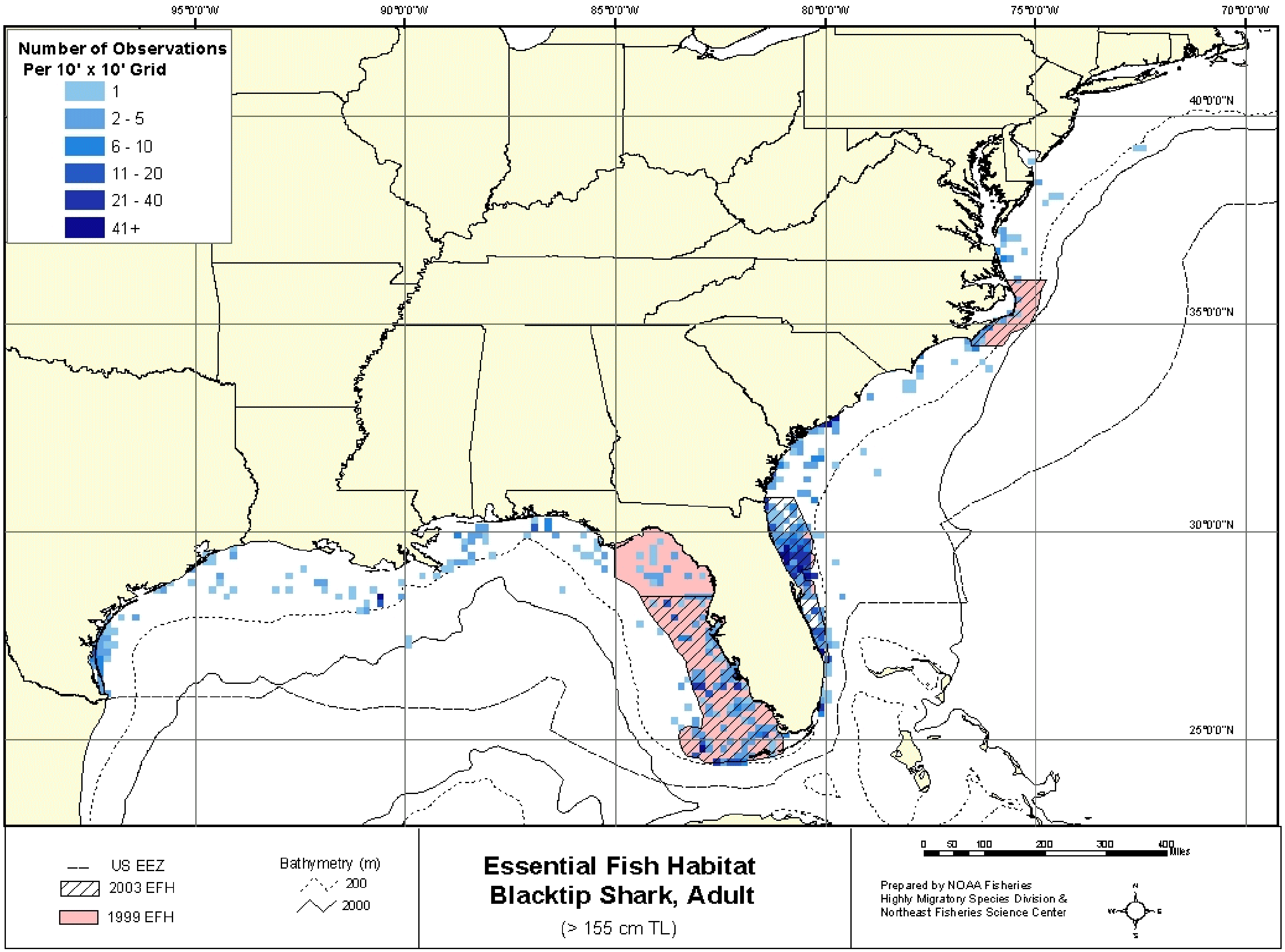

Figure 10.3a Essential Fish Habitat - Dusky Shark, All Life Stages

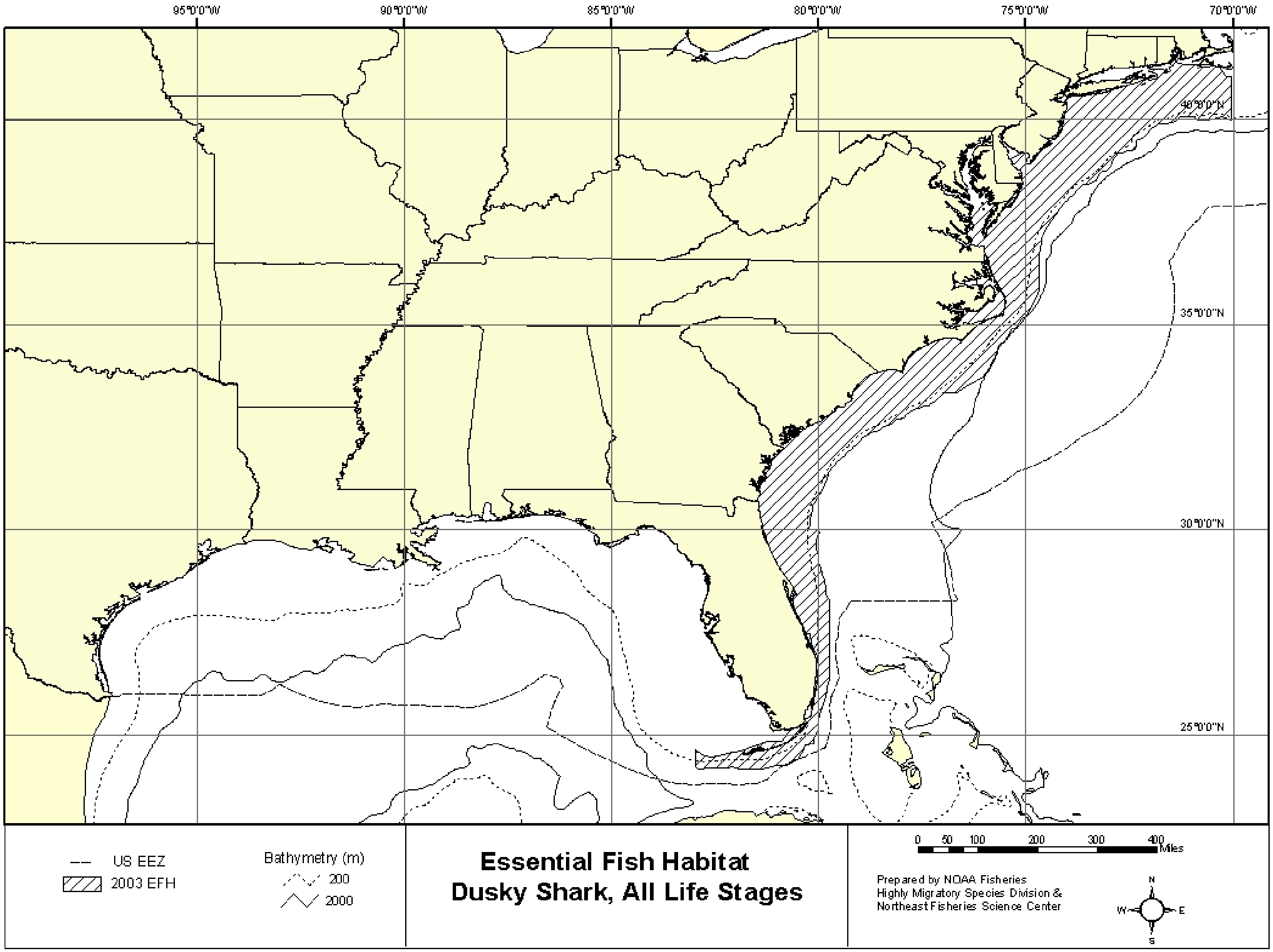

Figure 10.3b Essential Fish Habitat - Dusky Shark, Neonate

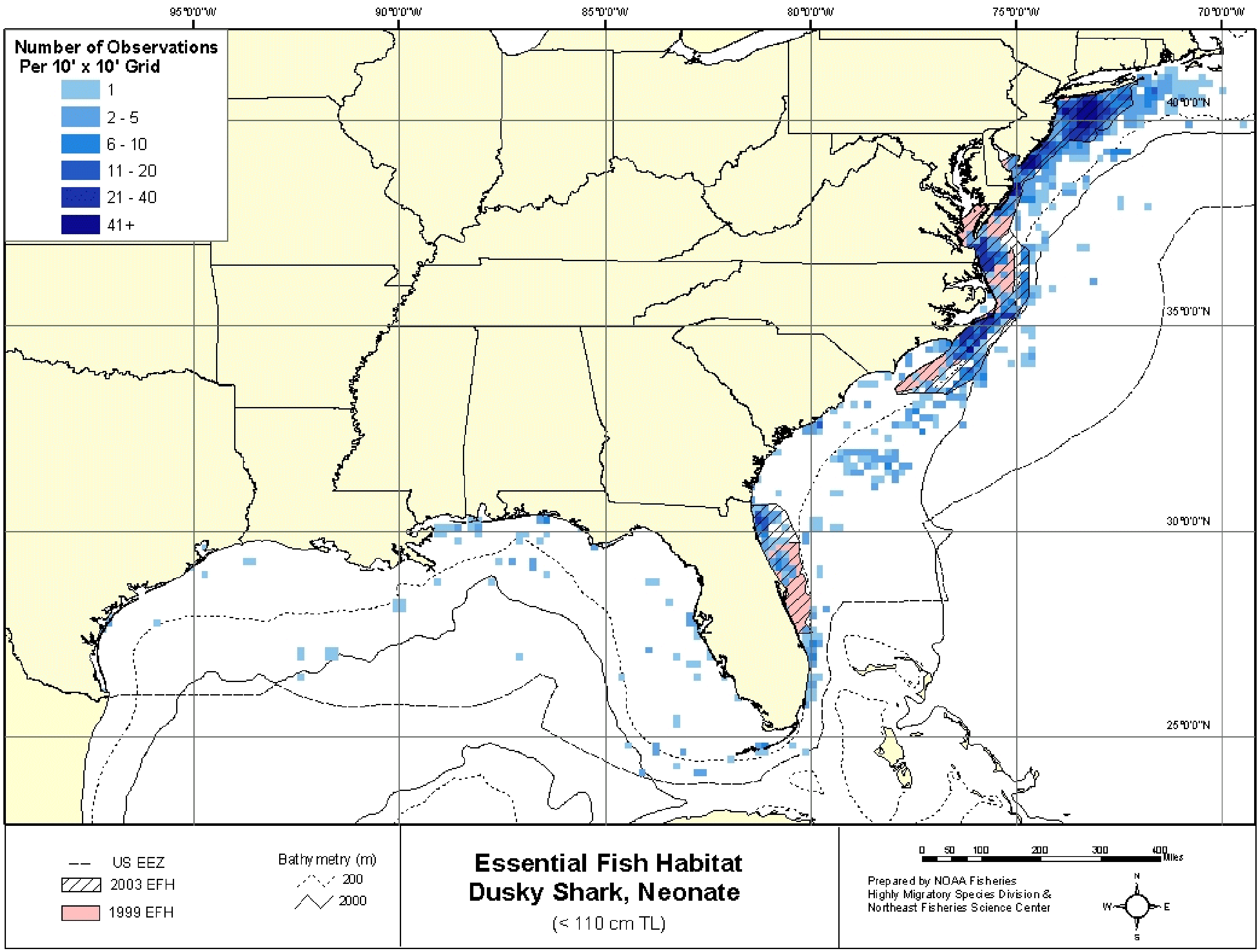

Figure 10.3c Essential Fish Habitat - Dusky Shark, Juvenile

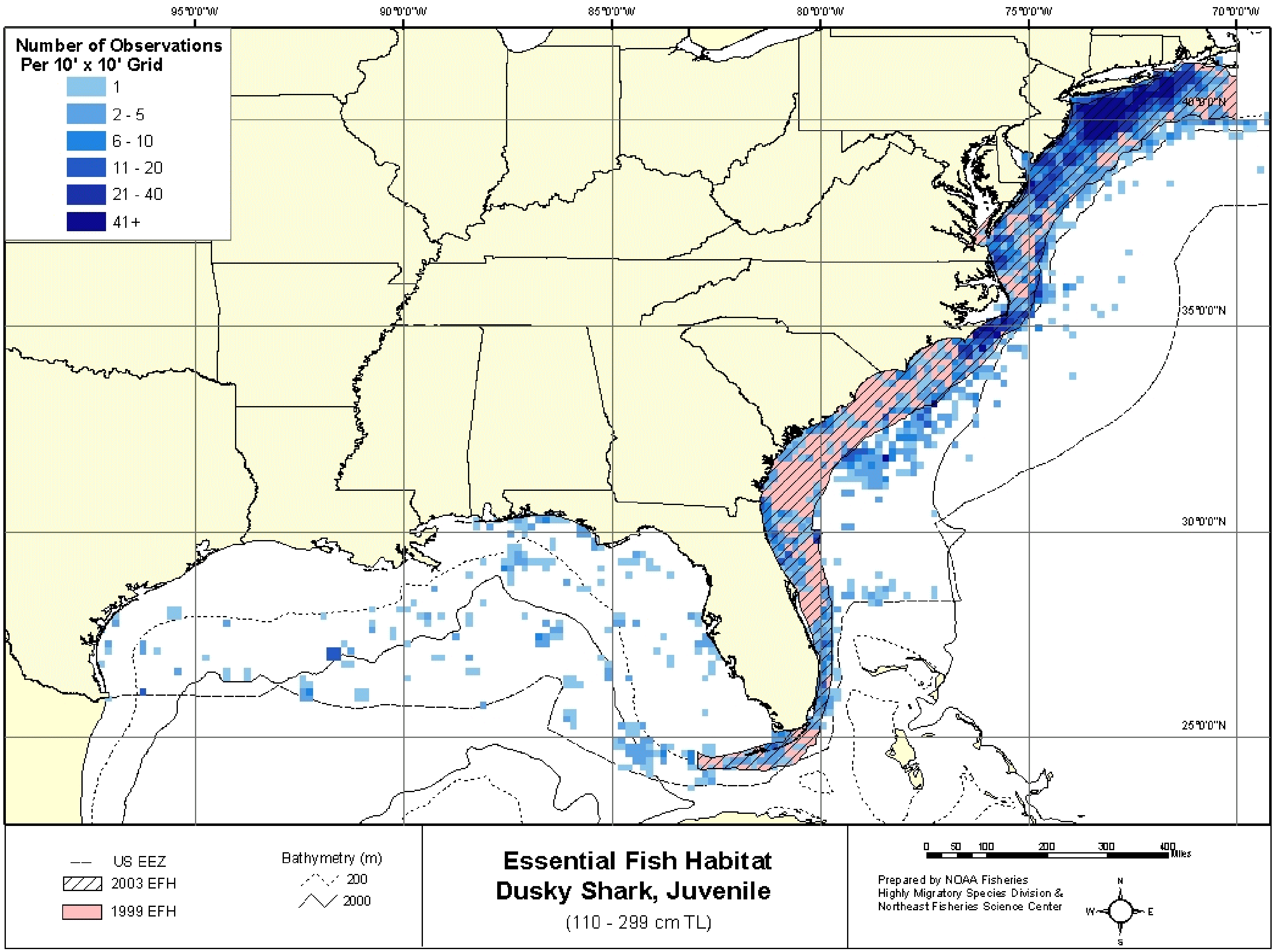

Figure 10.3d Essential Fish Habitat - Dusky Shark, Adult

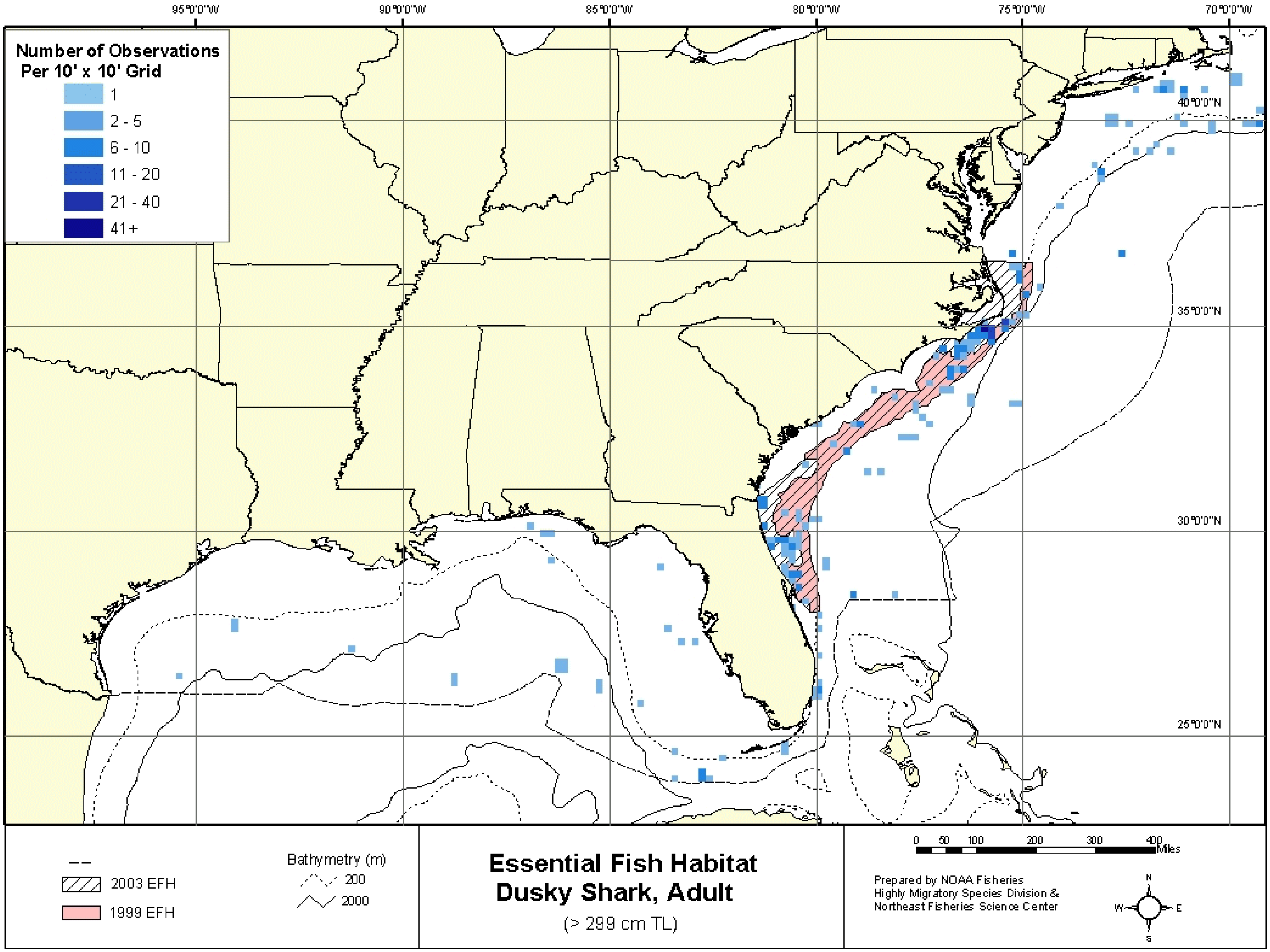

Figure 10.4a Essential Fish Habitat - Sandbar Shark, All Life Stages

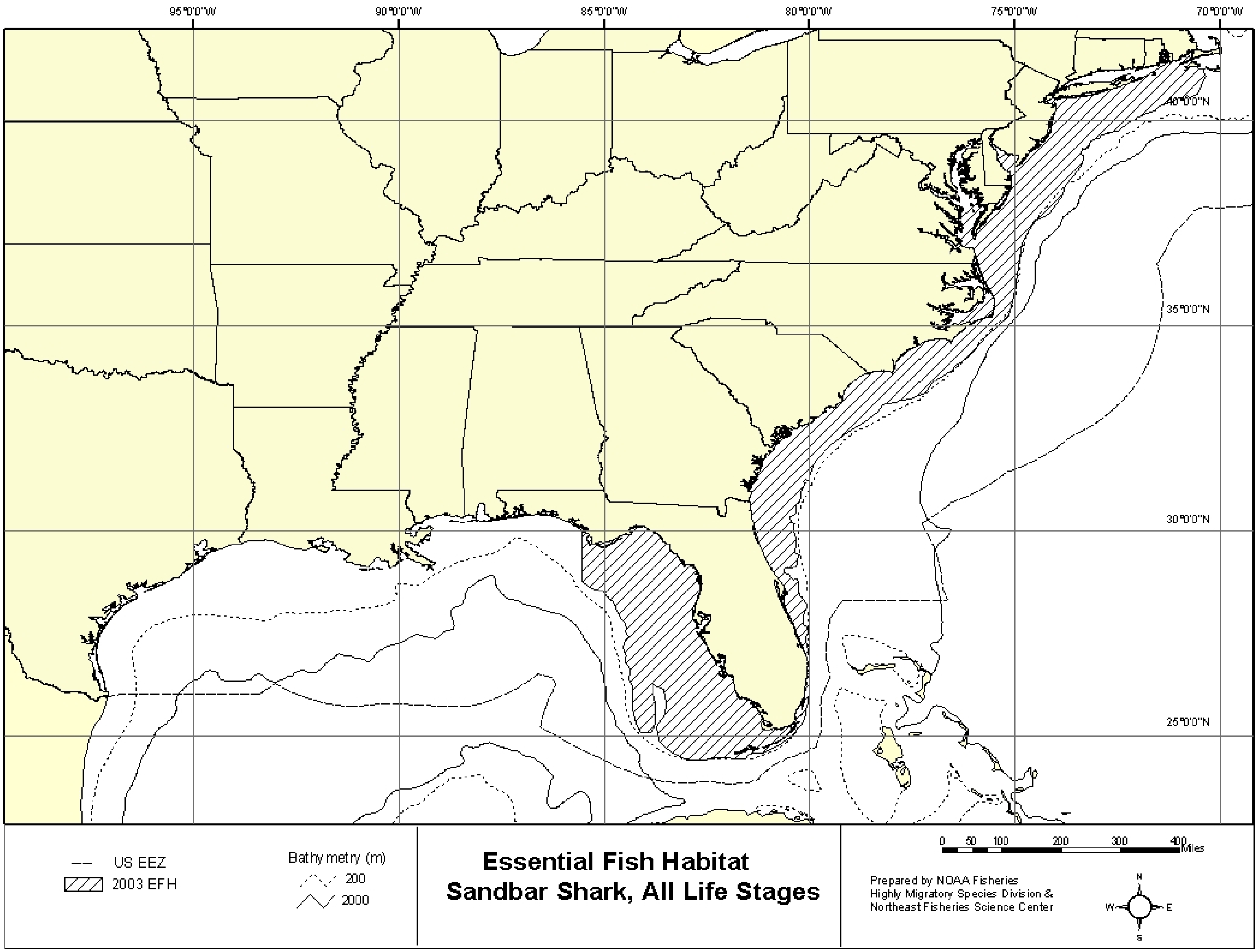

Figure 10.4b Essential Fish Habitat - Sandbar Shark, Neonate

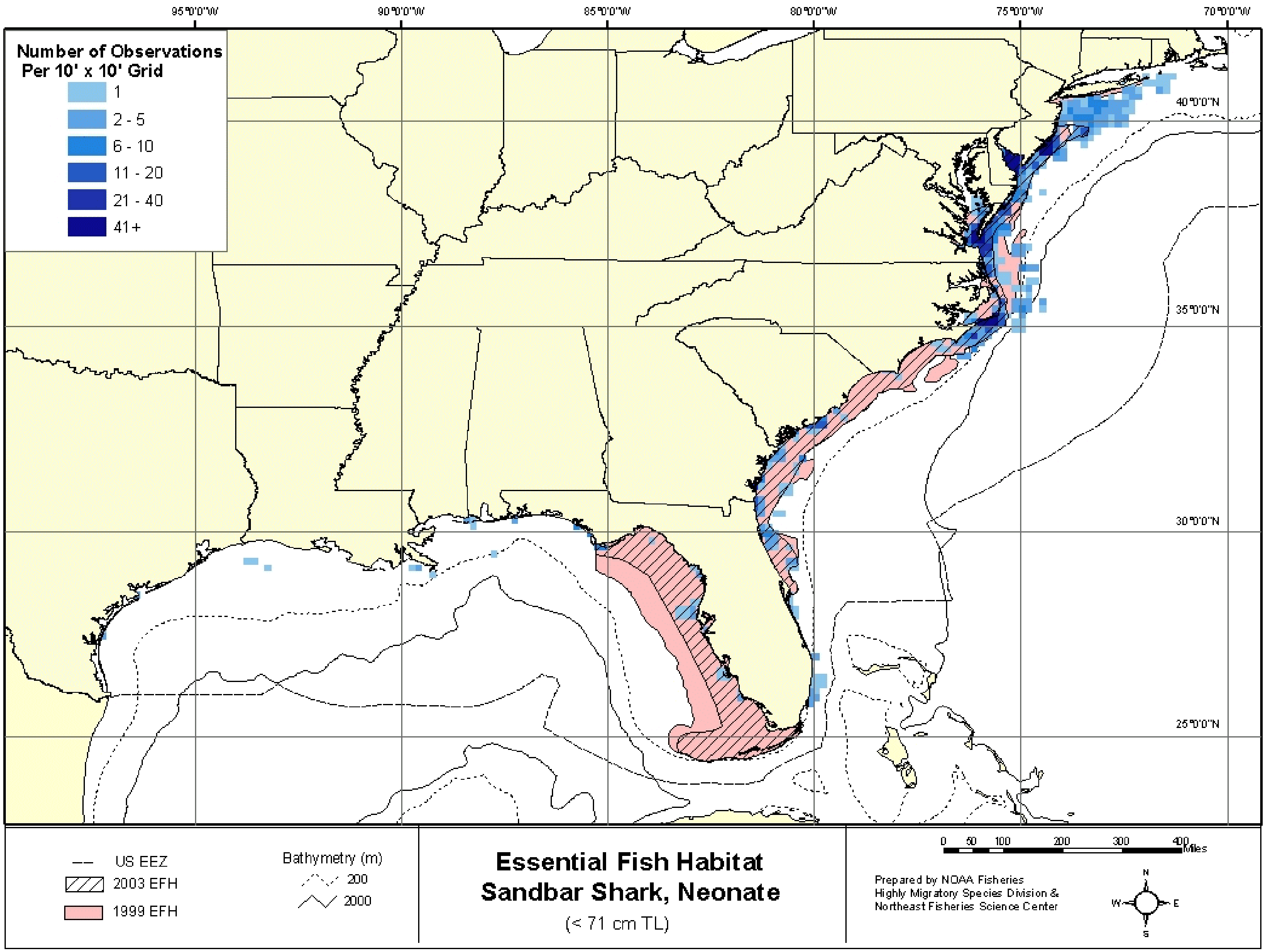

Figure 10.4c Essential Fish Habitat - Sandbar Shark, Juvenile

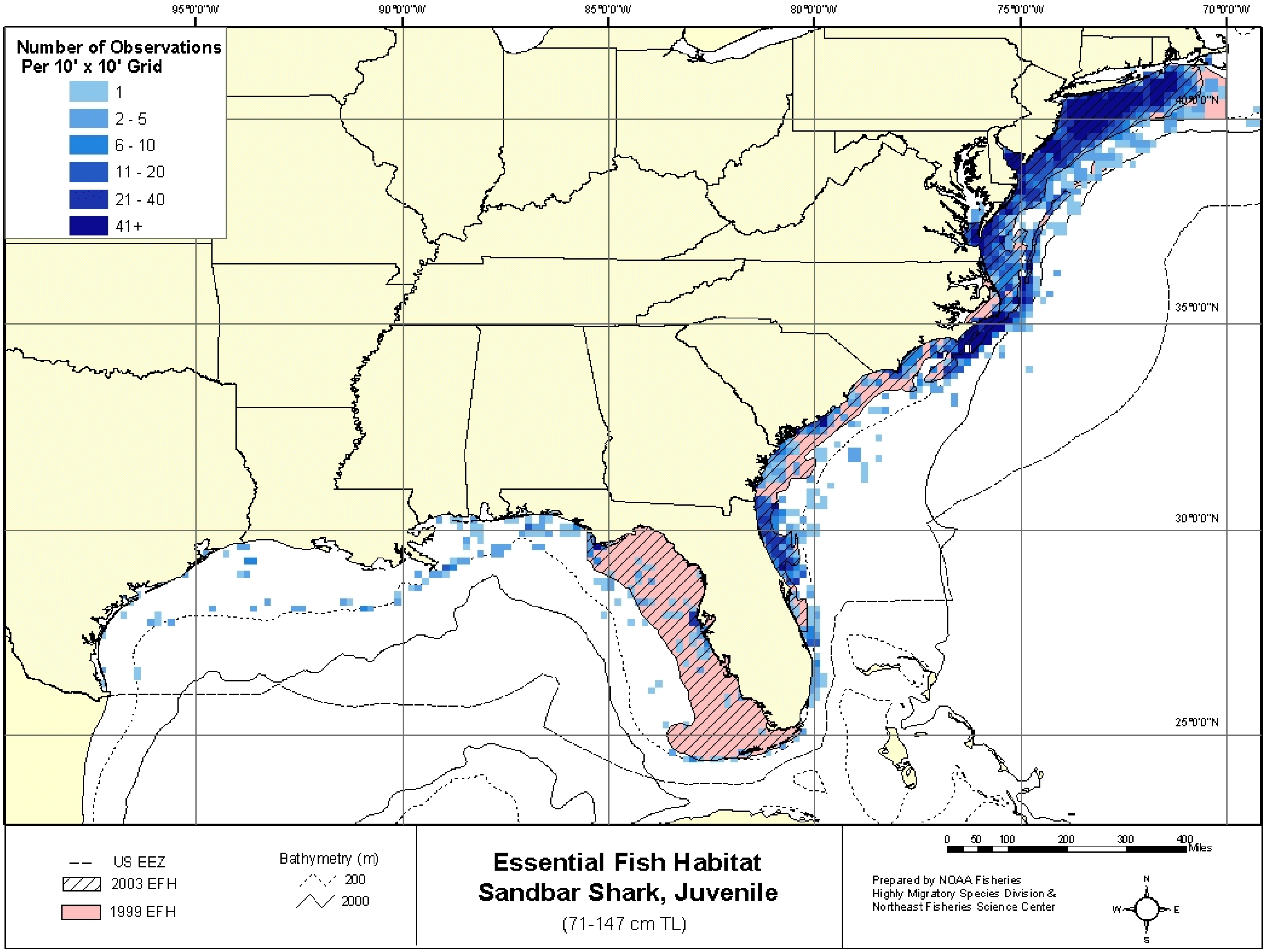

Figure 10.4d Essential Fish Habitat - Sandbar Shark, Adult

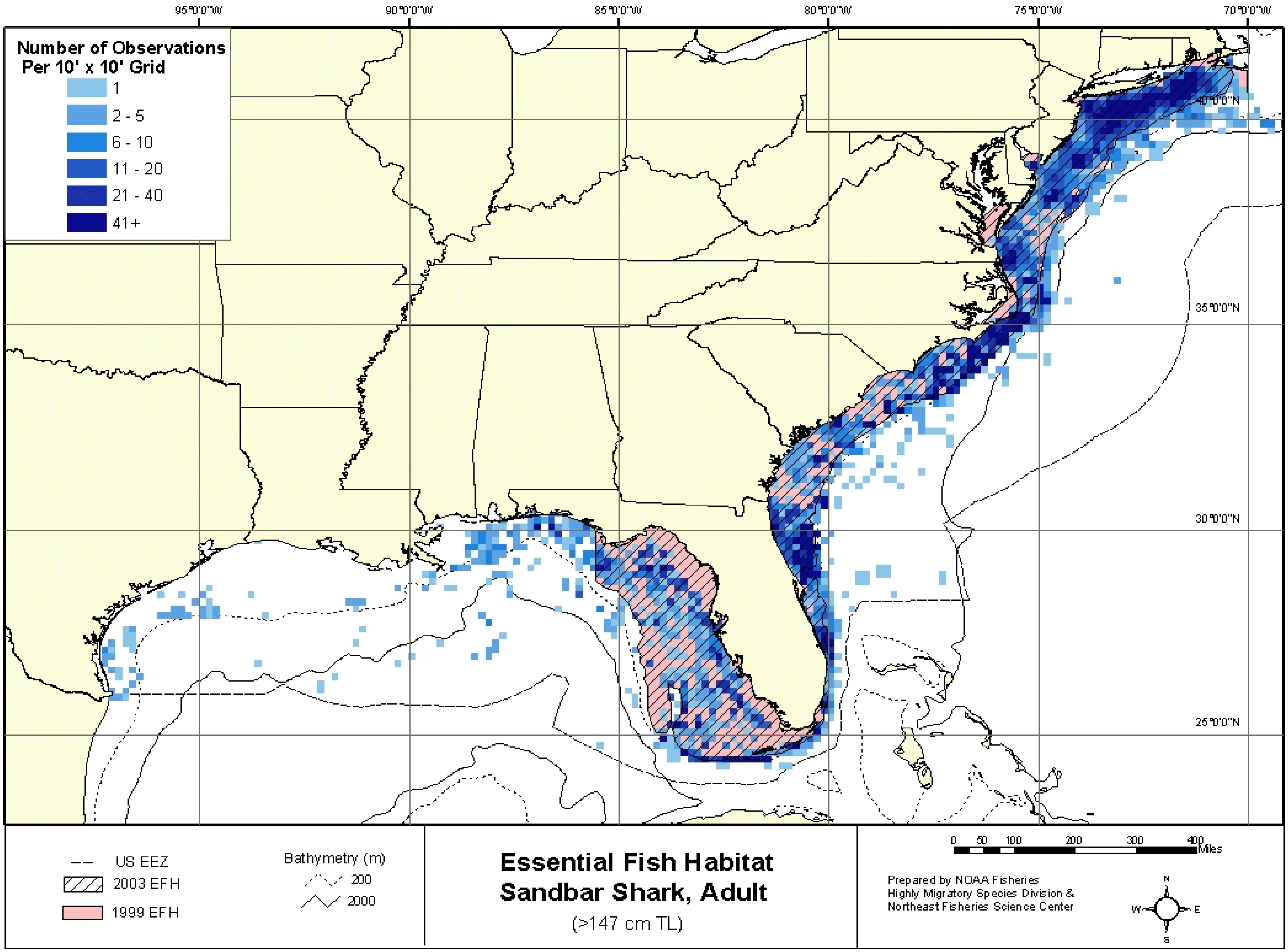

Figure 10.4e Habitat Area of Particular Concern - Sandbar Shark

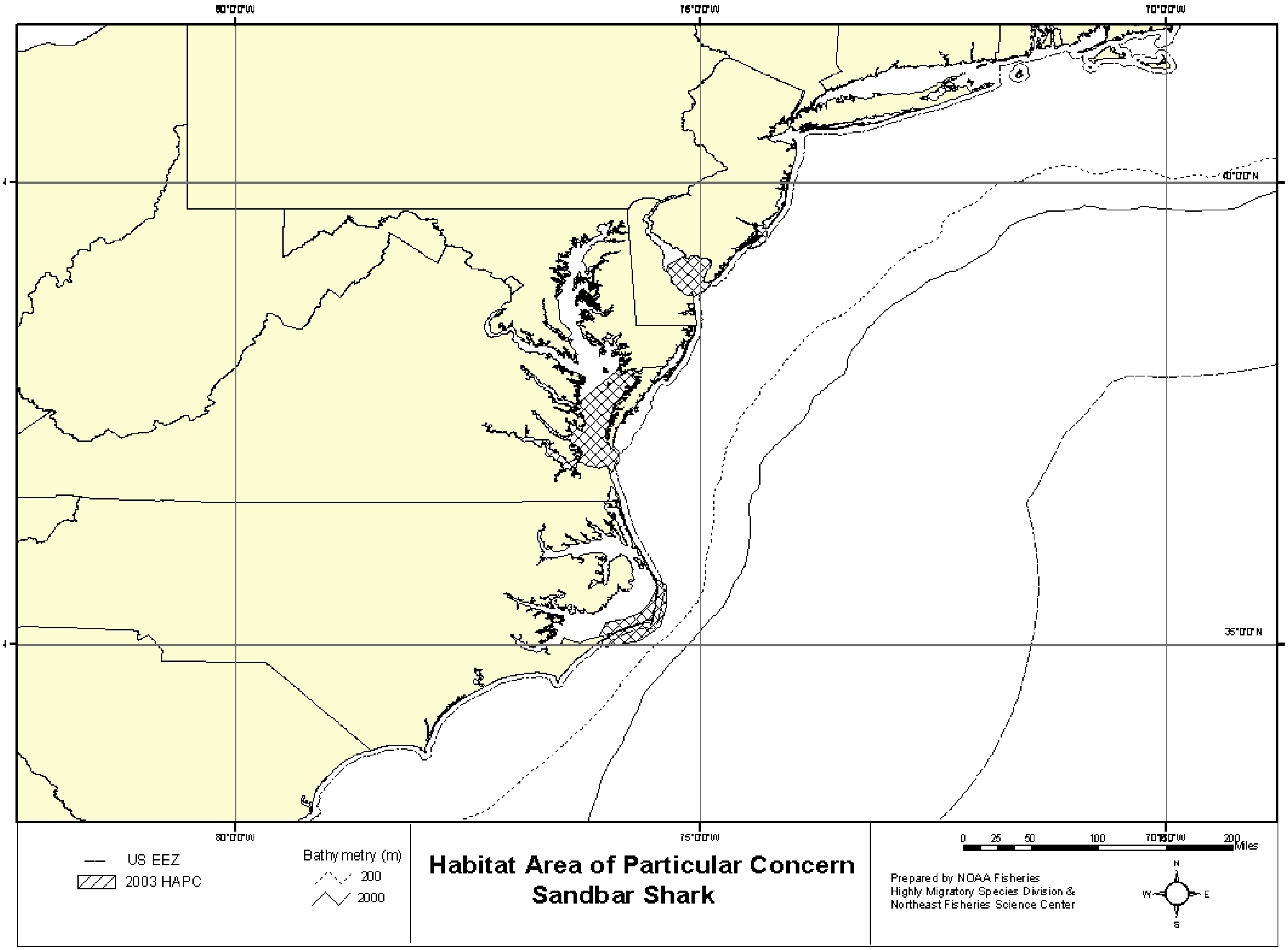

Figure 10.5a Essential Fish Habitat - Nurse Shark, All Life Stages

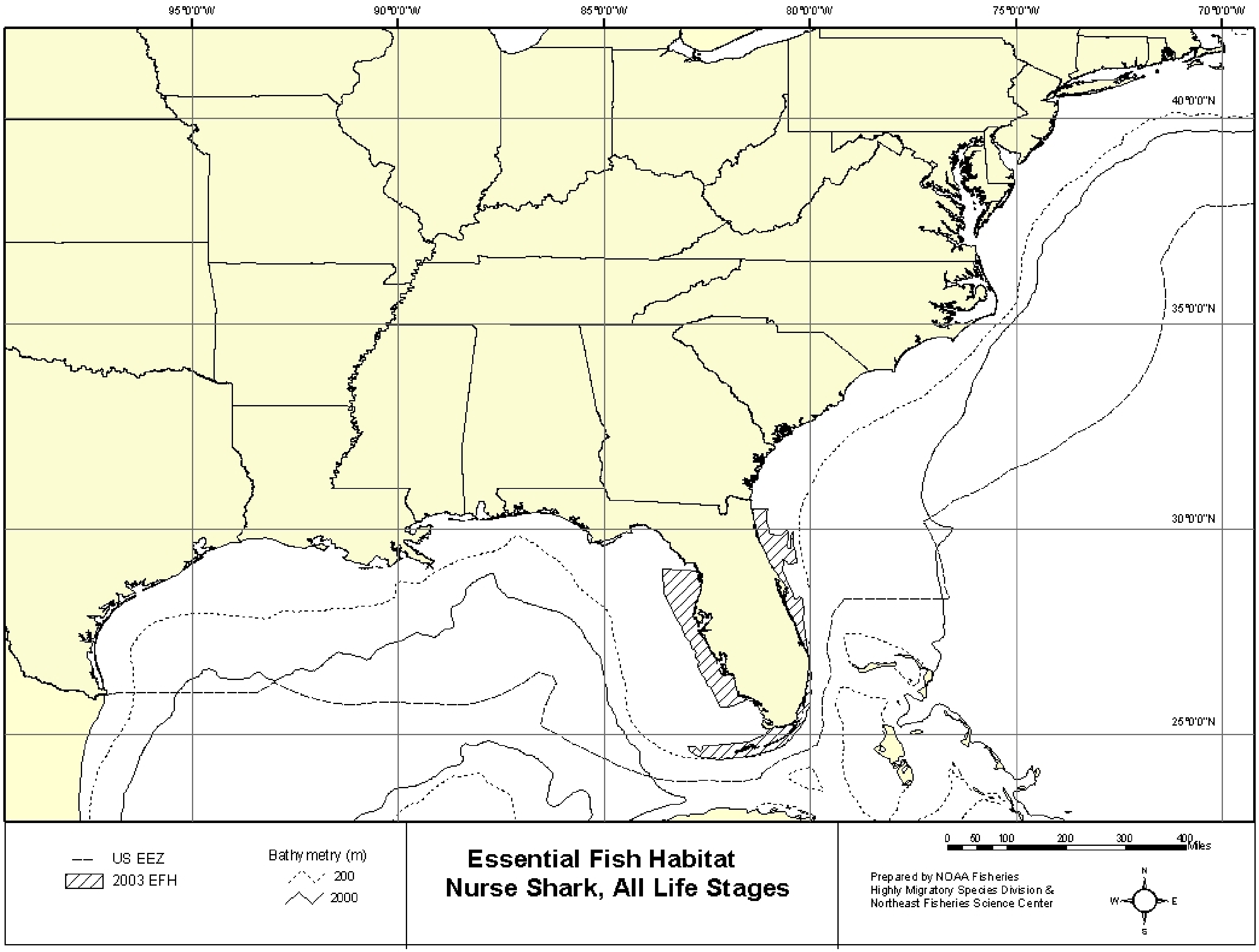

Figure 10.5b Essential Fish Habitat - Nurse Shark, Neonate

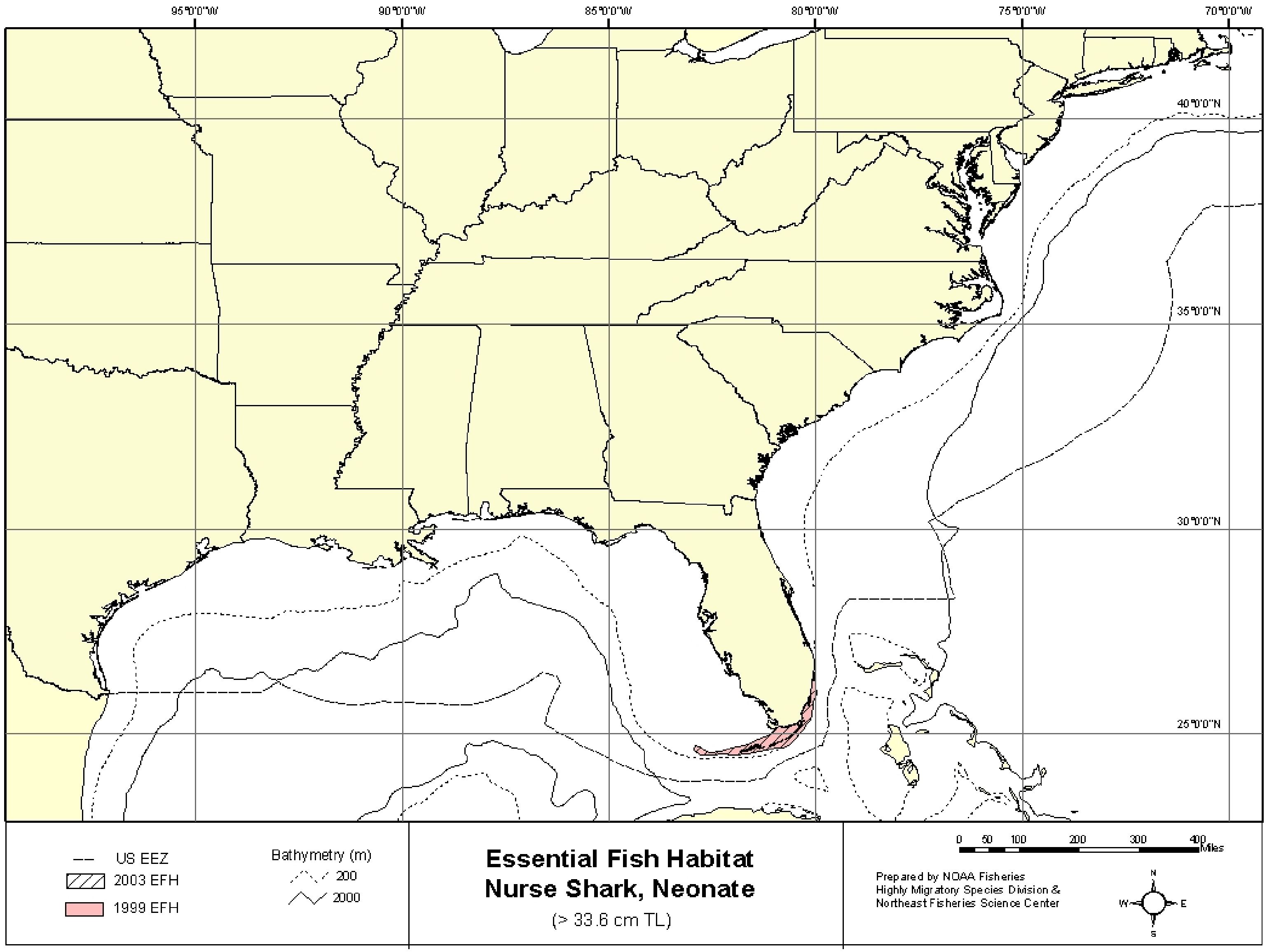

Figure 10.5c Essential Fish Habitat - Nurse Shark, Juvenile

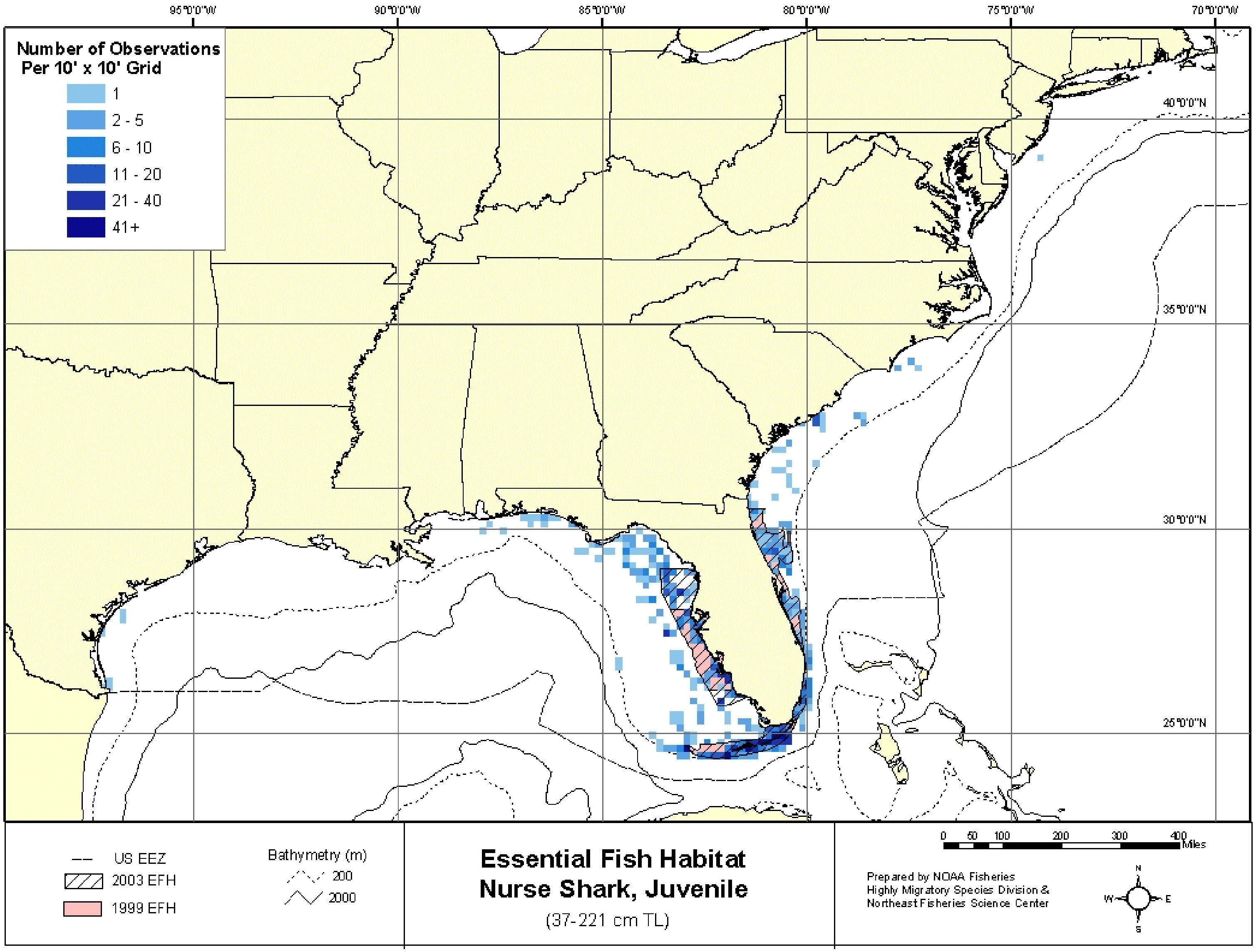

Figure 10.5d Essential Fish Habitat - Nurse Shark, Adult

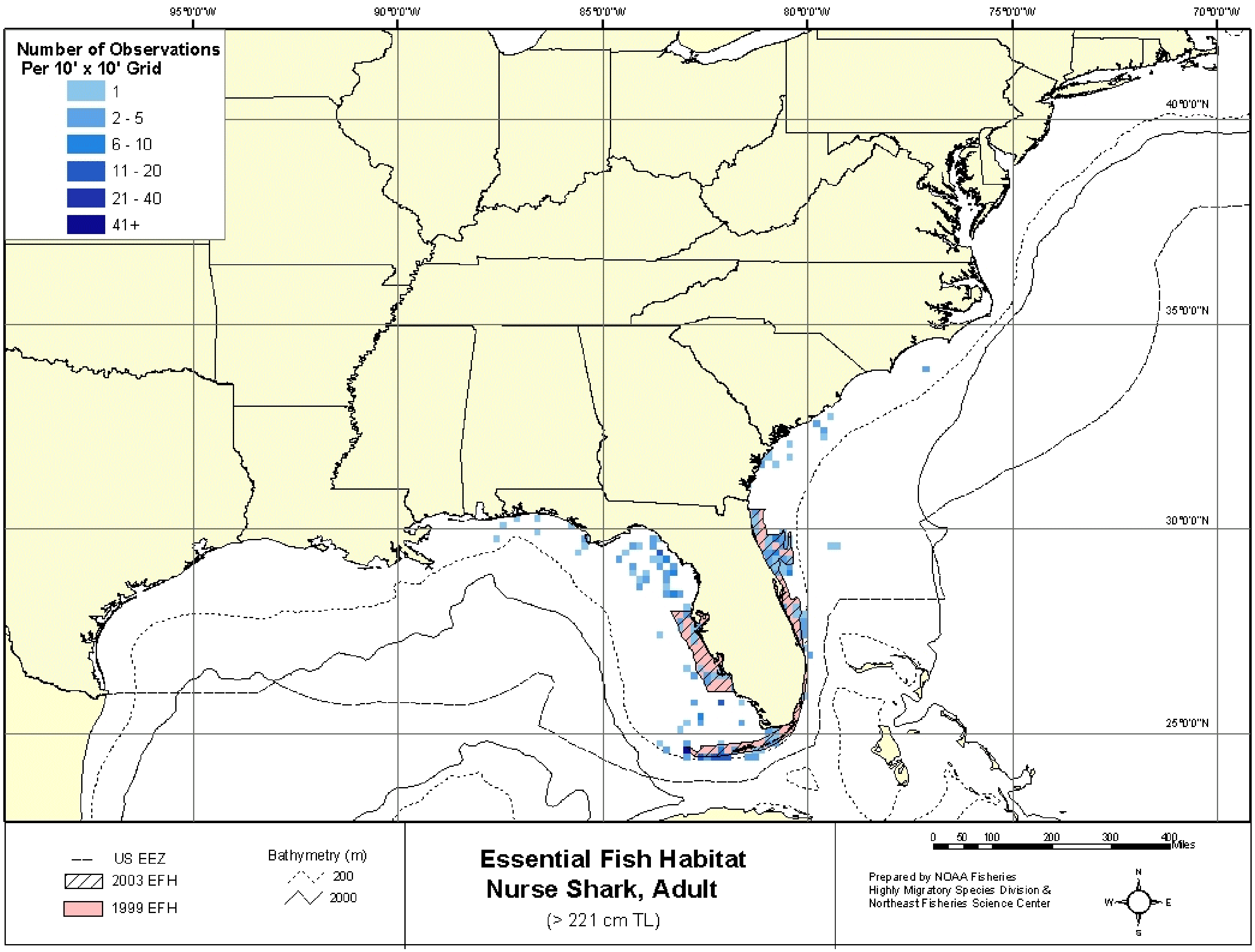

Figure 10.6a Essential Fish Habitat - Finetooth Shark, All Life Stages

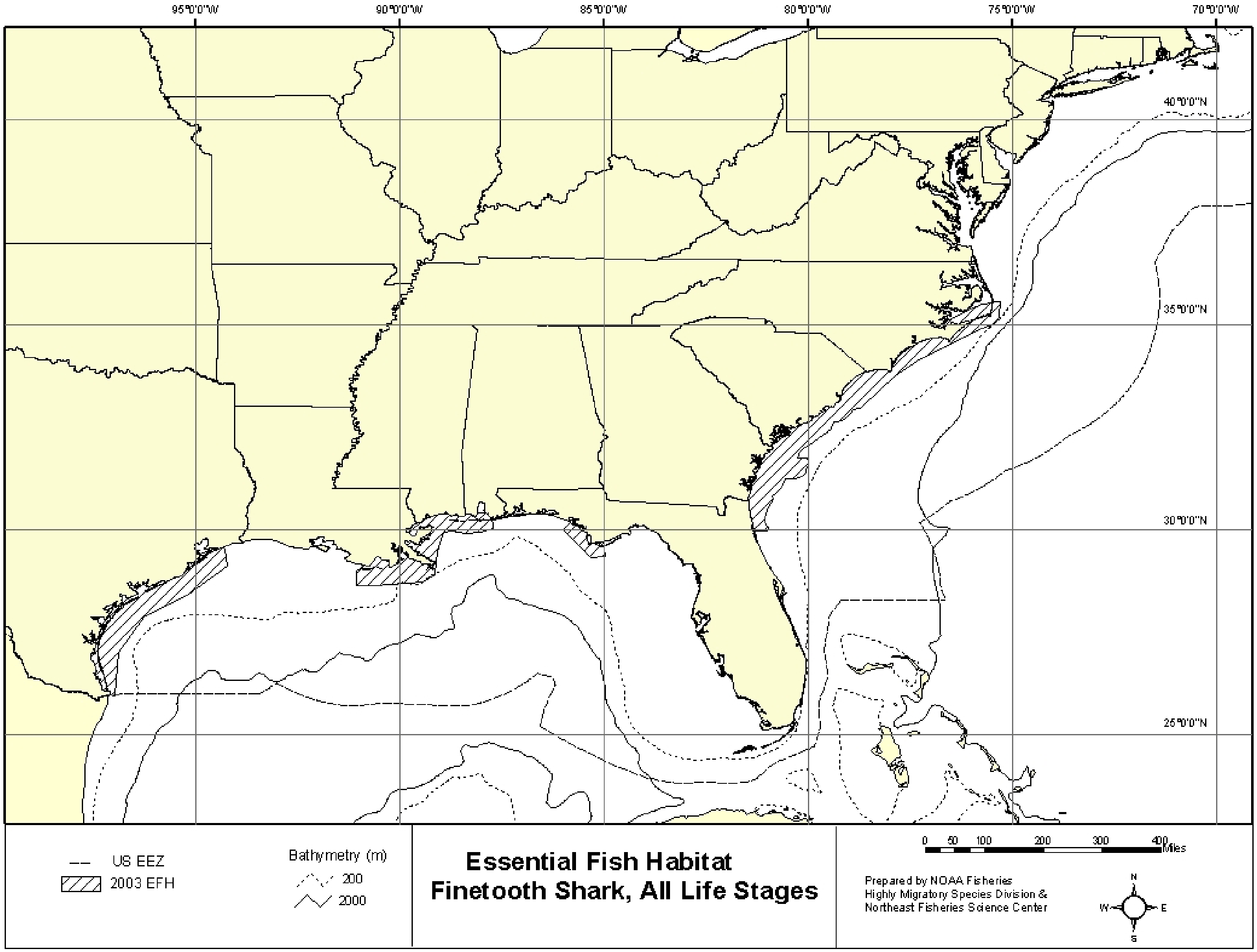

Figure 10.6b Essential Fish Habitat - Finetooth Shark, Neonate

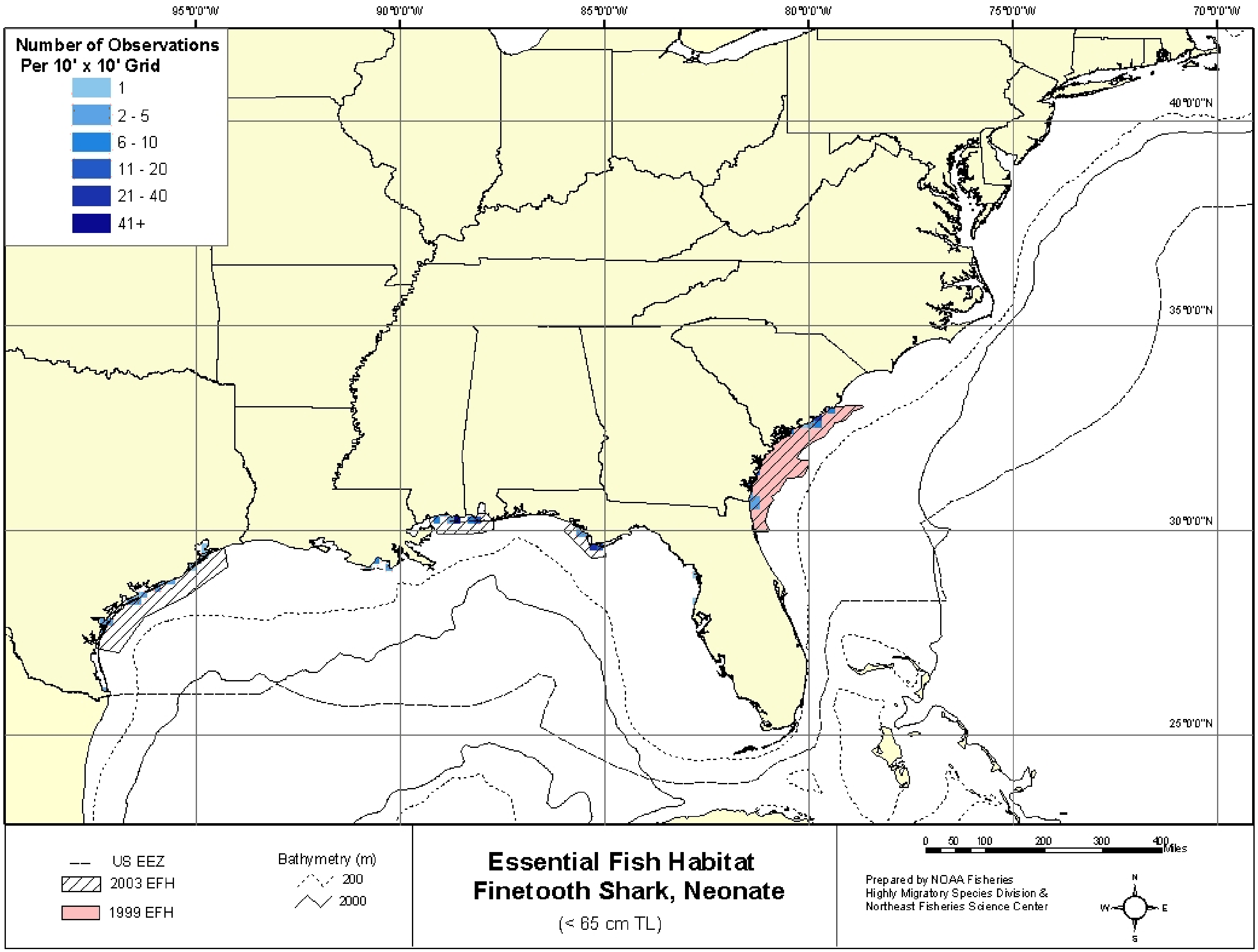

Figure 10.6c Essential Fish Habitat - Finetooth Shark, Juvenile

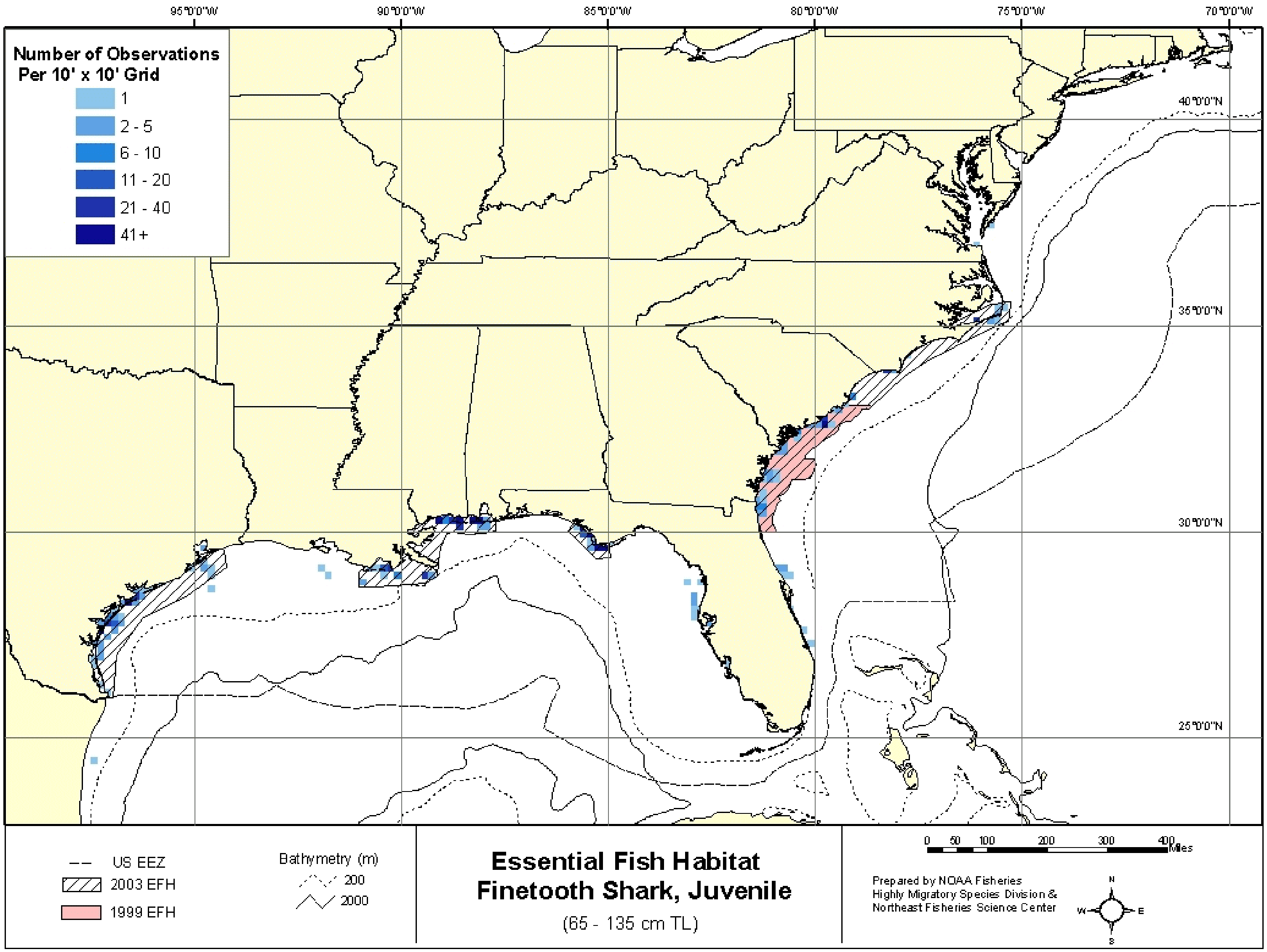

Figure 10.6d Essential Fish Habitat - Finetooth Shark, Adult

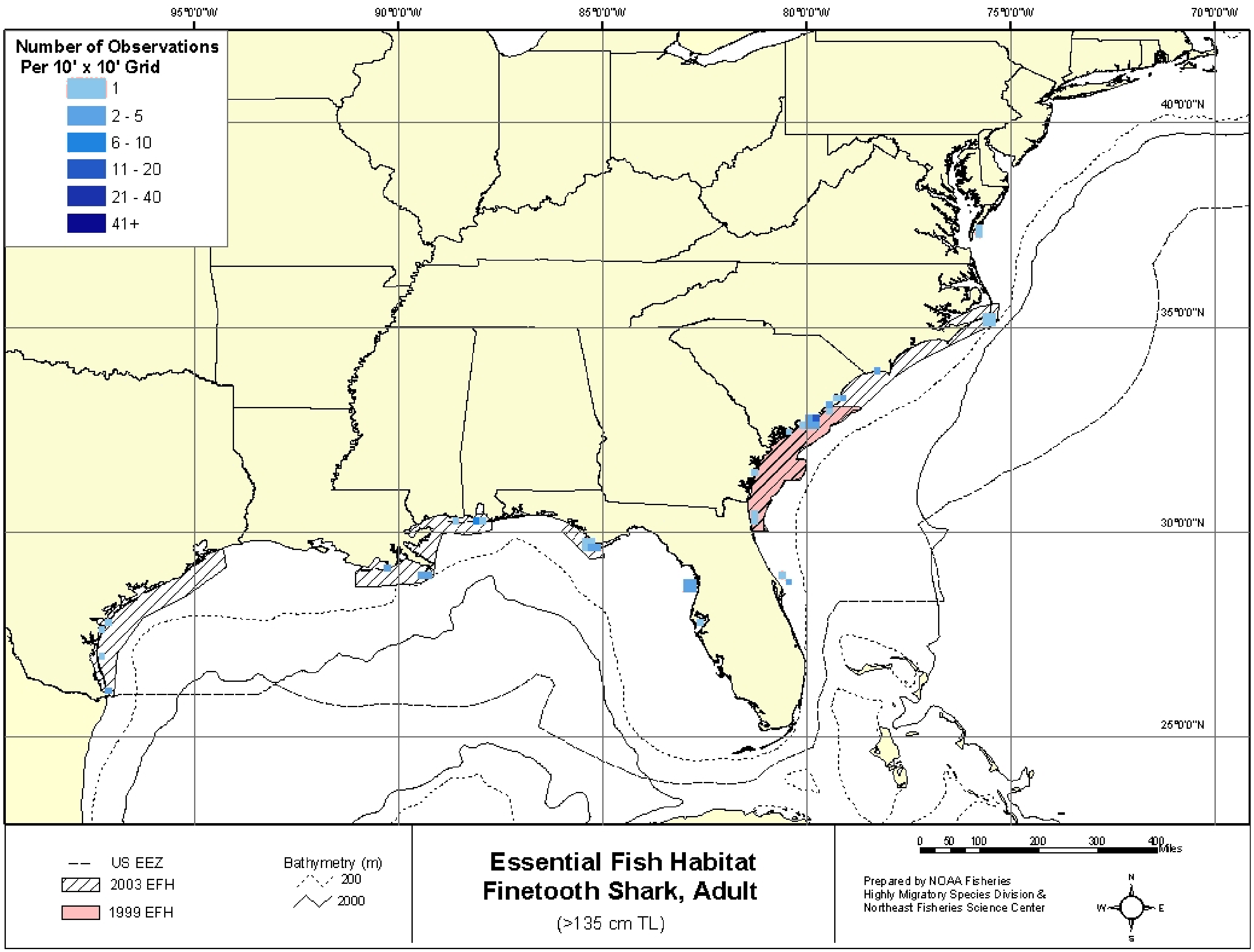

Table 10.8 List of Data Sources and Contacts Used to Update EFH Information.

American Littoral Society
Contact info: Pam Carlsen, 732-291-0055, The American Littoral Society, Sandy Hook, Highlands, NJ 07732

Cooperative Atlantic States Shark Pupping and Nursery Areas (COASTSPAN)
Contact info: Cami McCandless, Apex Predators Program, NMFS Narragansett Lab, 28 Tarzwell Drive, Narragansett, RI 02882

Cooperative Tagging Center
Contact info: Eric Prince, 305-361-4248, ext. 248 eric.prince@noaa.gov, Southeast Fishery Science Center, Room 320A, 75 Virginia Beach Drive, Miami, Florida 33149

Marine Recreational Fisheries Statistics Survey (MRFSS)
Contact info: David Van Voorhees, 301-713-2328, ext.154, dave.van.voorhees@noaa.gov, NMFS, F/ST1, Building SSMC3, Room 12454, 1315 East West Hwy, Silver Spring, MD 20910-3282

NMFS Northeast Longline Shark Survey
Contact info: Lisa Natanson, 401-782-3320, lisa.natanson@noaa.gov, Apex Predators Program, NOAA Fisheries Narragansett Lab, 28 Tarzwell Drive, Narragansett RI, 02882

Mote Center for Shark Research
Contact info: Robert Hueter, 941-388-4441, ext. 323, rhueter@mote.org, Center for Shark Research, Mote Marine Laboratory, 1600 Ken Thompson Pkwy, Sarasota, FL 34236.

NOAA Fisheries Cooperative Shark Tagging Program
Contact info: Nancy Kohler, 401-782-3332, nancy.kohler@noaa.gov, Apex Predators Program, NOAA Fisheries Narragansett Lab, 28 Tarzwell Drive, Narragansett, RI 02882

NOAA Fisheries Southeast Longline Shark Survey
Contact info: Mark Grace, 228-762-4591, ext. 281, mgrace@triton.pas.nmfs.gov, Southeast Fisheries Science Center, Pascagoula Laboratory, P.O. Drawer 1207, Pascagoula, MS 39567

Pelagic Longline Logbook (Fisheries Logbook System)
Contact info: John Poffenberger, 305-361-4263, ext. 235, john.poffenberger@noaa.gov, Southeast Fishery Science Center, Room 201, 75 Virginia Beach Drive, Miami, Florida 33149

Pelagic Observer Program
Contact info: Dennis Lee, 305-361-4247, ext. 247 dennis.lee@noaa.gov, Southeast Fishery Science Center, Room 324, 75 Virginia Beach Drive, Miami, Florida 33149

SCDNR Marine Game Fish Tagging Program
Contact info: Robert Wiggers, 843-953-9363, SCDNR Marine Game Fish Tagging Program, Office of Fisheries Management, P.O. Box 12559, Charleston, SC 29422

Shark Observer Program.
Contact info: George Burgess, 352-392-2360, gburgess@flmnh.ufl.edu, Florida Museum of Natural History-Division of Fishes, University of Florida, Gainesville, FL 32611
Southern Atlantic SEAMAP Shallow Water Trawl Survey
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Virginia Insitutue of Marine Science Longline Survey
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