SHARK NURSERY GROUNDS AND ESSENTIAL FISH HABITAT STUDIES

GULFSPAN GULF OF MEXICO-FY08
Cooperative Gulf of Mexico States Shark Pupping and Nursery Survey

REPORT TO NOAA FISHERIES, HIGHLY MIGRATORY SPECIES DIVISION

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National Marine Fisheries Service Panama City Laboratory Contribution 09-02

BACKGROUND

Declines in some US shark populations have been documented (NMFS 2006, NMFS 2007), necessitating the implementation of management and conservation measures. The importance of identifying shark nursery areas has increased in recent decades with the mandate to incorporate essential fish habitat (EFH) in all Fishery Management Plans (USDOC 2007). The increased use of EFH in management plans has recognized that all stages in a species life cycle are important, not just those stages vulnerable to exploitation. Thus, better understanding of those habitats or regions that serve as nurseries should improve shark conservation and management (USDOC 2007). Research on shark nursery areas has increased (McCandless et al., 2007); however, many areas along the US gulf-coast lack detailed information (NMFS, 2008).

The cooperative Gulf of Mexico Shark Pupping and Nursery (GULFSPAN) survey began in 2003 to examine the distribution and abundance of juvenile sharks in coastal areas. The ultimate intent of this survey is to further describe shark EFH. NOAA Fisheries Panama City Laboratory oversees the survey. This year, other participants included the Florida Natural History Museum at the University of Florida, Florida State University's Coastal and Marine Laboratory, Dauphin Island Sea Laboratory (Alabama), the University of Southern Mississippi's Gulf Coast Research Laboratory, and the School of the Coast and Environment at Louisiana State University. This report describes results from the GULFSPAN survey for 2008.

METHODS

All participating institutions modeled fishery independent surveys after those developed by Carlson and Brusher (1999) to provide a direct comparison of abundance among areas. A gill net consisting of six different mesh size panels was used for sampling in all areas by all participants. Stretched mesh sizes ranged from 7.6 cm (3.0") to 14.0 cm (5.5") in steps of 1.3 cm (0.5"). Each panel was 3.0 m (10 ft) deep and 30.5 m (100 ft) long. Panels were strung together and fished as a single gear.

The gear was randomly set within each area based on depth strata and GPS location. The Florida State University Coastal Marine Laboratory fished experimental longlines concurrently with gillnets (See Section 2 for gear specifics).

Captured sharks were measured (pre-caudal, PCL; fork, FL; total, TL; and stretched total length, STL in cm), sexed, and life history stage assessed and recorded (young-of-the-year, juvenile, or adult). Sharks in poor condition were sacrificed for life history studies and those in good condition were tagged and released. Captured rays were measured in disc width (DW in cm) and sexed. Because of the limited life history information for most ray species, a life history category could not always be assigned.

For each set of the gear, mid-water temperature (^{o}C), salinity, and dissolved oxygen (mg l^{-1}) were recorded from a YSI-85 environmental meter. Average depth (m) was calculated using gear start and end points recorded from the vessel's depth finder. Water clarity (depth of the photic zone) was measured by secchi disc (cm) and qualitative habitat type (e.g., mud, sand, oyster, etc.) was determined by personal observation or previously documented literature.

Catch-per-unit-effort of each set was defined as the number individuals caught divided by the soak time of the net (CPUE = animals caught per net hour). Nets were typically fished between 0.5-1.0 hours.

RESULTS AND DISCUSSION

1. Northwest Florida (NOAA Fisheries Panama City Laboratory)

Sampling sites were located in five major areas along the panhandle of Florida: St. Andrew Bay, Crooked Island Sound (Figure 1), St. Joseph Bay, the Gulf of Mexico-side of St. Vincent Island, and Apalachicola Bay, FL (Figure 2). A total of 128 sets were made, capturing eleven species of sharks and four species of rays. More than 74% of individuals encountered were immature.

Abundance trends

Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, a member of the small coastal management group, was the most abundant shark captured (females: 25.5-85.5 cm FL, mean = 45.3 cm FL and males: 23.0-89.0 cm FL, mean = 60.2 cm FL). Blacktip shark, *Carcharhinus limbatus*, was the second-most abundant species captured overall and the most abundant species captured from the large coastal shark management group (females: 47.0-105 cm FL, mean = 66.4 cm FL and males: 49.0-105 cm FL, mean = 69 cm FL). Bonnethead shark, *Sphyrna tiburo*, was the third-most abundant shark species encountered (females: 36.0-91.0 cm FL, mean = 63.4 cm FL and males: 34.5-75.5 cm FL, mean = 56.4 cm FL). Scalloped hammerhead shark, *S. lewini* (females: 33.5-64.0 cm FL, mean = 42.9 cm FL and males: 31.5-66.0 cm FL, mean = 45.9 cm FL) was the fourth-most abundant shark species encountered. Sharks caught in relatively the same abundance were blacknose shark, *C. acronotus* (females: 36.5-44.0 cm FL, mean = 38.8 cm FL and males: 34.0-98.0 cm FL, mean = 65.3 cm FL), spinner shark, *C. brevipinna* (females: 53.0-80.0 cm FL, mean = 65.5 cm FL and males: 53.0-100 cm FL, mean = 72.5 cm FL), and finetooth shark, *C. isodon* (females: 49.0-91.0 cm FL, mean = 71.0 cm FL and males: 42.0-110 cm FL, mean = 90.5 cm FL). Shark caught in low abundance (<5) included the Florida smoothhound, *Mustelus norrisi* (4 females: 39.0-53.0 cm FL, mean = 45.5 cm FL), the sandbar shark, *C. plumbeus* (2 females: 84.0 and 97.0 cm FL and 1 male: 76.5 cm FL), the bull shark, *C. leucas* (2 males: 89.0 and 141.5 cm FL), and the great hammerhead, *S. mokarran* (2 females: 174 cm FL and 200 cm TL).

Cownose ray, *Rhinoptera bonasus*, was the most abundant ray captured (females: 48.0-102 cm DW, mean = 90.7 cm DW and males: 42.5-97 cm DW, mean = 75.9 cm DW). Two smooth butterfly ray, *Gymnura micrura* (1 female: 28.5 cm DW and 1 male: 25.5 cm DW), and two southern stingray, *Dasyatis americana* (1 female: 20 cm DW and 1 male: 25.5 cm DW) were also captured.

Catch-per-unit-effort by area

St. Andrew Bay is a relatively large bay system that shares one opening with the Gulf of Mexico (Figure 1). This area is highly influenced by land use and development, recreational boat traffic, commercial shipping, and military operations. Habitats here include muddy, sandy bottoms as well as shallow seagrass beds and oyster. CPUE was relatively low in St. Andrew Bay. Young-of-the-year and juvenile Atlantic sharpnose (Table 1a), juvenile blacknose (Table 1b), and juvenile blacktip shark (Table 1c) were the only species encountered in this area. Juvenile Atlantic sharpnose shark was the most encountered species-life stage (0.20 sharks net hr^{-1}).

Crooked Island Sound is approximately 11 nautical miles south and east of St. Andrew Bay. This area is an undeveloped (bordered by Tyndall Air Force Base), relatively small and shallow (deepest point inside mouth is ~5 m at high tide) barrier island system that shares one opening with the Gulf of Mexico (Figure 1). This area receives a moderate amount of recreational boat traffic and military operations. Habitat here is characterized by sandy, muddy bottom with seagrass beds along the perimeter. Crooked Island Sound had the highest species diversity of all areas sampled in northwest Florida. Twelve of fourteen species encountered overall were encountered in this small bay. CPUE in this area was highest for juvenile Atlantic sharpnose (3.19 sharks net hr^{-1}), followed by young-of-the year Atlantic sharpnose (1.50 sharks net hr^{-1}), adult Atlantic sharpnose (1.48 sharks net hr^{-1}) (Table 1a), and young-of-the-year scalloped hammerhead (1.02 sharks net hr^{-1}; Table 1j). Other species-life stages encountered in Crooked Island Sound were: all stages of blacknose (Table 1b) and bonnethead (Table 1d), young-of-year and juvenile blacktip (Table 1c), juvenile bull (Table 1e), juvenile and adult cownose ray (Table 2a), juvenile and adult finetooth (Table 1f), young-of-the-year and juvenile spinner (Table 1k). Species only encountered in Crooked Island Sound were the great hammerhead (Table 1h) and smooth butterfly ray (Table 2c).

St. Joseph Bay is a relatively large, relatively undeveloped bay system approximately 20 nautical miles south and east of Crooked Island Sound. Bordered by the town of Port St. Joe, Cape San Blas, and St. Joseph Peninsula State Park, this bay receives a moderate amount of recreational boat traffic and commercial shipping. St. Joseph Bay has the highest habitat diversity of all the areas sampled in northwest Florida. The eastern section is characterized by sandy, muddy bottom, especially the area around the Gulf County Canal. The middle of St. Joseph Bay is relatively deep (~11 m) and characterized by muddy bottom. The western section is characterized by shallow seagrass beds and sand flats that drop steeply to depths greater than 5 m approximately 200 m from shore. The southern-most section (south of Blacks Island) is characterized by shallow seagrass beds and sand flats (less than 1 m depth). Unfortunately, this section of the bay was not sampled due to the shallow depth and draft of the research vessel. CPUE was highest for juvenile (2.96 sharks net hr^{-1}), followed by adult (1.96 sharks net hr^{-1}), and young-of-the-year (0.67 sharks net hr^{-1}) Atlantic sharpnose (Table 1a). Other species-life stages encountered in St. Joseph Bay included: all stages of blacknose (Table 1b), blacktip (Table 1c), and bonnethead (Table 1d), adult cownose ray (Table 2a), young-of-the-year and adult finetooth (Table 1f), and young-of-the-year and juvenile spinner (Table 1k).

The two remaining areas sampled by the NOAA Fisheries Panama City Laboratory were located in the western Apalachicola Bay system: the gulf-side of St. Vincent Island from West Pass to Indian Pass and inside Apalachicola Bay around Indian Pass and from West Pass to Sikes Cut (Figure 2). The Apalachicola Bay system is a large, river influenced, highly productive, relatively untouched, shallow barrier island system; the total aquatic area is about 63,000 hectares. Benthic habitat on the gulf-side of St. Vincent Island is generally uniform and characterized by a mix of clay, sand, and mud over a limestone bottom (Livingston 1984). Habitat inside the bay is variable from shallow seagrass flats on the backside of St. George Island and Sikes Cut to a mix of clay, sand, and mud over limestone and large oyster shoals around St. Vincent Island. On the gulf-coast of St. Vincent Island, CPUE was highest for adult Atlantic sharpnose (2.81 sharks net hr^{-1}), followed by juvenile blacktip (2.45 sharks net hr^{-1}), young-of-the-year Atlantic sharpnose (1.59 sharks net hr^{-1}), and young-of-the-year blacktip (1.43 sharks net hr^{-1}). Other species encountered on the gulf-side of St. Vincent Island included: juvenile Atlantic sharpnose (Table 1a), adult blacknose (Table 1b), and all stages of bonnethead (Table 1d) and finetooth (Table 1f). Inside Apalachicola Bay, CPUE was highest for juvenile blacktip (2.28 sharks net hr^{-1}). Other species encountered inside the bay system included: all stages of Atlantic sharpnose (Table 1a) and bonnethead

(Table 1d), young-of-the-year blacktip (Table 1 b), juvenile bull (Table 1e), finetooth (Table 1f), and sandbar (Table 1i), and young-of-the-year scalloped hammerhead (Table 1j).

Catch-per-unit-effort by month and life stage

CPUE trends were examined by month and life stage (all areas combined) for the four most abundant shark species captured overall: Atlantic sharpnose (Figure 3a), blacktip (Figure 3b), bonnethead (Figure 3c), and scalloped hammherhead shark (Figure 3d). No batoid species were examined this year due to low catches overall.

CPUE was highest for young-of-the-year Atlantic sharpnose in April. This spike is seen every year, representing young-of-the-year recruitment to estuaries in northwest Florida. Juvenile CPUE was relatively high (>1.0 sharks net hr^{-1}) throughout the summer and early fall. Adult Atlantic sharpnose CPUE was highest in the early summer (May and June), representing adult movement into the estuaries to pup and mate (Carlson and Brusher 1999). Adult males were found in the estuaries throughout the year; however, only two adult female Atlantic sharpnose were encountered in 2008 (1 in St. Joseph Bay in May and 1 in Crooked Island Sound in June). This gives further evidence that adult female Atlantic sharpnose sharks spend very little time within these estuaries, possibly pupping offshore.

No adult blacktip sharks were encountered using gillnets in 2008 in northwest Florida. CPUE spiked in May and June and again in September for juvenile blacktip. This trend was similar to the previous year. Young-of-the-year blacktip CPUE was highest in the fall (September and October). This trend is likely due to generally cooler water temperature experienced during these months (on average 7 ^{o}C cooler than in June and July).

Adult bonnetheads were encountered in all months, except June, with a spike in CPUE in May and a steady decrease for the remainder of the season. Juvenile bonnethead CPUE steadily increased throughout the spring and summer, peaked in July, and decreased through October. CPUE for young-of-the-year bonnetheads was highest in April and August. This trend is very different than in years past and could be due in part to the large amounts of rain (and thus variable salinity) experienced in 2008. Overall, salinity was more variable in 2008 than in 2007 (between 32-36 in 2007, between 26-34 in 2008).

No adult and very few juvenile scalloped hammerhead sharks were encountered in 2008 (n=10, 9 encountered in May). CPUE for young-of-the-year scalloped hammerhead was highest in June.

Catch-per-unit-effort by time period

Again in 2008, sampling times were expanded in Crooked Island Sound. Following Carlson and Bethea (2006), sampling was broken into three periods: dawn (0400-0900), day (0900-1500), and dusk (1500-2100). CPUE trends by time period were examined by species-life stage of the four most abundant species encountered in Crooked Island Sound (Figure 4) and by species (life stages combined) for all remaining species collected in this area (Figure 5).

Juvenile Atlantic sharpnose CPUE showed clear increases during Dawn and Dusk, while adult CPUE was highest during Dawn, and young-of-the-year CPUE increased continually over the entire time period (Figure 4a). Juvenile blacktip CPUE was highest during Dusk while young-of-the-year CPUE was highest during Dawn (Figure 4b). Adult bonnetheads were more likely encountered during Dawn or Day. Juvenile bonnethead CPUE increased continually over the entire time period while young-of-the-year CPUE spiked during Dawn (Figure 4c). Young-of-the-year scalloped hammerheads were not specific to any certain time of day and juveniles were not seen during Dusk (Figure 4d).

Blacknose shark CPUE increased over the time period, with no encounters during Dawn and the most encounters during Dusk (Figure 5a). Cownose rays were only encountered during Day (Figure 5b). Finetooth sharks were only encountered during Dawn (Figure 5c) while Florida smoothhounds were only encountered during Dusk (Figure 5d). Spinner shark CPUE was highest during Dawn, with similar CPUE for Day and Dusk (Figure 5e).

Species essential fish habitat profiles

Essential fish habitat (EFH) profiles for elasmobranchs collected in northwest Florida are summarized in Tables 3-17. The majority of sharks collected were immature; therefore, areas in northwest Florida remain important potential nurseries for both large and small coastal shark species (Tables 3-13). In general, young-of-the-year sharks were more often collected in shallower water with higher temperature, lower salinity, and more turbid conditions compared to juveniles and adults. Small, young sharks may select these habitats as a haven from larger, more active predators. Except for cownose ray, EFH requirements for ray species were sparse (Tables 14-17). Data for cownose rays continues to suggest that these animals can tolerate a wide range of all environmental factors (Table 14).

In an attempt to better refine EFH, the long-term data series available at the NOAA Fisheries Panama City Lab (2003-2008) was used to examine the relationship of CPUE with several environmental factors. Following Forney (2000), generalized additive models were used to examine the relationship between temperature, salinity, turbidity/water clarity, and dissolved oxygen and CPUE by life stage of most abundant species encountered (Atlantic sharpnose, blacktip, bonnethead, and scalloped hammerhead shark).

Adult Atlantic sharpnose CPUE showed significant correlation with turbidity/water clarity (Figure 6; p=0.027, 125-250 cm) and salinity (Figure 7; p=0.041, 30-35). Juvenile blacktip CPUE showed significant correlation with turbidity/water clarity (Figure 8; p=0.003, 150-300 cm). When all life stages were combined, bonnethead CPUE significantly correlated with salinity (Figure 9, p=0.031, 32-35) and scalloped hammerhead CPUE significantly correlated with turbidity/water clarity (Figure 10; p=0.042, 150-250 cm). It should be noted that the majority of the scalloped hammerhead encountered throughout the dataset were young-of-the-year.

EFH profiles could co-vary with area. In the future, we plan to examine this relationship as well as anthropogenic influences such as the level of urban development and land use surrounding the bays were we conduct surveys.

Age, Growth, and Reproduction

Finetooth, blacktip, and sandbar sharks are being collected for age, growth and reproductive analysis through GULFSPAN surveys, the shark bottom longline observer program (SBLOP), and the shark gillnet fishery observer program (SGFOP). Samples obtained from observer programs are collected from fishery-dependent offshore longlines or gillnets and are generally comprised of larger animals while samples obtained from GULFSPAN surveys are collected from fishery-independent gillnets in coastal waters and are generally comprised of smaller animals.

Life history estimates for the finetooth shark have previously been described for the Gulf of Mexico (Carlson et al. 2003), but reproductive periodicity and fecundity have not been not assessed. In 2007 the Small Coastal Complex (SCC) Southeast Data Assessment and Review (SEDAR) was unable to perform a species-specific assessment of the finetooth shark due to data deficiency (NMFS, 2006). To ensure proper management, specific recommendations made by SCC SEDAR scientists included a mandate for more species-specific life history information for this species.

Blacktip and sandbar sharks are the two main shark species landed in the U.S. commercial shark fishery. In 2004 the Large Coastal Complex (LCC) SEDAR found blacktip sharks were not overfished and overfishing was not occurring. However, a recent review has prompted concern about the status of the stock and called for a revision of the current life history demographics (NMFS, 2007). Conversely, the LCC SEDAR found sandbar sharks to be overfished with overfishing occurring; therefore, the species was placed on the prohibited list and a revision of the current life history demographics was requested.

2. Turkey Point, Florida (Florida State University)

The distributions of the 25 gillnet and 11 longline sets conducted by FSUCML in 2008 is shown in Figure 9. Initial GULFSPAN sampling in Turkey Point and St. George Sound in 2008 was a collaborative effort between biologists from the Florida State University Coastal Marine Laboratory

(FSUCML) and the NOAA Fisheries Panama City Laboratory. Fourteen gillnet sets were fished in mid-June in this effort. Station locations were chosen haphazardly between Dog Island and Alligator Point. FSUCML was an unfunded GULFSPAN partner in 2008; therefore, subsequent sampling was limited (8 sets in July and 3 sets in late September and October) and was concentrated near the laboratory, primarily between Turkey Point Shoal and Dog Island Reef.

Experimental longlines designed to capture all size classes of coastal sharks were fished concurrently with each of the final 11 gillnet sets. A standard set in the FSUCML longline survey included 100 demersal gangions spaced at twenty-meter intervals along a mainline made of 6.4 mm tarred and twisted nylon. Each end of the mainline is anchored and marked with a large buoy bearing the number of the FWC Special Activity License permitted for the project. The line was composed of four 25-hook sections separated by buoys and a unique hook size was employed within each section. The total length of a standard set was approximately 2,100 meters. Four sizes of Mustad circle hooks (10/0, 12/0, 14/0, and 16/0) were used to minimize size-selection bias and allow capture of all sharks present from the smallest neonate sharks to the largest adult sharks. Each gangion began with a stainless steel tuna clip attached to two-meters of monofilament (136kg test for 10/0, 12/0 and 14/0 hooks and 318kg test for the 6/0 hooks). The monofilament was crimped to an 8/0 stainless steel barrel swivel followed by a one-meter section of 7x7 stainless-steel aircraft cable (1.8mm for 10/0, 12/0, and 14/0 hooks; 2.2mm for 16/0 hooks). Each gangion was terminated by a circle hook crimped to the steel cable. Hooks were baited with local fish with high oil content, primarily Spanish mackerel (*Scomberomorus maculatus*) and menhaden (*Brevoortia* spp.). Each set soaked for one to three hours from first hook in the water until last hooked removed from the water. Baits were typically lost in the first soak hour, therefore soak time was not considered in calculating catch rates.

In total, 439 sharks from nine species were caught. Gillnets captured 292 sharks from five species while longlines captured 147 sharks from seven species. Only one batoid, a cownose ray (*R. bonasus*), was captured in the gillnets and no batoids were captured on the longlines. Catch per unit of effort summaries are provided for all ten species of elasmobranchs captured in Table 18. Sampling in 2008 revealed that this region of Apalachicola Bay serves as a primary nursery, as evidenced by the presence of young-of-the-year individuals, for at least five species of sharks. This included three small coastal species (Atlantic sharpnose sharks, *R. terraenovae;* bonnethead sharks, *S. tiburo*; and blacknose sharks, *C. acronotus*) and two large coastal species (blacktip sharks, *C. limbatus*; and spinner sharks, *C. brevipinna*).

Abundance trends

Atlantic sharpnose sharks (7.77 sharks net hr^{-1}; Table 18a) and bonnethead sharks (3.01 sharks net hr^{-1}; Table 18d) combined for 98.3% of the shark catch in gillnets. Lengths of captured Atlantic sharpnose sharks (33.0-85.0 cm FL, mean = 61.8 cm FL) and bonnethead sharks (37.5-85.0 cm FL, mean = 61.8 cm FL) were very similar. Catch of Atlantic sharpnose sharks comprised primarily of juvenile and adult males while catch of bonnethead sharks was dominated by juvenile females. Only five sharks of other species were captured in gillnets, including one young-of-the-year and one adult blacknose shark (39.0 and ~80.0 cm FL; Table 18b), two juvenile blacktip sharks (92.5 and 101.5 cm FL; Table 18c), and one young-of-the-year spinner shark (56.0 cm FL; Table 18j).

Atlantic sharpnose sharks were also the dominant species in the longline catch (57% of total) and were captured at comparable rates (7.64 sharks 100-hooks^{-1}) to the gillnets. However, the length frequencies and mean lengths (25.5-86.0 cm FL, mean = 54.1 cm FL) differed between gear types, reflecting the fact that young-of-the-year Atlantic sharpnose sharks were far more common on the longline than in gillnets. Most Atlantic sharpnose sharks captured on the longlines were males (84.5%) and most of the females captured (10 of 13) were young-of-year. Bonnethead sharks, the second most common species in gillnet catches, were entirely absent from the longline catches. Blacktip sharks and blacknose sharks, which were rare in the gillnet catches were common in the longline catches. Blacktip sharks were the second most common species caught on the longlines (44.0-140.0 cm FL, mean = 92.6

cm FL) and included all life stages of both sexes. Blacknose sharks were the third most common shark caught on longlines (35.0-94.0 cm FL, mean = 82.7 cm FL) and most (70.3%) were adult males. Six sharks of other species were caught on the longlines. One juvenile female (140 cm FL) and two adult male (184 and 187 cm FL) nurse sharks, *Ginglymostoma cirratum*, were captured (Table 18i). One adult female (100 cm FL; Table 18g) finetooth shark, *C. isodon*, one juvenile male (152 cm FL; Table 18e) bull shark, *C. leucas*, and one juvenile male (137 cm FL; Table 18h) great hammerhead shark, *S. mokarran*, were also captured.

Species essential fish habitat profiles

The essential fish habitat profiles for sharks in Turkey Point area are summarized in Tables 19-28. This region clearly includes habitats that serve as important primary and secondary nurseries for several species of large coastal and small coastal sharks. All life stages of Atlantic sharpnose sharks except adult females were found in all habitats sampled. All life stages of bonnethead sharks were most common in seagrass habitats. All life stages of blacktip sharks and blacknose sharks were typically captured on the edges of muddy and sandy channels and ledges adjacent to seagrass habitats. Most sampling during 2008 was conducted during June and July when water temperature and salinity are relatively stable. However, limited sampling in late September and early October suggest emigration begins when water temperatures drop below 25°C. Shark catch rates in the gillnets were high in June (10.75 sharks net-hr^{-1}) and July (13.86 sharks net-hr^{-1}) when water temperatures were above 28°C but were much lower in late September and October (4.43 sharks net-hr^{-1}) when water temperatures were between 22°C and 25°C. Similarly, longline catch rates were much higher in July (16.75 sharks 100-hooks^{-1}) than in September and October (4.00 sharks 100-hooks^{-1}).

3. Cedar Key Region, Florida (University of Florida)

Sampling within the Cedar Key region was conducted from July through October 2008. The sampling region is bounded by Horseshoe Beach in the north and Yankeetown to the south out to three nautical miles. This area was divided into three approximately equal areas for sampling: Cedar Key, Suwannee Sound, and Waccasassa Bay (Figure 10). Stations and alternate stations were randomly selected from within the three regions using Hawth's Tools extension for ArcMap. During the sampling period, 29 gillnet sets were made. It should be noted that on August 23, 2008, Tropical Storm Fay passed through this region. Salinity, water temperature, and water clarity were drastically affected by this storm and most likely moved shark and ray species offshore of the sampling areas for some time.

Abundance

A total of 245 sharks consisting of five species were captured and five batoids consisting of three species were captured. Shark species captured were bonnethead shark, *S. tiburo,* blacktip shark, *C. limbatus,* Atlantic sharpnose shark, *R. terraenovae,* scalloped hammerhead, *S. lewini*, and blacknose shark, *C. acronotus*. Batoid species encountered were cownose ray, *R. bonasus*, southern stingray, *D. americana,* and spotted eagle ray, *A. narinari*.

The most abundant shark encountered was the bonnethead shark (females: 37.5-82.0 cm FL, mean = 57.2 cm FL and males: 24.6-80.0 cm FL, mean = 58.5 cm FL; Table 29d). Bonnetheads accounted for 46% of the total shark catch. Adults were most abundant in the Cedar Key area, while young of the year were most abundant in the Suwannee sound area. Atlantic sharpnose sharks accounted for 38% of the shark catch and were most abundant in the Suwannee Sound area (females: 33.9-47.5 cm FL, mean = 38.8 cm FL and males: 28.6-82.0 cm FL, mean = 62.4 cm FL; Table 29a). Blacktip sharks accounted for 15% of the total shark catch and were most abundant in the Waccasassa Bay area (females: 52.5-108.0 cm FL, mean = 64.7cm FL and males: 45.7-113.0 cm FL, mean = 67.4 cm FL; Table 29c). One blacknose shark (female, 38.5 cm FL) and one scalloped hammerhead (male, 58.9 cm FL) were caught as well (Table 29b, e).

Only five rays were caught during the sampling period (Table 30). Two cownose rays (1 female, 72.6 cm DW; 1 male, 43.5 cm DW) and two spotted eagle rays (1 female, 57.0 cm DW; 1 male 52.4 cm DW) were captured in the Cedar Key area. One southern stingray (unknown sex, not measured) was captured in the Waccasassa Bay area.

Species Essential Fish Habitat Profiles

The essential fish habitat profiles for sharks in the Cedar Key region area are summarized in Tables 31-34.

The predominant bottom types where sharks were caught were hard mud and seagrass. Immature bonnethead sharks were encountered over hard mud substrate while immature blacktips were encountered over seagrass habitat. Both immature and adult Atlantic sharpnose sharks were captured most often over hard mud substrate.

Mean water temperature, salinity, and dissolved oxygen were similar for all shark species caught (Tables 31-34). Bonnethead sharks were found in the widest range of salinities (22.2-33.2) and adult bonnethead sharks were found in the widest range of temperatures (24.7-31.0 ^{o}C; Table 33); whereas, blacktip sharks were not encountered in salinities below 28.1 (Table 32). Only five rays were captured and in relatively the same environmental factors (Table 34).

The Cedar Key region provides potential nursery habitat to most of the species encountered. Immature blacktip sharks prefer higher salinity and seagrass habitat within the region. Immature Atlantic sharpnose sharks (Table 31) and bonnetthead sharks preferred mud substrate and a wide range of salinities (Table 33). More data is needed to refine habitat preferences and possible habitat partitioning between species. It is likely that the small coastal sharks occupy lower salinity water to avoid predation by larger blacktip sharks in the region.

4. Alabama (University of South Alabama)

Funds were provided to sample in waters off Point Aux Pins and the west end of Dauphin Island

(Mississippi Sound), Little Dauphin Island, and Pelican Bay (Mobile and Perdido Bay (Figure 10). A total of 94 sets were made from April to October, 2008.

Catch rates

In Alabama waters, seven species of shark were collected. Over 90% of individuals collected were immature. The Atlantic sharpnose shark, *R. terraenovae*, was the most abundant species caught (females: 30.5-84.7 cm FL, mean = 50.2 cm FL and males: 27.5-85.0 cm FL, mean = 53.4 cm FL; Table 35a). Other shark species collected were (in descending order of abundance): finetooth, *C. isodon*, (females: 42.0-78.5 cm FL, mean = 62.4 cm FL and makes: 47.0-102.5 cm FL, mean = 66.1 cm FL, Table 35e), bonnethead, *S. tiburo* (females: 61.0-87.0 cm FL, mean = 73.1 cm FL and males: 60.5-78.0 cm FL, mean = 68.3 cm FL, Table 35c), blacktip, *C. limbatus* (females: 48.0-92.0 cm FL, mean = 66.6 cm FL and males: 46.0-93.0 cm FL, mean = 69.4 cm FL, Table 35b), bull, *C. leucas* (females: 55.5-62.0 cm FL, mean = 58.8 cm FL and males: 75.0-105.8 cm FL, mean = 80.5 cm FL, Table 35d) and scalloped hammerhead shark (females: 39.5-49.0 cm FL, mean = 45.5 cm FL and males: 39.5-51.5, mean = 45.4 cm FL, Table 35f). In addition, one immature male spinner shark, *C. brevipinna*, was captured (FL = 74 cm, Table 35g).

In general, shark abundance was higher in western sites (Mississippi Sound) than middle or eastern sites (Mobile Bay, Perdido Bay). The highest CPUE for sharks was observed at the West End of Dauphin Island (4.7 ± 1.4 sharks net hr $^{-1}$) and was primarily comprised of large catches of juvenile Atlantic sharpnose shark and juvenile and adult bonnethead. The second highest CPUE was observed at Point Aux Pins (2.0 ± 0.7 sharks net hr $^{-1}$), where juvenile finetooth shark dominated the catch. CPUE remained high for Atlantic sharpnose shark at Point Aux Pins, though a greater majority of young-of-the-year animals were encountered there. Bull sharks were most commonly caught at Point Aux Pins and were rare in other locations. A relatively high catch for young-of-the-year Atlantic sharpnose sharks was also observed to the east at Little Dauphin Island, though CPUE for all sharks was reduced (0.90 ± 0.37

sharks net hr $^{-1}$). Interestingly, no finetooth sharks were caught off of Little Dauphin Island in 2008, despite high catches in this region over previous years (Bethea et al., 2008; Parsons and Hoffmayer, 2007). Pelican Bay produced even lower overall CPUE for sharks (0.73 ± 0.26 sharks net hr $^{-1}$), but had the highest CPUE for scalloped hammerhead sharks. The majority of scalloped hammerheads captured were young-of-the-year, supporting previous research that Dauphin Island may serve as a nursery ground for this species (Parsons and Hoffmayer, 2007). Though effort was greatly reduced in the eastern sites, no sharks were caught in Perdido Bay or Bayou St. John throughout the sampling period (April-October). The lack of shark abundance in this eastern region is not yet understood.

A total of 67 rays were caught, 90% of which were immature. The most abundant species caught was the cownose ray, *R. bonasus* (n=53, females: 29.4- 86.0 cm DW, mean = 48.5 cm and males: 35.0 - 75.2 cm DW, mean = 55.1 cm DW; Table 36b), followed by the Atlantic stingray, *D. sabina* (n=12, females: 21.0 - 28.0 cm DW, mean = 24.9 cm DW and males: 14.5 - 30.5 cm DW, mean = 22.5 cm DW; Table 36a), and southern stingray, *D. americana* (n=7, females: 19.5 cm DW and males: 18.5 - 65.5 cm DW, mean = 42.0 cm DW; Table 36c). Cownose rays were captured across all regions, but were most abundant at Point Aux Pins and Perdido Bay mostly due to the high catches of young-of-the-year in the mid-to-late summer and early fall. Cownose ray CPUE was reduced at the West End of Dauphin Island and Pelican Bay, though large aggregations of adults are commonly seen at both of these locations outside the sampling period during March and November (M.J. Ajemian, pers. obs). Southern stingrays appeared to be more constrained to higher saline regions and were most commonly encountered in the sand and seagrass flats of Bayou St. John. Atlantic stingrays were relatively uncommon, but most often encountered across western sites in a variety of habitats.

Species Essential Fish Habitat Profiles

For Atlantic sharpnose sharks, juveniles were encountered over a wider range of environmental parameters than young-of-the-year and adult sharks (Table 37). A continuum of maturity levels was lacking for many species, precluding a comprehensive understanding of habitat partitioning with life stage. However, on average, young-of-the-year Atlantic sharpnose, finetooth, and scalloped hammerhead sharks were encountered in warmer waters with higher turbidity levels than juvenile and adults (Tables 37, 44, 45). The same trend can be seen for cownose ray (Table 41). Bonnetheads were primarily encountered over seagrass habitat, owing to their restricted distribution to the West End of Dauphin Island, where seagrass meadows were denser than in previous years. In this region, bonnethead primarily feed on blue crab (*Callinectes sapidus*) and mantis shrimp (*Squilla empusa*), both of which aggregate in seagrass habitat (M.J. Ajemian, unpub. data). Smaller seagrass beds were also present in Bayou St. John (Perdido Bay), but no sharks were captured there. Bull sharks were most tolerant of low turbidity (mean = 80 cm) and salinity (mean = 20.7) and were captured within the narrowest range of dissolved oxygen levels among all sharks (Table 40). Other shark species seemed to occupy a variety of habitats and environmental conditions.

5. Mississippi (University of Southern Mississippi)

A total of 40 sets at nine sampling stations were performed in Mississippi coastal waters from May to October 2008 (Figure 11).

Catch rates

Six species of shark were collected in Mississippi waters, 60 % of which were immature. Atlantic sharpnose sharks, *R. terraenovae* (females: 36.2 – 41.9 cm FL, mean = 40.5 cm FL and males: 38.7 – 82.0 cm FL, mean = 65.7 cm FL), were the most abundant species caught followed by blacktip, *C. limbatus* (females: 43.0 – 78.0 cm FL, mean = 58.3 cm FL and males: 43.0 – 84.0 cm FL, mean = 61.7 cm FL), finetooth, *C. isodon* (females: 42.2 – 75.8 cm FL, mean = 53.2 cm FL and males: 51.0 – 52.8 cm FL, mean = 51.9 cm FL), bull, *C. leucas* (female: 68.5 cm FL and male: 107.2 cm FL), bonnethead, *S. tiburo* (82.0 cm FL), and spinner, *C. brevipinna*, (61.0 cm FL) sharks. Two species of ray were collected, cownose ray, *R. bonasus* (females: 44.0 – 84.0 cm DW, mean = 60.6 cm DW and males: 43.5 – 82.5 cm DW, mean = 59.6 cm DW), and Atlantic stingray, *D. sabina* (females: 19.7 cm DW and males: 44.6) (Table 47).

Cat Island is situated in the western portion of the Mississippi Sound, approximately seven nautical miles south of Long Beach, Mississippi. Though it forms the western boundary of the Mississippi barrier islands, it is heavy influenced by the Pearl River. Habitat is characterized by a sandy, silty, and muddy bottom with sparse seagrass beds along the parameter. The waters of the western Mississippi Sound north of Cat Island were the most productive area during this study (6.1 ± 1.1 sharks net hr^{-1}). Catch per unit effort was highest for young-of-the-year Atlantic sharpnose (2.95 sharks net hr^{-1}), followed by juvenile Atlantic sharpnose (0.79 shark net hr^{-1}) (Table 47a), young-of-the-year finetooth (0.78 sharks net hr^{-1}; Table 47e), and juvenile blacktip sharks (0.39 shark net hr^{-1}; Table 47b). Other species-life stages encountered included juvenile finetooth (Table 47e), adult bonnethead (Table 47c), and young-of-the-year blacktip sharks (Table 47b). Species only encountered in water surrounding Cat Island only include bonnethead sharks (Table 47c).

Horn Island is situated in the central portion of the Mississippi Sound, approximately 13 nautical miles south of Ocean Springs, Mississippi. It has only a slight influence of freshwater from the Pascagoula River and its habitat consists of sandy, silty, muddy bottom, with grassbeds around the parameter. Horn Island was the second most productive sampling location (4.7 ± 1.5 sharks net hr^{-1}) within Mississippi coastal waters. Catch per unit effort was highest for adult Atlantic sharpnose sharks (6.11 shark net hr^{-1}), followed by juvenile Atlantic sharpnose (0.84 sharks net hr^{-1}) (Table 47a), and juvenile blacktip sharks (0.74 sharks net hr^{-1}; Table 47b).

Round Island is situated in the Mississippi Sound, approximately one nautical mile south of Pascagoula, Mississippi. It has a moderate influence from the Pascagoula River and is surrounded by relatively shallow waters (< 4m). Habitat is characterized by mud, silt, sand, and artificial reef. Round Island was the third most productive site (2.6 ± 0.5 sharks net hr^{-1}), and had the highest species diversity of all area sampling in Mississippi coastal waters. Five of the eight species encountered overall were encountered in this area. Catch per unit effort was highest for adult cownose (0.60 rays net hr^{-1}; Table 48b), followed by young-of-the-year cownose (0.52 rays net hr^{-1}; Table 48b), young-of-the-year blacktip (0.52 sharks net hr^{-1}; Table 47b), juvenile cownose (0.37 rays net hr^{-1}; Table 48b), and young-of-the-year finetooth sharks (0.22 sharks net hr^{-1}; Table 47e). Other species-life stages encountered in waters surrounding Round Island include juvenile bull sharks (Table 47d), and juvenile and adult Atlantic stingray (Table 48a). Species only encountered in waters surrounding Round Island was the Atlantic stingray (Table 48a).

Two locations were sampled in the north central portion of the Mississippi Sound; Deer Island and Davis Bayou. Deer Island is an inshore island situation in the north central Mississippi Sound, approximately 500 m from Biloxi, Mississippi. It sits at the mouth of Biloxi Bay and the surrounding waters are directly influenced by various tributaries that terminate in Biloxi Bay. Habitat is characterized as muddy, silty, sandy bottom with various artificial and natural oyster reefs present in waters to its south. Davis Bayou is a relative small estuarine bayou that is situated just east of Biloxi Bay and Deer Island. The waters of Davis Bayou are relatively shallow (< 1.5 m) and brackish (<15 psu), and its habitat is characterized as mud flat. Catch per unit effort in waters surrounding Deer Island included young-of-the-year cownose rays (0.22 rays net hr^{-1}; Table 48b), and young-of-the-year spinner sharks (0.16 shark net hr^{-1}; Table 47f). Only young-of-the-year bull sharks (0.33 shark net hr^{-1}; Table 47d) were collected in Davis Bayou.

Monthly nominal catch rates typically peaked during the summer and declined during the fall months. Similar to 2007, catch rates were highest during June (7.8 ± 1.5 sharks per net hour) and August (6.1 ± 1.4 sharks per net hour), and declined during September (2.3 ± 0.9 sharks per net hour) and October (0.2 ± 0.2 sharks per net hour).

Species Essential Fish Habitat Profiles

Information on essential fish habitat profiles for the six shark and two ray species were relatively similar (Tables 49-55); however, there were a few interesting observations. The majority of sharks collected in this study were immature, indicating that the Mississippi Sound continues to be a potential nursery area for several shark species. Juvenile and young-of-the-year sharks appeared to prefer the shallow, warmer, lower salinity, and more turbid waters compared to adult sharks. These small sharks may be selecting shallow water habitats, and as a result these waters are warmer and typically have more of a freshwater influence, which lowers both salinity and turbidity.

The bull shark was the only species encountered at Davis Bayou, which isn't surprising given the preference for low salinity by immature life stages (Table 52). Only one bonnethead shark was collected in this study at Cat Island, corresponding with the offshore migration of gravid blue crabs, *Callinectis sapdius*. This is not unusual since blue crabs are the primary prey of bonnethead sharks in this region. The only spinner shark was collected at Deer Island in relatively cooler water (24˚C) (Table 51). The Atlantic stingray and cownose rays are common within the waters of the Mississippi Sound. All rays were collected in waters with relatively high salinity (mean = 24.0; range: 16.0 – 28.8), warm water temperature (mean: 27.7˚C; range: 21.5 – 29.4˚C), high dissolved oxygen content (mean: 6.6 mg/l; range: 4.8 - 6.7 mg/l), and similar bottom type (sand/silt/clay, Table 55).

6. Louisiana (Louisiana State University)

Catch rates

A total of nine sets were made at nine different sampling locations in the coastal waters of Terrebonne Bay, Louisiana (Figure 13). A total of thirty-seven sharks were collected, representing three species, 95 % of which were immature. Blacktip shark, *C. limbatus* (females: 44.5 – 50 cm FL, mean = 47.3 cm FL and males: 44 – 52.5 cm FL, mean = 48.2 cm FL) was the most abundant species caught followed by Atlantic sharpnose, *R. terraenovae* (males: 27.5 – 81 cm FL, mean = 50.1 cm FL), and finetooth shark, *C. isodon* (females: 43.5 cm, FL and males: 40 – 44.5 cm FL, mean = 42.3 cm FL). Several cownose rays, *R. bonasus* (40.0-62.0 cm, DW) were also collected during this study period, and tagged and released. The CPUE for sharks and rays by species and life history stage is summarized in Table 56.

Species Essential Fish Habitat Profiles

Essential fish habitat requirements for all elasmobranch species collected in Terrebonne Bay were relatively similar (Tables 57-60). Since the overwhelming majority of life stages of sharks collected were young-of-the-year and juvenile (95%), the areas sampled in Terrebonne Bay appear to be important nursery habitats for both large and small coastal shark species. Thompson et al. (2002) found similar results in a previous 3-year study of sharks in coastal Louisiana with immature stages making up 80-90% of sharks captured. Only two adult sharks (2 male Atlantic sharpnose shark; Table 57) were captured during this study; however, no sampling was made after June of this season. Several cownose rays were collected from two sets in June, making EFH requirements for ray species sparse (Table 59).

TAG RECAPTURE DATA

NOAA Fisheries Panama City Laboratory and NOAA Fisheries Mississippi Labs have been tagging elasmobranchs in the Gulf of Mexico and southeast US Atlantic Ocean since 1994. In order to expand the coastal tagging program, GULFSPAN participants were supplied with NOAA Fisheries Panama City Laboratory tags and tagging equipment beginning in 2006. The primary goal of this ongoing tagging cooperative is to gain information on migration routes, growth rates, stock identity, and population dynamics of large and small coastal shark species as well as ray and pelagic shark species in the Gulf of Mexico.

In 2008, 1023 elasmobranchs were tagged by GULFSPAN survey participants using NOAA Fisheries Panama City Laboratory tags. Tag recapture data were collected for 19 animals in 2008 (Table

61). Data on these sharks were returned by recreational anglers using hook and line, GULFSPAN surveys using gillnet, and commercial fishermen. The shark at liberty the longest was a male Atlantic sharpnose shark. It was tagged on May 16, 2003, in St. Joseph Bay, FL, and recaptured 1,938 days later in Crooked Island Sound, FL, approximately 48 km to the east. The shark that traveled the longest distance was a female Florida smooth hound tagged by NOAA Fisheries Mississippi Labs offshore of the Mississippi River delta and recaptured 262 days later approximately 835 km southwest offshore Port Isabel/Brownsville, TX. Recapture data continues to support the hypothesis that immature Atlantic sharpnose sharks tagged in Crooked Island Sound return to that area every summer (1 shark at liberty 297 days and 1 shark at liberty 1146 days tagged and recaptured in Crooked Island Sound).

The NOAA Fisheries Southeast Fisheries Science Center Elasmobranch Tag and Recapture Database currently contains detailed catch information on over 5000 tagged animals. Efforts are underway to complete entering archived GULFSPAN tag and recapture data (through 1999) and NOAA Fisheries Mississippi Labs bottom and pelagic longline tag and recapture data (through 2003) by February 2009. This database will eventually serve as a centralized elasmobranch tag and recapture database for the NOAA Fisheries Panama City Laboratory (including both the Gillnet and Bottom Longline Observer Programs), NOAA Fisheries Mississippi Labs, and GULFSPAN survey participants. The ultimate goal is to have all colleagues gain access, query, and be able to add records to the database online by the beginning of sampling season, April 2009.

CONCLUSIONS

The GULFSPAN project now has six institutions collaborating to determine essential fish habitat for elasmobranchs in the Gulf of Mexico. Survey data collected are being incorporated into stock assessment models as abundance trends and life history parameters (NMFS, 2006 and NMFS, 2007). Continued funding of this program is vital to preserving the time series data. Moreover, future collaborations with Texas Parks and Wildlife Department have already been initiated and sampling by this agency may occur in 2009 as funds permit.

ACKNOWLEDGEMENTS

D.M. Bethea, L.D. Hollensead, and J.K. Carlson thank everyone at the NOAA Fisheries Panama City Laboratory who aided in field work and gear maintenance, especially the 2008 Shark Population Assessment Group interns: O. Crawford, T. Dillion, H. McCann, and H. Moncrief. C. Gardner helped create the northwest Florida figures. I. Baremore, L. Hale, and M. Passerotti provided language for Age, Growth, and Reproduction in the northwest Florida section. M.J. Ajemian would like to thank the various technicians, graduate students, and summer and fall interns of the fisheries ecology lab at the Dauphin Island Sea Lab for their invaluable field assistance. D. Grubbs thanks D. Bethea and L. Hollensead for helping establish the FSUCML survey, D. Tinsley, B. Henderson, and M. Daniels for vessel support, and the volunteers that helped in the field, especially T. Nichols, S. Romer, W. Gilliford, R. Ford, and E. Driscoll. K. Kingon helped create the map of the sampling locations in Turkey Point, FL. E.R. Hoffmayer thanks J. Hendon, J. McKinney, G. Gray, W. Dempster, and J. Tilley at the Gulf Coast Research Laboratory who aided in field work. R. Del Rio, G.W. Peterson, D.M. Baltz wish to thank B. Milan for his effort in the field and J. Lentz who created the Louisiana location map figure. J. Romine wishes to thank interns E. Gallagher and R. Thaler, and volunteers, J. Fernández de Carvalho, R. Coelho, C. Walker, K. Curry, D. Ehret, M. Stevens, L. Wilson, N. Koenig and R. Leder for field assistance. Special thanks also go to J. Fernández de Carvalho and E. Gallagher for assistance with gear maintenance.

LITERATURE CITED

Bethea, D.M., L. Hollensead, J.K. Carlson, C.L. Conrath, M.J. Ajemian, E.R. Hoffmayer, and G.W. Peterson (2008) Shark nursery grounds and essential fish habitat studies. Gulfspan Gulf of Mexico-FY07. An Internal Report to NOAA's Highly Migratory Species Division. Sustainable Fisheries Division Contribution No. PCB-08/02.

Carlson JK, Bethea DM (2006) SEDAR 13-DW-06: Standardized catch rates of small coastal sharks from a fishery-independent gillnet survey in northwest Florida (http://www.sefsc.noaa.gov/sedar/Sedar_Documents.jsp?WorkshopNum=13&FolderType=Data)

Carlson JK, Brusher JH (1999) An index of abundance for juvenile coastal species of sharks from the northeast Gulf of Mexico. Mar. Fish. Rev. 61(3): 37-45.

Carlson, J.K., E. Cortés, and D.M. Bethea (2003) Life history and population dynamics of the finetooth shark (*Carcharhinus isodon*) in the northeastern Gulf of Mexico. Fish. Bull. (US) 101:281-292.

Forney KA (2000) Environmental models of cetacean abundance: reducing uncertainty in population trends. Cons. Biol. 14(5): 1271-1286.

Livingston RJ (1984) Resource atlas of the Apalachicola estuary. Florida Sea Grant Publication. 64 p.

NMFS (2006) SEDAR 11: Stock assessment report large coastal complex, blacktip, and sandbar shark. US Department of Commerce, National Oceanic and Atmospheric Administration, Highly Migratory Species Division, Silver Spring, MD. http://www.sefsc.noaa.gov/sedar/Sedar_Workshops.jsp?WorkshopNum=11

NMFS (2007) SEDAR 13: Stock assessment report small coastal shark complex, Atlantic sharpnose, blacknose, bonnethead, and finetooth shark. US Department of Commerce, National Oceanic and Atmospheric Administration, Highly Migratory Species Division, Silver Spring, MD. http://www.sefsc.noaa.gov/sedar/Sedar_Workshops.jsp?WorkshopNum=13

NMFS (2008) Draft Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan Essential Fish Habitat. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. Public Document. 343p.

McCandless CT, Pratt Jr. HL, Kohler NE (eds) (2007) Shark nursery grounds of the Gulf of Mexico and East Coast waters of the United States. American Fisheries Society, Symposium 50. Bethesda, MD.

Parsons GR, Hoffmayer ER (2007) Identification and characterization of shark nursery grounds along the Mississippi and Alabama gulf coasts. *In:* Shark nursery grounds of the U.S. Atlantic and Gulf of Mexico. (Eds. McCandless CT, Pratt Jr. HL, Kohler NE). American Fisheries Society, Symposium 50. Bethesda, MD. 301-316.

Thompson B, Condrey RE, Neer JA, Barry KP, Blackburn JK, deSilva JA, Peterson GW (2002) Essential shark conservation needs: A timely assessment of the role Louisiana's waters play as critical pupping and nursery grounds. Third-year Annual Report and Project Summary to the Coypu Foundation Trust. 26p + 3 Appendices.

USDOC US Department of Commerce, NOAA National Oceanic and Atmospheric Administration, NMFS National Marine Fisheries Service (2007) Magnusen-Stevens Fishery Conservation and Management Act, as amended through Jan. 12, 2007. NMFS, Silver Spring, MD. 170p.

Table 1. Summary of CPUE (number of animals per net hour) for sharks by life history stage and major area sampled in northwest Florida for FY-08. Means (standard deviations) are presented. Young-of-the-year includes neonate life stage. Sexes are combined. Specimens with an undetermined life stage are included in total CPUE calculation. Species are listed alphabetically by common name.

(a) Atlantic sharpnose shark, *Rhizoprionodon terraenovae*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	0.10 (0.48)	1.50 (2.82)	0.67 (1.32)	0.35 (0.70)	1.59 (5.14)
Juveniles	0.20 (0.52)	3.19 (3.32)	2.96 (5.67)	0.23 (0.57)	0.67 (1.15)
Adults	--	1.48 (2.22)	1.69 (1.93)	0.33 (0.44)	2.81 (5.17)
All	0.29 (0.84)	6.17 (4.29)	5.32 (6.63)	0.91 (0.97)	5.07 (7.93)

(b) Blacknose shark, *Carcharhinus acronotus*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	0.06 (0.32)	0.17 (0.82)	--	--
Juveniles	0.07 (0.26)	0.04 (0.22)	0.07 (0.25)	--	--
Adults	--	0.11 (0.44)	0.03 (0.18)	--	0.04 (0.19)
All	0.07 (0.26)	0.21 (0.57)	0.27 (1.04)	--	0.04 (0.19)

(c) Blacktip shark, *Carcharhinus limbatus*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	0.33 (1.01)	0.07 (0.31)	0.72 (1.48)	1.43 (3.34)
Juveniles	0.03 (0.17)	0.41 (0.88)	0.11 (0.27)	2.28 (5.25)	2.45 (3.38)
Adults	--	--	0.03 (0.19)	--	--
All	0.03 (0.17)	0.74 (1.79)	0.21 (0.49)	3.00 (5.35)	3.88 (5.04)

(d) Bonnethead, *Sphyrna tiburo*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	0.43 (0.79)	0.09 (0.40)	0.19 (0.34)	0.07 (0.25)
Juveniles	--	0.63 (1.00)	0.39 (1.57)	0.34 (0.65)	0.11 (0.39)
Adults	--	0.25 (0.63)	0.35 (1.38)	0.39 (1.30)	0.39 (0.74)
All	--	1.31 (1.41)	0.83 (2.52)	0.92 (1.44)	0.57 (0.87)

(e) Bull shark, *Carcharhinus leucas*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	--	--	--	--
Juveniles	--	0.03 (0.15)	--	0.05 (0.16)	--
Adults	--	--	--	--	--
All	--	0.03 (0.15)	--	0.05 (0.16)	--

(f) Finetooth shark, *Carcharhinus isodon*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	--	0.04 (0.25)	--	0.02 (0.10)
Juveniles	--	0.02 (0.12)	--	0.05 (0.17)	0.16 (0.42)
Adults	--	0.05 (0.18)	0.02 (0.09)	--	0.17 (0.48)
All	--	0.07 (0.21)	0.06 (0.27)	0.05 (0.17)	0.35 (0.60)

(g) Florida smooth hound, *Mustelus norrisi*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	0.03 (0.17)	0.07 (0.27)	--	--	--
Juveniles	--	--	--	--	--
Adults	--	--	--	--	--
All	0.03 (0.17)	0.07 (0.27)	--	--	--

(h) Great hammerhead, *Sphyrna mokarran*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	--	--	--	--
Juveniles	--	0.05 (0.21)	--	--	--
Adults	--	--	--	--	--
All	--	0.05 (0.21)	--	--	--

(i) Sandbar shark, *Carcharhinus plumbeus*

	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	--	--	--	--
Juveniles	--	--	--	0.04 (0.13)	0.04 (0.20)
Adults	--	--	--	--	--
All	--	--	--	0.04 (0.13)	0.04 (0.20)

(j) Scalloped hammerhead, *Sphyrna lewini*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	1.02 (2.00)	--	0.22 (0.41)	0.75 (1.39)
Juveniles	--	--	--	--	0.22 (0.61)
Adults	--	--	--	--	--
All	--	1.02 (2.01)	--	0.22 (0.41)	0.97 (1.42)

(k) Spinner shark, *Carcharhinus brevipinna*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	0.04 (0.16)	0.11 (0.34)	--	0.08 (0.23)
Juveniles	--	0.04 (0.16)	0.02 (0.09)	--	0.34 (0.68)
Adults	--	--	--	--	--
All	--	0.08 (0.22)	0.13 (0.34)	--	0.42 (0.68)

Table 2. Summary of CPUE (number of animals per net hour) for rays by major area sampled in northwest Florida for FY-08. Means (standard deviations) are presented. Sexes are combined. Young-of-the-year includes neonate life stage. Specimens with an undetermined life stage are included in total CPUE calculation. Species are listed alphabetically by common name.

(a) Cownose ray, *Rhinoptera bonasus*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	--	--	0.21 (0.50)	0.03 (0.14)
Juveniles	--	0.15 (0.84)	--	0.16 (0.39)	--
Adults	--	0.02 (0.12)	0.51 (1.53)	--	0.19 (0.48)
All	--	0.17 (0.96)	0.51 (1.53)	0.37 (0.73)	0.22 (0.49)

(b) Manta ray, *Manta birostis*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Unknown	--	--	--	--	0.02 (0.10)

(c) Smooth butterfly ray, *Gymnura micrura*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	0.05 (0.18)	--	--	--

(d) Southern stingray, *Dasyatis americana*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay	Gulf-side of St. Vincent Island
Young-of-the-year	--	0.02 (0.13)	--	--	--
Juveniles	--	--	--	--	--
Adults	--	--	0.03 (0.17)	--	--
All	--	0.02 (0.13)	0.03 (0.17)	--	--

Table 3. Summary of the habitat associations for Atlantic sharpnose shark, *Rhizoprionodon terraenovae*,

by life stage in northwest Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year n=171	26.2 (19.4-30.3)	31.8 (24.4-34.1)	4.4 (1.1-8.9)	199.9 (65-425)	5.0 (2.7-6.7)	Mud/Sand/ Seagrass
Juveniles n=288	28.4 (19.4-33.1)	33.1 (25.5-34.2)	4.3 (1.3-8.9)	211.0 (65-425)	4.8 (3.5-6.7)	Sand/Mud/ Seagrass
Adults n=239	26.4 (19.4-30.7)	32.9 (25.1-34.7)	5.1 (1.8-8.9)	203.4 (65-425)	4.9 (2.7-6.7)	Mud/Sand/ Seagrass

Table 4. Summary of the habitat associations for blacknose shark, *Carcharhinus acronotus*, by life stage in northwest Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year n=13	29.6 (28.9-30.0)	33.6 (33.1-33.8)	4.4 (2.5-7.4)	225.0 (150-300)	4.5 (4.4-4.7)	Sand/Mud
Juveniles n=6	28.4 (27.3-29.3)	32.1 (29.2-34.0)	4.8 (3.7-7.4)	266.7 (150-400)	4.6 (4.3-5.0)	Sand/Mud/ Seagrass
Adults n=8	29.1 (28.4-30.0)	32.6 (32.1-34.2)	3.0 (1.7-4.2)	190.6 (75-300)	4.3 (4.2-4.5)	Sand/Mud/ Seagrass

Table 5. Summary of the habitat associations for blacktip shark, *Carcharhinus limbatus*, by life stage in northwest Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year n=107	27.2 (21.0-30.7)	31.1 (22.3-34.2)	4.6 (1.7-8.7)	174.4 (75-325)	4.8 (3.9-6.5)	Mud/Sand
Juveniles n=161	27.7 (20.2-30.7)	31.9 (25.1-34.7)	5.0 (1.7-8.7)	214.6 (65-425)	5.0 (2.7-6.7)	Mud/Sand/ Seagrass/Oyster
Adults n=1	29.5 --	32.9 --	5.7 --	160 --	5.3 --	Sand

Table 6. Summary of the habitat associations for bonnethead, *Sphyrna tiburo*, by life stage in northwest Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year n=30	27.0 (21.0-30.4)	32.8 (31.3-34.0)	3.9 (1.9-6.0)	189.5 (125-325)	5.0 (4.0-6.7)	Sand/Mud/ Seagrass
Juveniles n=57	28.1 (21.0-30.4)	32.9 (22.3-34.1)	4.7 (1.1-9.0)	259.6 (105-425)	4.6 (3.9-6.5)	Sand/Mud/ Seagrass
Adults n=52	25.5 (21.0-30.4)	31.5 (25.1-34.2)	5.0 (1.8-8.7)	218.0 (75-425)	5.3 (4.1-6.2)	Sand/Mud/ Oyster/Seagrass

Table 7. Summary of the habitat associations for bull shark, *Carcharhinus leucas*, by life stage in northwest Florida for FY-08. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	-- --	-- --	-- --	-- --	-- --	--
Juveniles n=2	27.3 (24.2-30.3)	32.2 (31.3-33.0)	3.5 (2.6-4.3)	187.5 (125-250)	5.2 (4.5-5.8)	Sand/Mud
Adults	-- --	-- --	-- --	-- --	-- --	--

Table 8. Summary of the habitat associations for finetooth shark, *Carcharhinus isodon*, by life stage in northwest Florida for FY-08. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year n=3	28.5 (28.4-28.6)	31.3 (29.9-32.7)	5.8 (5.1-6.5)	137.5 (100-175)	4.2 --	Sand/Mud
Juveniles n=9	24.3 (21.0-30.7)	31.2 (28.3-33.8)	4.3 (3.2-8.7)	128.9 (65-240)	5.3 (4.2-5.7)	Mud
Adults n=10	26.5 (22.2-30.3)	32.7 (29.9-34.0)	3.9 (2.8-5.9)	157.5 (100-350)	4.8 (2.7-6.1)	Mud/Sand

Table 9. Summary of the habitat associations for the Florida smooth hound, *Mustelus norrisi*, by life stage in northwest Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	24.8	30.7	3.1	275	4.8	Sand/Mud
n=1	--	--	--	--	--	
Juveniles	26.9	32.8	3.7	175.0	5.5	
n=3	(24.4-28.0)	(31.4-33.9)	(2.1-4.0)	(125-210)	(5.0-5.9)	Sand/Mud
Adults	--	--	--	--	--	--
	--	--	--	--	--	

Table 10. Summary of the habitat associations for the great hammerhead, *Sphyrna mokarran* by life stage in northwest Florida for FY-08. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	--	--	--	--	--	--
	--	--	--	--	--	
Juveniles	30.1	33.0	3.6	250.0	4.2	Mud
n=2	(29.9-30.3)	(32.6-33.4)	(2.9-4.2)	-	(4.0-4.3)	
Adults	--	--	--	--	--	--
	--	--	--	--	--	

Table 11. Summary of the habitat associations for sandbar shark, *Carcharhinus plumbeus*, by life stage in northwest Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	--	--	--	--	--	--
	--	--	--	--	--	
Juveniles	28.0	33.8	3.8	125.0	4.5	Mud
n=3	(24.8-29.6)	(33.5-34.4)	(3.3-4.0)	(75-150)	(4.1-5.2)	
Adults	--	--	--	--	--	--
	--	--	--	--	--	

Table 12. Summary of the habitat associations for scalloped hammerhead, *Sphyrna lewini*, by life stage in northwest Florida for FY-08. Young-of-the-year includes neonate life. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year n=75	28.2 (20.2-30.7)	32.7 (24.4-34.2)	4.0 (2.1-7.2)	170.0 (40-300)	4.6 (2.7-6.6)	Mud/Sand
Juveniles n=9	23.3 (22.3-29.0)	33.6 (33.3-34.0)	5.0 (3.8-7.0)	152.0 (100-300)	5.3 (4.2-5.9)	Mud
Adults	-- --	-- --	-- --	-- --	-- --	--

Table 13. Summary of the habitat associations for spinner shark, *Carcharhinus brevipinna*, by life stage northwest Florida for FY-08. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year n=9	29.2 (28.0-33.1)	32.2 (29.9-34.0)	4.4 (1.3-8.7)	180.6 (100-290)	4.4 (4.1-4.9)	Sand/Mud/ Seagrass
Juveniles n=15	26.7 (21.8-30.3)	33.4 (31.7-34.2)	5.5 (3.6-8.1)	204.3 (75-350)	4.7 (2.7-5.7)	Mud/Sand
Adults	-- --	-- --	-- --	-- --	-- --	--

Table 14. Summary of the habitat associations for cownose ray, *Rhinoptera bonasus*, by life stage in northwest Florida for FY-08. Young-of-the-year includes neonate life stage. Means (ranges) are presented. Bottom type is presented in descending predominance unless otherwise stated. NA indicated data not available.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year n=5	27.0 (24.8-29.0)	30.1 (22.3-34.4)	3.2 (1.7-4.6)	116.7 (75-150)	4.8 (3.9-5.2)	Mud
Juveniles n=11	23.1 (21.9-24.8)	31.7 (25.1-34.4)	3.6 (1.8-3.9)	183.5 (75-225)	6.0 (5.2-6.2)	Mud/Oyster
Adults n=33	25.9 (21.0-27.3)	33.0 (31.6-34.0)	4.9 (3.6-7.8)	206.6 (100-350)	5.3 (4.7-6.3)	Sand/Mud/ Seagrass

Table 15. Summary of the habitat associations for manta ray, *Manta birostris*, by life stage in northwest Florida for FY-08. Raw data is presented.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Unknown	28.6	29.9	5.1	100	4.2	Mud
n=1, 300 cm DW	--	--	--	--	--	

Table 16. Summary of the habitat associations for smooth butterfly ray, *Gymnura micrura*, by life stage northwest Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	29.4	32.8	4.3	212.5	4.3	Mud/Sand
n=2	(28.4-30.4)	(32.2-33.3)	(4.2-4.3)	(200-225)	(4.2-4.4)	
Juveniles	--	--	--	--	--	--
	--	--	--	--	--	
Adults	--	--	--	--	--	--
	--	--	--	--	--	

Table 17. Summary of the habitat associations for southern stingray, *Dasyatis americana*, by life stage in northwest Florida for FY-08. Raw data are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	29.0	32.1	1.7	150	4.3	Sand/Mud/
n=1	--	--	--	--	--	Seagrass
Juveniles	--	--	--	--	--	--
	--	--	--	--	--	
Adults	21.9	33.3	1.2	120	5.1	Seagrass/Sand
n=1	--	--	--	--	--	

Table 18. Summary of CPUE in gillnet (number of animals per net hr) and longline (number of animals per 100 hooks) for elasmobranchs by life history stage sampled in Turkey Point, Florida, for FY-08. Means (standard deviations) are presented. Young-of-the-year includes neonate life stage. Sexes are combined. Specimens with an undetermined life stage are included in total CPUE calculation. Species are listed alphabetically by common name.

(a) Atlantic sharpnose shark, *Rhizoprionodon terraenovae*

Life stage	Gillnet	Longline
Young-of-the-year	0.16 (0.53)	2.45 (2.58)
Juveniles	3.74 (6.02)	1.91 (2.43)
Adults	3.87 (3.94)	3.27 (3.69)
All	7.77 (8.94)	7.64 (5.50)

(b) Blacknose shark, *Carcharhinus acronotus*

Life stage	Gillnet	Longline
Young-of-the-year	0.05 (0.24)	0.09 (0.30)
Juveniles	--	0.36 (0.50)
Adults	0.04 (0.20)	2.00 (2.19)
All	0.09 (0.30)	2.45 (2.25)

(c) Blacktip shark, *Carcharhinus limbatus*

Life stage	Gillnet	Longline
Young-of-the-year	--	0.64 (2.11)
Juveniles	0.09 (0.32)	1.18 (1.47)
Adults	--	0.91 (1.22)
All	0.09 (0.32)	2.64 (2.87)

(d) Bonnethead shark, *Sphyrna tiburo*

Life stage	Gillnet	Longline
Young-of-the-year	0.26 (0.66)	--
Juveniles	1.97 (3.29)	--
Adults	0.79 (1.30)	--
All	3.01 (4.09)	--

(e) Bull shark, *Carcharhinus leucas*

Life stage	Gillnet	Longline
Young-of-the-year	--	--
Juveniles	--	0.09 (0.30)
Adults	--	--
All	--	0.09 (0.30)

(f) Cownose ray, *Rhinoptera bonasus*

Life stage	Gillnet	Longline
Young-of-the-year	0.03 (0.13)	--
Juveniles	--	--
Adults	--	--
All	0.03 (0.13)	--

(g) Finetooth shark, *Carcharhinus isodon*

Life stage	Gillnet	Longline
Young-of-the-year	--	--
Juveniles	--	--
Adults	--	0.09 (0.30)
All	--	0.09 (0.30)

(h) Great hammerhead shark, *Sphyrna mokarran*

Life stage	Gillnet	Longline
Young-of-the-year	--	--
Juveniles	--	0.09 (0.30)
Adults	--	--
All	--	0.09 (0.30)

(i) Nurse shark, *Ginglymostoma cirratum*

Life stage	Gillnet	Longline
Young-of-the-year	--	--
Juveniles	--	0.09 (0.30)
Adults	--	0.18 (0.40)
All	--	0.27 (0.47)

(j) Spinner shark, *Carcharhinus brevipinna*

Life stage	Gillnet	Longline
Young-of-the-year	0.03 (0.14)	--
Juveniles	--	--
Adults	--	--
All	0.03 (0.14)	--

Table 19. Summary of the habitat associations for Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (^{o}C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	27.55 (24.5-30.1)	31.9 (29.7-33.8)	3.0 (0.75-8.0)	--	--	Sand, Seagrass, Mud
Juveniles	27.35 (22.3-30.6)	31.8 (29.7-33.7)	3.1 (1.0-8.0)	--	4.8 (3.9-7.3)	Sand, Seagrass, Mud
Adults	28.65 (22.3-30.1)	32.7 (29.7-33.8)	3.6 (1.0-8.0)	--	3.3 (3.9-5.0)	Sand, Seagrass, Mud

Table 20. Summary of the habitat associations for blacknose shark, *Carcharhinus acronotus*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage.

Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	28.7	32.7	2.5	--	--	Mud, Sand
	--	--	--	--	--	
Juveniles	29.5	33.1	5.4	--	--	Mud, Sand,
	(28.7-30.1)	(32.7-33.8)	(3.5-8.0)	--	--	Seagrass
Adults	29.3	33.1	4.1	--	--	Mud, Sand
	(28.7-30.1)	(32.7-33.8)	(1.5-7.0)	--	--	

Table 21. Summary of the habitat associations for blacktip shark, *Carcharhinus limbatus*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	28.7	32.7	5.3	--	--	Sand
	--	--	--	--	--	
Juveniles	28.7	32.7	3.05	--	5.0	Sand, Seagrass
	(22.3-29.8)	(29.7-33.3)	(0.75-7.0)	--	--	
Adults	28.6	32.7	3.4	--	--	Sand, Mud
	(22.3-30.1)	(30.7-33.8)	(1.-6.0)	--	--	

Table 22. Summary of the habitat associations for bonnethead shark, *Sphyrna tiburo*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	29.1	33.2	2.4	--	4.7	Seagrass, Sand
	(28.1-30.0)	(32.7-33.7)	(1.0-5.5)	--	(4.4-5.0)	
Juveniles	28.5	32.0	2.2	--	5.0	Seagrass, Sand
	(24.5-30.6)	(29.7-33.3)	(0.5-7.0)	--	(3.9-7.3)	
Adults	28.8	32.8	2.6	--	5.2	Seagrass, Sand
	(25.3-30.6)	(30.7-33.7)	(1.0-8.0)	--	(4.2-7.3)	

Table 23. Summary of the habitat associations for bull shark, *Carcharhinus leucas*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	--	--	--	--	--	--
Juveniles	28.7	32.7	5.3	--	--	Mud
Adults	--	--	--	--	--	--

Table 24. Summary of the habitat associations for cownose ray, *Rhinoptera bonasus*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage.

Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	29.0	33.3	3.3	--	--	Sand
Juveniles	--	--	--	--	--	--
Adults	--	--	--	--	--	--

Table 25. Summary of the habitat associations for finetooth shark, *Carcharhinus isodon*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	--	--	--	--	--	--
Juveniles	--	--	--	--	--	--
Adults	24.5	29.7	5.0	--	--	Sand

Table 26. Summary of the habitat associations for great hammerhead shark, *Sphyrna mokarran*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	--	--	--	--	--	--
Juveniles	29.5	33.1	6.5	--	--	Sand
Adults	--	--	--	--	--	--

Table 27. Summary of the habitat associations for nurse shark, *Ginglymostoma cirratum*, by life stage in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	-- --	-- --	-- --	-- --	-- --	--
Juveniles	28.8	32.8	3.3	-- --	-- --	Sand, Mud
Adults	29.1 (28.8-29.4)	33.0 (32.8-33.2)	2.9 (1.5-4.5)	-- --	-- --	Sand, Mud

Table 28. Summary of the habitat associations for spinner shark, *Carcharhinus brevipinna*, by life stage

in Turkey Point, Florida for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	29.4	33.2	1.0	--	--	Seagrass
Juveniles	--	--	--	--	--	--
Adults	--	--	--	--	--	--

Table 29. Summary of CPUE (number of sharks/net/hour) for sharks by major area sampled in the Cedar Key region of Florida FY-08. Means (standard deviations) are presented. Young of the year includes neonate life stage.

(a) Atlantic sharpnose shark, *Rhizoprionodon terraenovae*

Life stage	Suwannee Sound	Cedar Key	Waccasassa Bay
Young-of-the-year	1.08 (1.52)	0.62 (0.90)	0.50 (0.68)
Juveniles	--	--	--
Adults	2.43 (3.80)	0.89 (1.01)	2.36 (3.91)
All	3.82 (4.18)	1.61 (1.50)	2.98 (4.29)

(b) Blacknose shark, *Carcharhinus acronotus*

Life stage	Suwannee Sound	Cedar Key	Waccasassa Bay
Young-of-the-year	--	--	--
Juveniles	0.06 (0.18)	--	--
Adults	--	--	--
All	0.06 (0.18)	--	--

(c) Blacktip shark, *Carcharhinus limbatus*

Life stage	Suwannee Sound	Cedar Key	Waccasassa Bay
Young-of-the-year	--	0.63 (0.90)	1.88 (2.95)
Juveniles	0.23 (0.50)	0.48 (0.89)	0.15 (0.47)
Adults	--	--	--
All	0.23 (0.50)	1.21 (1.34)	2.09 (2.84)

(d) Bonnethead, *Sphyrna tiburo*

Life stage	Suwannee Sound	Cedar Key	Waccasassa Bay
Young-of-the-year	1.61 (1.89)	0.21 (0.42)	0.12 (0.25)
Juveniles	0.63 (0.99)	--	1.02 (1.47)
Adults	1.60 (1.90)	3.32 (4.58)	1.10 (1.14)
All	3.87 (4.14)	3.60 (4.67)	2.31 (2.30)

(e) Scalloped hammerhead, *Sphyrna lewini*

Life stage	Suwannee Sound	Cedar Key	Waccasassa Bay
Young-of-the-year	--	--	--
Juveniles	--	0.06 (0.17)	--
Adults	--	--	--
All	--	0.06 (0.17)	--

Table 30. Summary of CPUE (number of rays/net/hour) for rays by major area sampled in the Cedar Key region of Florida FY-08. Means (standard deviations) are presented. Young-of-the-year includes neonate

life stage.

(a) Cownose ray, *Rhinoptera bonasus*

Life stage	Suwannee Sound	Cedar Key	Waccasassa Bay
Young-of-the-year	--	--	--
Juveniles	--	0.18 (0.37)	--
Adults	--	--	--
All	--	0.18 (0.37)	--

(b) Southern stingray, *Dasyatis americana*

Life stage	Suwannee Sound	Cedar Key	Waccasassa Bay
Young-of-the-year	--	--	--
Juveniles	--	--	--
Adults	--	--	--
All	--	--	0.05 (0.45)

(d) Spotted eagle ray, *Aetobatus narinari*

Life stage	Suwannee Sound	Cedar Key	Waccasassa Bay
Young-of-the-year	--	--	--
Juveniles	--	0.15 (1.33)	--
Adults	--	--	--
All	--	0.15 (1.33)	--

Table 31. Summary of the habitat associations for the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, by life stage in the Cedar Key region of Florida for FY-08. Young-of-the-year includes neonate life stage. Ranges (mean) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	26.8 (22.3-30.6)	29.1 (24.6-32.1)	4.4 (2.8-7.2)	6.1 (5.3-7.3)	Hard mud/ Seagrass/ Sand/Shell
Juveniles	-- --	-- --	-- --	-- --	--
Adults	25.6 (22.2-31.0)	28.4 (22.4-33.2)	3.9 (2.4-7.2)	5.9 (5.0-7.1)	Hard mud/ Seagrass/ Sand/Shell/Oyster

Table 32. Summary of the habitat associations for the blacktip shark, *Carcharhinus limbatus*, by life stage in the Cedar Key region of Florida for FY-08. Young-of-the-year includes neonate life stage. Ranges (mean) are presented. Bottom type is presented in descending predominance unless otherwise

stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	25.8 (25.0-27.4)	28.7 (28.1-30.0)	3.9 (2.4-6.8)	5.8 (5.0-7.0)	Seagrass/ Hard mud/ Sand/ Shell
Juveniles	27.5 (24.7-30.2)	30.5 (28.7-32.1)	5.6 (3.0-7.2)	6.0 (5.5-6.8)	Hard mud/ Seagrass/ Sand/ Shell
Adults	-- --	-- --	-- --	-- --	--

Table 33. Summary of the habitat associations for the bonnethead shark, *Sphyrna tiburo*, by life stage in the Cedar Key region of Florida for FY-08. Young-of-the-year includes neonate life stage. Ranges (mean) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	26.8 (24.7-31.0)	30.2 (22.4-33.2)	4.9 (2.9-7.2)	6.0 (5.0-6.8)	Hard mud/ Sand/ Oyster/ Seagrass
Juveniles	26.7 (24.7-30.4)	29.4 (22.4-32.4)	3.9 (2.4-5.4)	5.9 (5.3-6.8)	Seagrass/ Hard mud/ Sand
Adults	26.4 (20.8-30.6)	29.3 (22.2-32.4)	3.8 (2.4-6.8)	5.9 (5.0-9.0)	Hard mud/ Seagrass Sand/ Shell

Table 34. Summary of the habitat associations for the ray species captured in the Cedar Key region of Florida for FY-08. Due to the small number of rays captured, life history stages are combined. Ranges (mean) are presented. Bottom type is presented in descending predominance unless otherwise stated.

Species	Temperature (ºC)	Salinity	Depth (m)	Dissolved Oxygen (mg l-1)	Bottom type
Cownose ray	26 --	28.7 --	2.9 (2.7-3.1)	5.5 --	Hard mud/ Seagrass
Spotted eagle ray	26 --	28.7 --	3.1 --	5.5 --	Hard mud

Table 35. Summary of CPUE (number of animals per net hour) for sharks by major area sampled in Alabama FY-08. Means (standard deviations) are presented. Young-of-the-year includes neonate life

stage. Species are listed alphabetically by common name.

(a) Atlantic sharpnose shark, *Rhizoprionodon terraenovae*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	0.90 (2.32)	0.08 (0.28)	0.03 (0.11)	0.49 (0.80)	--	--
Juveniles	0.28 (0.71)	3.11 (7.32)	0.21 (0.59)	--	--	--
Adults	--	0.50 (0.87)	0.10 (0.39)	--	--	--
All	1.2 (2.83)	3.71 (7.92)	0.34 (0.66)	0.49 (0.80)	--	--

(b) Blacktip shark, *Carcharhinus limbatus*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	0.02 (0.12)	0.03 (0.12)	0.04 (0.14)	--	--	--
Juveniles	--	0.02 (0.11)	--	0.30 (0.66)	--	--
Adults	--	--	--	--	--	--
All	0.02 (0.12)	0.05 (0.16)	0.04 (0.14)	0.30 (0.66)	--	--

(c) Bonnethead, *Sphyrna tiburo*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	--	--	--	--	--	--
Juveniles	--	0.23 (0.57)	--	--	--	--
Adults	0.04 (0.20)	0.36 (1.01)	--	--	--	--
All	0.04 (0.20)	0.59 (1.28)	--	--	--	--

(d) Bull shark, *Carcharhinus leucas*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	--	--	--	--	--	--
Juveniles	0.23 (0.62)	0.02 (0.11)	--	0.05 (0.19)	--	--
Adults	--	--	--	--	--	--
All	0.23 (0.62)	0.02 (0.11)	--	--	--	--

(e) Finetooth shark, *Carcharhinus isodon*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	0.06 (0.21)	0.08 (0.21)	0.02 (0.08)	--	--	--
Juveniles	0.46 (1.4)	0.45 (0.90)	0.05 (0.20)	--	--	--
Adults	--	0.01 (0.05)	--	--	--	--
All	0.52 (1.4)	0.15 (0.57)	0.07 (0.21)	--	--	--

(f) Scalloped hammerhead, *Sphyrna lewini*

Life stage	Point Aux	West End	Pelican Bay	Little	Perdido	Bayou

	Pins	Dauphin Island		Dauphin Island	Bay	St. John
Young-of-the-year	--	0.05 (0.15)	0.14 (0.37)	0.06 (0.22)	--	--
Juveniles	--	0.01 (0.05)	0.04 (0.15)	--	--	--
Adults	--	--	--	--	--	--
All	--	0.06 (0.18)	0.18 (0.22)	0.06 (0.22)	--	--

(g) Spinner shark, *Carcharhinus brevipinna*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	--	--	--	--	--	--
Juveniles	--	0.02 (0.11)	--	--	--	--
Adults	--	--	--	--	--	--
All	--	0.02 (0.11)	--	--	--	--

Table 36. Summary of CPUE (number of animals per net hour) for rays by major area sampled in Alabama coastal waters FY-08. Means (standard deviations) are presented. Young-of-the-year includes neonate life stage. Specimens with an undetermined life stage are included in total CPUE calculation. Species are listed alphabetically by common name.

(a) Atlantic Stingray, *Dasyatis sabina*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	--	--	--	--	--	--
Juveniles	0.10 (0.25)	0.11 (0.55)	--	--	--	--
Adults	0.08 (0.28)	0.04 (0.16)	0.15 (0.55)	--	--	--
All	0.17 (0.39)	0.15 (0.57)	0.15 (0.55)	--	--	--

(b) Cownose ray, *Rhinoptera bonasus*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	0.48 (1.36)	--	--	0.08 (0.28)	0.56 (1.10)	--
Juveniles	0.03 (0.16)	0.05 (0.28)	0.16 (0.42)	--	0.12 (0.42)	0.14 (0.30)
Adults	0.10 (0.28)	0.05 (0.16)	--	--	0.11 (0.24)	--
All	0.61 (1.50)	0.10 (0.42)	0.16 (0.42)	0.08 (0.28)	0.80 (1.14)	0.14 (0.30)

(c) Southern stingray, *Dasyatis americana*

Life stage	Point Aux Pins	West End Dauphin Island	Pelican Bay	Little Dauphin Island	Perdido Bay	Bayou St. John
Young-of-the-year	--	--	--	--	--	--
Juveniles	--	0.03 (0.17)	--	--	--	0.38 (0.84)
Adults	--	--	--	--	--	0.36 (0.56)
All	--	0.03 (0.17)	--	--	--	0.74 (1.37)

Table 37. Summary of the habitat associations for the Atlantic sharpnose shark, *Rhizoprionodon*

terraenovae, by life history stage in Alabama for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented for all life stages. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	29.9 (28.6-32.0)	26.0 (17.8-30.8)	2.7 (1.2-4.8)	93 (50-120)	5.9 (4.1-7.2)	Mud/Sand/ Seagrass/Oyster
Juveniles	26.5 (22.8-31.2)	25.9 (18.7-32.0)	2.8 (1.2-4.0)	126 (75-180)	6.3 (5.0-8.2)	Mud/Sand/Seagrass
Adults	24.5 (22.8-27.7)	26.5 (22.5-32.0)	3.4 (1.2-4.5)	127 (90-180)	6.0 (4.6-8.2)	Mud/Sand/Seagrass

Table 38. Summary of the habitat associations for the blacktip shark, *Carcharhinus limbatus*, by life history stage in Alabama for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented for young-of-the-year and juvenile life stages. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	29.3 (24.9-32.0)	24.0 (21.0-28.4)	3.3 (2.4-4.3)	160 (100-200)	6.6 (4.9-8.1)	Mud/Sand/Seagrass
Juveniles	27.3 (22.8-31.5)	26.1 (23.2-27.5)	3.0 (1.4-4.2)	125 (90-170)	5.4 (3.9-7.2)	Mud/Sand/Oyster
Adults	-- --	-- --	-- --	-- --	-- --	--

Table 39. Summary of the habitat associations for the bonnethead, *Sphyrna tiburo*, by life history stage in Alabama for FY-08. Sexes are combined. Means (ranges) are presented for juvenile and adult life stages. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	-- --	-- --	-- --	-- --	-- --	--
Juveniles	26.9 (24.9-28.1)	27.7 (22.5-32.0)	1.6 (1.2-2.4)	143 (100-180)	6.7 (4.6-8.1)	Sand/Seagrass
Adults	28.8 (27.7-29.5)	30.0 (25.5-32.0)	2.4 (1.2-4.5)	98 (50-160)	5.5 (4.6-6.2)	Mud/Sand/Seagrass

Table 40. Summary of the habitat associations for the bull shark, *Carcharhinus leucaso*, by life history stage in Alabama for FY-08. Sexes are combined. Means (ranges) are presented for juvenile stages.

Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	-- --	-- --	-- --	-- --	-- --	--
Juveniles	25.2 (22.7-31.2)	20.7 (16.0-25.7)	2.3 (1.8-4.5)	80 (50-140)	5.4 (5.0-5.9)	Mud/Sand
Adults	-- --	-- --	-- --	-- --	-- --	--

Table 41. Summary of the habitat associations for the cownose ray, *Rhinoptera bonasus*, by life history stage in Alabama for FY-08. Sexes are combined. Means (ranges) are presented for all life stages. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	26.9 (16.7-30.9)	23.3 (19.1-28.8)	1.99 (1.2-4.8)	88.8 (50-170)	5.8 (3.6-8.1)	Mud/Seagrass/ Sand/Oyster
Juveniles	22.6 (16.7-25.3)	25.5 (16.3-28.8)	2.4 (1.2-4.5)	121 (80-200)	6.7 (5.4-7.9)	Mud/Seagrass/Sand
Adults	25.9 (24.4-29.3)	25.3 (16.3-28.5)	2.8 (1.4-4.0)	103 (80-140)	6.2 (4.9-7.9)	Mud/Sand/Seagrass

Table 42. Summary of the habitat associations for the southern stingray, *Dasyatis americana*, by life history stage in Alabama for FY-08. Sexes are combined. Means (ranges) are presented for juvenile and adult life stages. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	-- --	-- --	-- --	-- --	-- --	--
Juveniles	27.3 (23.3-30.6)	25.5 (23.4-28.7)	1.7 (1.5-1.8)	155 (140-170)	7.0 (5.6-8.3)	Sand/Seagrass
Adults	23.3 --	24.4 --	1.8 --	80 - 200 --	8.3 --	Sand/Seagrass

Table 43. Summary of the habitat associations for the Atlantic stingray, *Dasyatis sabina*, by life history stage in Alabama for FY-08. Sexes are combined. Means (ranges) are presented for juvenile and adult life stages. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	-- --	-- --	-- --	-- --	-- --	-- --
Juveniles	25.9 (23.2-29.5)	22.2 (19.6-30.9)	1.6 (1.1-2.4)	80 (50-100)	6.6 (5.6-7.5)	Mud/Seagrass
Adults	24.2 (24.1-24.2)	23.8 (18.7-29.9)	2.1 (1.7-2.5)	120 (95-140)	6.1 (5.0-7.6)	Mud/Sand/Seagrass

Table 44. Summary of the habitat associations for the finetooth shark, *Carcharhinus isodon*, by life history stage in Alabama for FY-08. Sexes are combined. Means (ranges) are presented for all life stages. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	29.0 (23.5-32.0)	23.3 (18.7-27.1)	3.4 (1.5-4.8)	107 (95-150)	5.4 (3.6-7.3)	Mud
Juveniles	27.2 (17.6-30.9)	24.9 (12.7-32.0)	3.3 (1.2-4.5)	117 (70-200)	6.0 (4.6-8.7)	Mud/Sand/Seagrass
Adults	24.9 --	22.5 --	2.4 --	180 --	8.14 --	Seagrass/Sand

Table 45. Summary of the habitat associations for the scalloped hammerhead, *Sphyrna lewini*, by life history stage in Alabama for FY-08. Sexes are combined. Means (ranges) are presented for young-of-the-year and juvenile life stages. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (ºC)	Salinity	Depth (m)	Water clarity (cm)	Dissolved Oxygen (mg l-1)	Bottom type
Young-of-the-year	28.6 (23.5-32.0)	24.9 (17.8-30.9)	4.1 (2.9-5.0)	138 (100-200)	5.3 (4.5-6.0)	Mud/Sand
Juveniles	27.2 (23.5-30.9)	25.8 (23.2-28.4)	4.4 (4.3-4.5)	170 (140-200)	5.2 (4.9-5.4)	Sand/Mud
Adults	-- --	-- --	-- --	-- --	-- --	--

Table 46. Summary of the habitat associations for the spinner shark, *Carcharhinus brevipinna*, by life history stage in Alabama for FY-08. Sexes are combined. Means are presented for the juvenile life stage. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature	Salinity	Depth	Water clarity	Dissolved Oxygen	Bottom type

	(ºC)		(m)	(cm)	(mg l-1)	
Young-of-the-year	--	--	--	--	--	--
	--	--	--	--	--	--
Juveniles	28.5	25.8	4.2	170	6.0	Mud
	--	--	--	--	--	--
Adults	--	--	--	--	--	--
	--	--	--	--	--	--

Table 47. Summary of CPUE (number of animals per net hour) for sharks by life history stage and major area sampled in Mississippi coastal waters for FY-08. Mean values are presented and numbers in parentheses represent standard deviation. Young-of-the-year includes neonates. Species are listed alphabetically by common name.

(a) Atlantic sharpnose shark, *Rhizoprionodon terraenovae*

Life stage	Round Island	Horn Island	Cat Island	Deer Island	Davis Bayou
Young-of-the-year	--	--	2.95	--	--
Juveniles	--	0.84 (0.60)	0.79	--	--
Adults	--	6.11 (4.32)	--	--	--
All	--	6.95 (4.91)	3.74	--	--

(b) Blacktip shark, *Carcharhinus limbatus*

Life stage	Round Island	Horn Island	Cat Island	Deer Island	Davis Bayou
Young-of-the-year	0.52 (0.90)	--	0.20	--	--
Juveniles	--	0.74 (1.04)	0.39	--	--
Adults	--	--	--	--	--
All	0.52 (0.90)	0.74 (1.04)	0.59	--	--

(c) Bonnethead shark, *Sphyrna tiburo*

Life stage	Round Island	Horn Island	Cat Island	Deer Island	Davis Bayou
Young-of-the-year	--	--	--	--	--
Juveniles	--	--	--	--	--
Adults	--	--	0.20	--	--
All	--	--	0.20	--	--

(d) Bull shark, *Carcharhinus leucas*

Life stage	Round Island	Horn Island	Cat Island	Deer Island	Davis Bayou
Young-of-the-year	--	--	--	--	0.33

Juveniles	0.08 (0.13)	--	--	--	--
Adults	--	--	--	--	--
All	0.08 (0.13)	--	--	--	0.33

(e) Finetooth shark, *Carcharhinus isodon*

Life stage	Round Island	Horn Island	Cat Island	Deer Island	Davis Bayou
Young-of-the-year	0.22 (0.22)	--	0.78	--	--
Juveniles	--	--	0.20	--	--
Adults	--	--	--	--	--
All	0.22 (0.22)	--	0.98	--	--

(f) Spinner shark, *Carcharhinus brevipinna*

Life stage	Round Island	Horn Island	Cat Island	Deer Island	Davis Bayou
Young-of-the-year	--	--	--	0.16 (0.22)	--
Juveniles	--	--	--	--	--
Adults	--	--	--	--	--
All	--	--	--	0.16 (0.22)	--

Table 48. Summary of CPUE (number of animals per net hour) for rays by life history stage and major area sampled in Mississippi coastal waters for FY-08. Mean values are presented and numbers in parentheses represent standard deviation. Young-of-the-year includes neonates. Species are listed alphabetically by common name.

(a) Atlantic stingray, *Dasyatis sabina*

Life stage	Round Island	Horn Island	Cat Island	Deer Island	Davis Bayou
Young-of-the-year	--	--	--	--	--
Juveniles	0.07 (0.13)	--	--	--	--
Adults	0.07 (0.13)	--	--	--	--
All	0.15 (0.26)	--	--	--	--

b) Cownose ray, *Rhinoptera bonasus*

Life stage	Round Island	Horn Island	Cat Island	Deer Island	Davis Bayou
Young-of-the-year	0.52 (0.47)	--	--	0.22	--
Juveniles	0.37 (0.47)	--	--	--	--
Adults	0.60 (1.04)	--	--	--	--
All	1.50 (1.80)	--	--	0.22	--

Table 49. Summary of the habitat associations for the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, by life stage in Mississippi coastal waters for FY-08. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature	Salinity	Depth	Water clarity	Dissolved oxygen	Bottom type

	(°C)		(m)	(cm)	(mg l^{-1})	
Young-of-the year	27.7 --	26.0 --	4.5 --	136 --	4.8 --	Slit/Clay/Sand
Juvenile	27.7 --	27.8 (26.0-29.6)	4.9 (4.5-5.3)	118.0 (99.0-136.0)	3.4 (2.0-4.8)	Slit/Clay/Sand
Adult	27.7 --	27.8 (26.0-29.6)	4.9 (4.5-5.3)	118.0 (99.0-136.0)	3.4 (2.0-4.8)	Sand/Silt/Clay

Table 50. Summary of the habitat associations for the blacktip shark, *Carcharhinus limbatus*, by life stage in Mississippi coastal waters for FY-08. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	28.6 (29.2-31.2)	22.8 (16.0-29.6)	4.0 (2.7-5.3)	99.0 --	4.3 (2.0-6.7)	Slit/Clay/Sand
Juvenile	27.7 --	27.8 (26.0-29.6)	4.9 (4.5-5.3)	118.0 (99.0-136.0)	3.4 (2.0-4.8)	Sand/Silt/Clay
Adult	-- --	-- --	-- --	-- --	-- --	--

Table 51. Summary of the habitat associations for the bonnethead shark, *Sphyrna tiburo*, by life stage in Mississippi coastal waters for FY-08. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	-- --	-- --	-- --	-- --	-- --	--
Juvenile	-- --	-- --	-- --	-- --	-- --	--
Adult	27.7 --	26.0 --	4.5 --	136 --	4.8 --	Silt/Clay/Sand

Table 52. Summary of the habitat associations for the bull shark, *Carcharhinus leucas*, by life stage in Mississippi coastal waters for FY-08. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l-1)	Bottom type
Young-of-the-year	31.1 --	17.2 --	1.2 --	67.0 --	4.3 --	Mud/Clay
Juvenile	29.4 --	16.0 --	2.7 --	78 --	6.7 --	Silt/Sand/Clay
Adult	-- --	-- --	-- --	-- --	-- --	--

Table 53. Summary of the habitat associations for the finetooth shark, *Carcharhinus isodon*, by life stage in Mississippi coastal waters for FY-08. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l-1)	Bottom type
Young-of-the year	28.6 (27.7-29.4)	21.0 (16.0-26.0)	3.6 (2.7-4.5)	107.0 (78.0-136.0)	5.7 (4.8-6.7)	Sand/Silt/Clay
Juvenile	27.7 --	26.0 --	4.5 --	136 --	4.8 --	Silt/Clay/Sand
Adult	-- --	-- --	-- --	-- --	-- --	--

Table 54. Summary of the habitat associations for the spinner shark, *Carcharhinus brevipinna*, by life stage in Mississippi coastal waters for FY-08. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l-1)	Bottom type
Young-of-the year	24.2 --	26.0 --	3.0 --	56.0 --	5.6 --	Sand/Silt/Clay
Juvenile	-- --	-- --	-- --	-- --	-- --	--
Adult	-- --	-- --	-- --	-- --	-- --	--

Table 55. Summary of the habitat associations for skates and rays in Mississippi coastal waters for FY-08. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance unless otherwise stated.

Species	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Atlantic stingray	29.4	16.0	2.7	78	6.7	Silt/Sand/Clay
	--	--	--	--	--	
Cownose ray	26.0	24.0	3.0	114.3	6.5	Sand/Slit/Clay
	(21.5-29.4)	(16.0-28.8)	(2.7-4.5)	(75.0-168.0)	(4.8-6.7)	

Table 56. Summary of CPUE (number of animals/net/hour) for elasmobranchs by life history stage sampled in Terrebonne Bay, Louisiana for FY-08. Means (standard deviations) are presented. Young-of-the-year includes neonate life stage. Sexes are combined. Specimens with an undetermined life stage are included in total CPUE calculation. Species are listed alphabetically by common name.

(a) Atlantic sharpnose shark, *Rhizoprionodon terraenovae*

Life stage	Terrebonne Bay
Young-of-the-year	0.19 (0.58)
Juveniles	--
Adults	0.04 (0.11)
All	0.23 (0.58)

(b) Blacktip shark, *Carcharhinus limbatus*

Life stage	Terrebonne Bay
Young-of-the-year	0.72 (1.4)
Juveniles	--
Adults	--
All	0.72 (1.4)

(c) Cownose ray, *Rhinoptera bonasus*

Life stage	Terrebonne Bay
Young-of-the-year	--
Juveniles	--
Adults	0.11 (0.33)
All	0.69 (1.86)

(d) Finetooth shark, *Carcharhinus isodon*

Life stage	Terrebonne Bay
Young-of-the-year	0.06 (0.17)
Juveniles	--
Adults	--
All	0.06 (0.17)

Table 57. Summary of the habitat associations for the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, by life history stage in Terrebonne Bay, Louisiana, for FY-08. Sexes are combined. Young-of-the-year includes neonate life stage. Means (ranges) are presented for young-of-the-year. Raw data are presented for juveniles. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	30.4 --	19.2 --	2.29 --	50 --	9.59 --	Sand
Juveniles	-- --	-- --	-- --	-- --	-- --	--
Adults	26.5 --	18.8 --	2.73 --	45 --	7.2 --	--

Table 58. Summary of the habitat associations for the blacktip shark, *Carcharhinus limbatus*, by life history stage in Terrebonne Bay, Louisiana, for FY-08. Young-of-the-year includes neonate life stage. Means (ranges) are presented for young-of-the-year. Raw data are presented for juveniles and adults. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	29.3 (26.5-31.0)	18.9 (18.6-19.2)	2.38 (2.13-2.73)	50 (45-55)	5.4 (7.2-9.6)	Clay/Shell/Mud Sand
Juveniles	-- --	-- --	-- --	-- --	-- --	--
Adults	-- --	-- --	-- --	-- --	-- --	--

Table 59. Summary of the habitat associations for the cownose ray, *Rhinoptera bonasus*, by life history stage in Terrebonne Bay, Louisiana, for FY-08. Young-of-the-year includes neonate life stage. Raw data are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Undetermined	30.7 (30.4-31.0)	18.9 (18.6-19.2)	7.3 (7.0-7.3)	52.5 (50-55)	8.9 (8.3-9.6)	--
Adults	31 --	18.6 --	2.13 --	55 --	8.3 --	Mud/Shell/Clay

Table 60. Summary of the habitat associations for the finetooth shark, *Carcharhinus isodon*, by life history stage in Terrebonne Bay, Louisiana, for FY-08. Young-of-the-year includes neonate life stage.

Raw data are presented. Bottom type is presented in descending predominance unless otherwise stated.

Life stage	Temperature (°C)	Salinity	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year	26.5	18.8	2.73	45	7.2	--
	--	--	--	--	--	
Juveniles	--	--	--	--	--	--
	--	--	--	--	--	
Adults	--	--	--	--	--	--
	--	--	--	--	--	

Table 61. FY-08 recapture information for sharks tagged in GULFSPAN and NOAA Fisheries Mississippi Labs surveys. Data are sorted by days at liberty in descending order. -- indicates minimal (<5 km) distance moved.

Species Common Name	Sex	Mode of Recapture	Days at Liberty	Distance Moved (km), Direction	Location Tagged	Location Recaptured
Atlantic sharpnose shark	M	GULFSPAN	1938	48, W	Florida; St. Joseph Bay	Florida; Crooked Island Sound
Atlantic sharpnose shark	M	Recreational Angler	1146	--	Florida; Crooked Island Sound	Florida; Crooked Island Sound
Atlantic sharpnose shark	M	Recreational Angler	640	16, W	Florida; Crooked Island Sound	Florida; St. Andrew Bay near Old Pass
Atlantic sharpnose shark	M	Recreational Angler	612	11, W	Florida; St. Joseph Bay	Florida; Mexico Beach
Spinner shark	F	Commercial Longline	491	420, W	Florida; Gulf-side St. Vincent Island	Louisiana; Southwest Pass
Tiger shark	M	Recreational Angler	466	254, SE	Florida; South of Apalachee Bay	Florida; Bradenton Beach
Gulf smooth hound	F	Recreational Angler	333	10, E	Louisiana; Offshore Mississippi Delta	Louisiana; South Pass Block 83A
Atlantic sharpnose shark	M	Recreational Angler	297	--	Florida; Crooked Island Sound	Florida; Crooked Island Sound
Florida smooth hound	F	Commercial Trawler	262	835, SW	Louisiana; Offshore Mississippi Delta	Texas; Offshore Port Isabel/Brownsville
Blacktip shark	F	Recreational Angler	186	6, SE	Florida; Crooked Island Sound	Florida; Gulf-side St. Vincent Island
Atlantic sharpnose shark	M	Recreational Angler	157	129, NE	Florida; St. Joseph Bay	Florida; St. Marks River Lighthouse
Atlantic sharpnose shark	M	Recreational Angler	36	--	Florida; Crooked Island Sound	Florida; Crooked Island Sound
Bonnethead	F	GULFSPAN	35	--	Florida; Crooked Island Sound	Florida; Crooked Island Sound
Atlantic sharpnose shark	M	Recreational Angler	31	--	Florida; St. Joseph Bay	Florida; St. Joseph Bay
Cownose ray	Unk	Recreational Angler	22	12	Alabama; Point Aux Pins	Alabama; Dauphin Island Bridge
Atlantic sharpnose shark	M	Recreational Angler	13	--	Florida; Crooked Island Sound	Florida; Crooked Island Sound
Bonnethead	F	Recreational Angler	11	--	Florida; Crooked Island Sound	Florida; Crooked Island Sound
Atlantic sharpnose shark	M	Recreational Angler	5	--	Florida; Crooked Island Sound	Florida; Crooked Island Sound

Figure 1. Locations of sets made in FY-08 for areas in St. Andrew Bay and Crooked Island Sound in northwest Florida. The opening to St. Andrew Bay located at approximately 30^{o}5'N is no longer open.

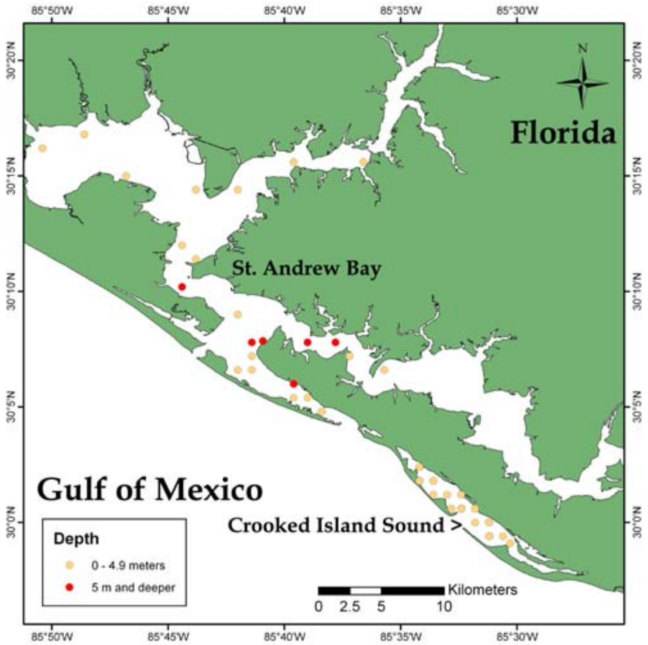

Figure 2. Locations of sets made in FY-08 for areas in St. Joseph Bay, the gulf-side of St. Vincent Island, and Apalachicola Bay in northwest Florida.

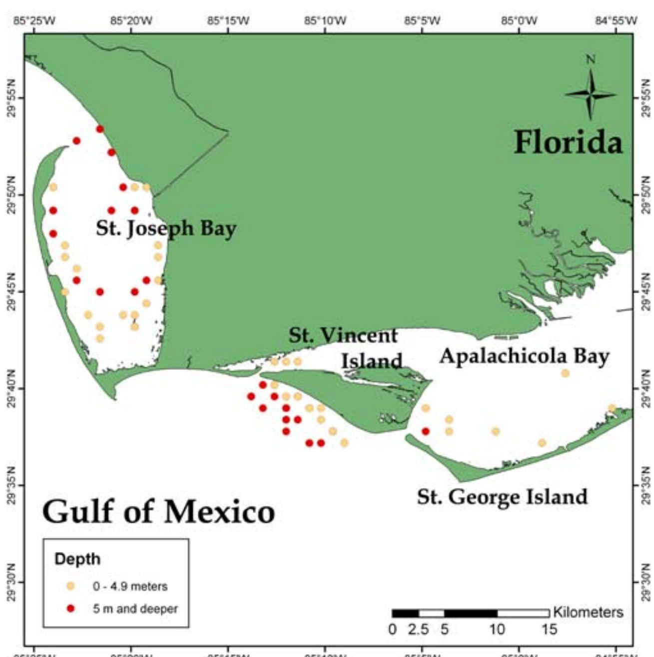

Figure 3. CPUE by month and life stage for four most encountered shark species collected in all areas combined in northwest Florida, FY08.

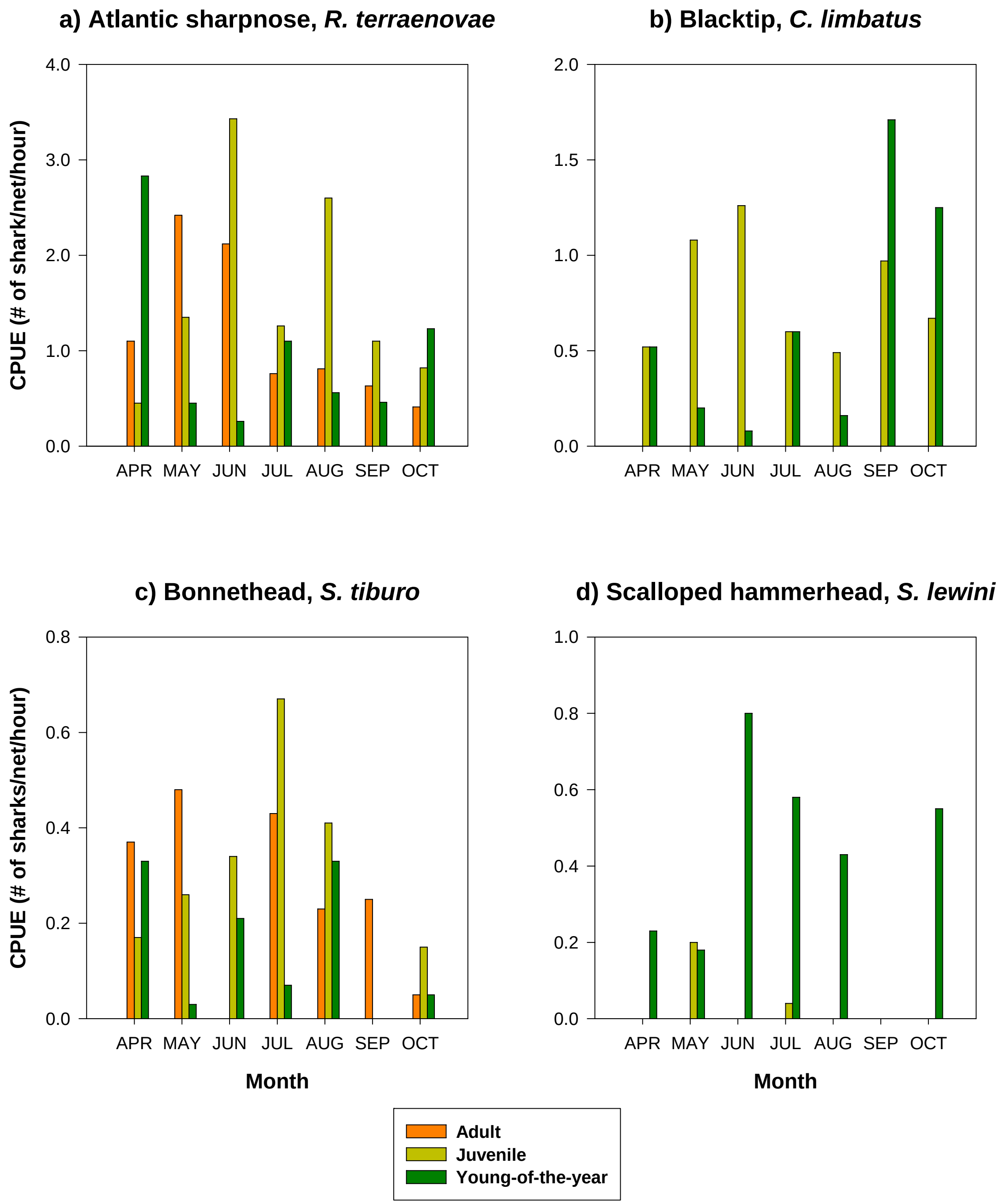

Figure 4. CPUE by time for four most encountered species collected in Crooked Island Sound, FL, in northwest Florida, FY-08, by life stage. Dawn = 0400-0900, Day = 0900-1500, Dusk = 1500-2100.

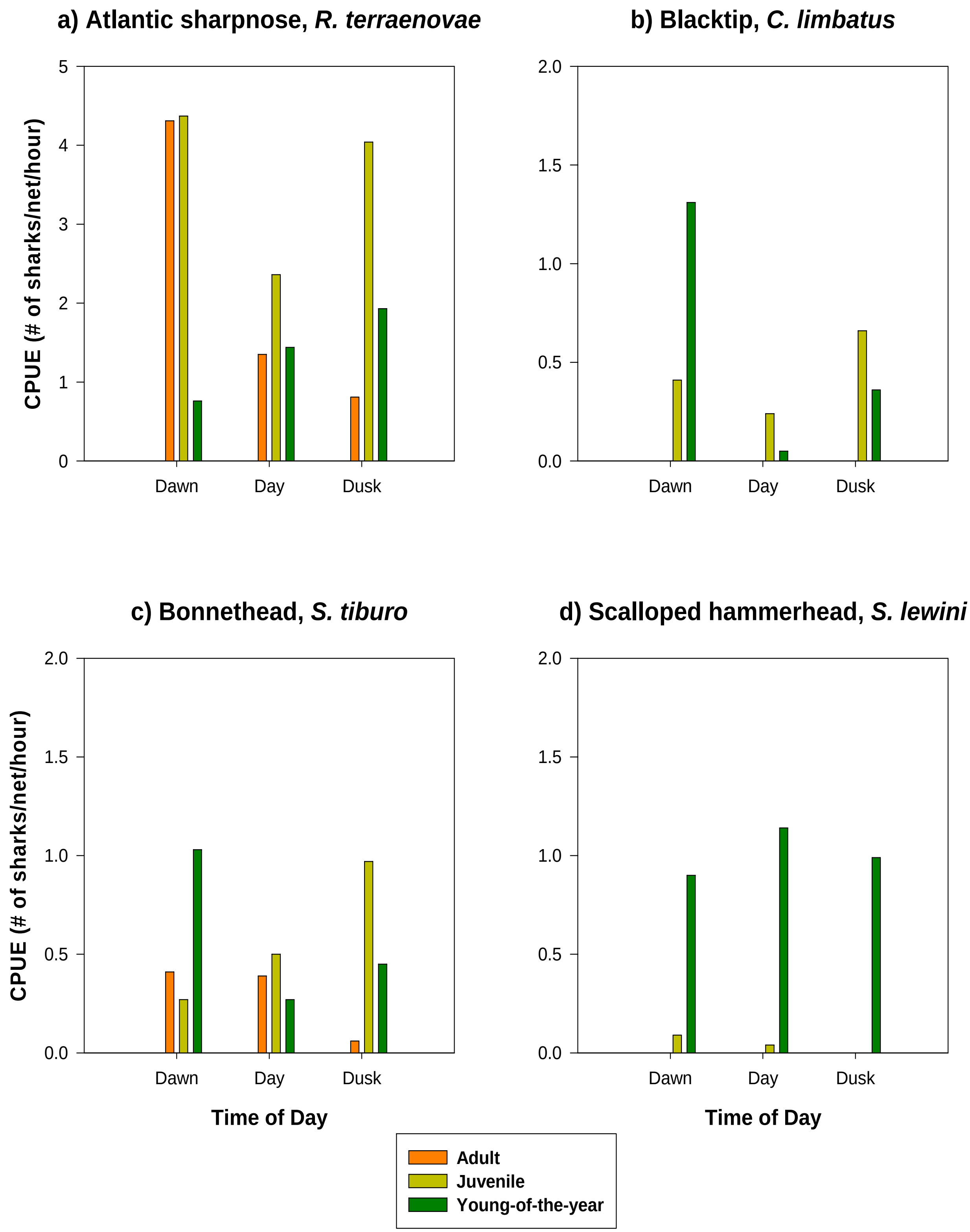

Figure 5. CPUE by time for other species collected in Crooked Island Sound, FL, in northwest Florida, FY-08.

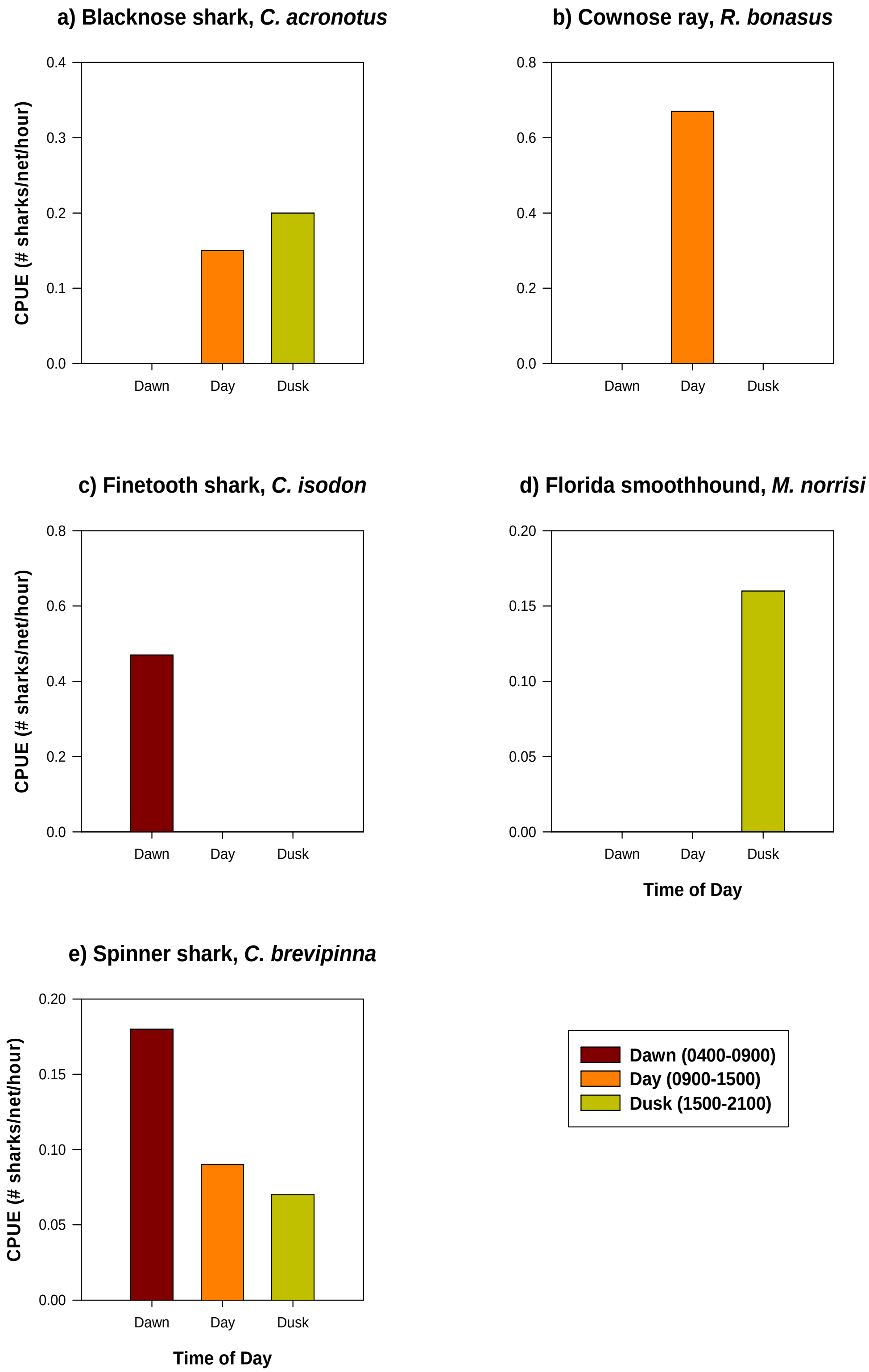

Figure 6. Generalized additive model function of adult Atlantic sharpnose shark CPUE in relation to turbidity/water clarity for sets made in northwest Florida GULFSPAN FY03-08. Turbidity/water clarity is measured as the depth of the photic zone using a secchi disk (turbidity, in cm). The model is significant at p=0.027 and shows high correlation in CPUE with turbidity/water clarity 125-250 cm.

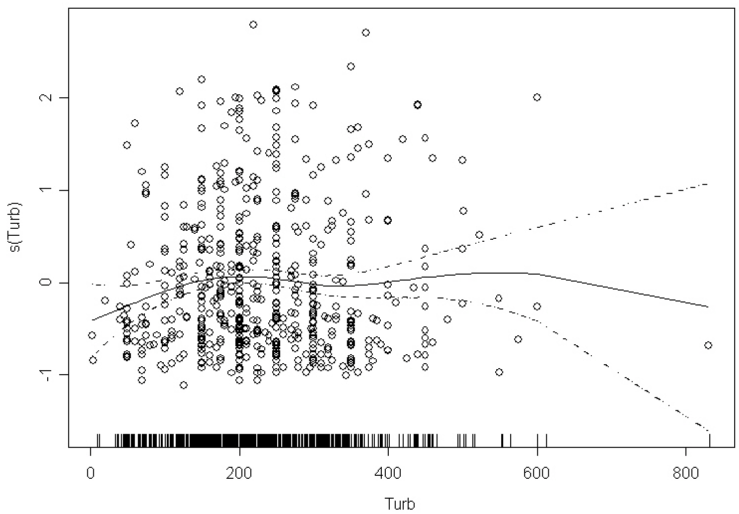

Figure 7. Generalized additive model function of adult Atlantic sharpnose shark CPUE in relation to salinity for sets made in northwest Florida GULFSPAN FY03-08. Salinity is measured using an YSI environmeter. The model is significant at p=0.041 and shows high correlation in CPUE with salinity 30-35.

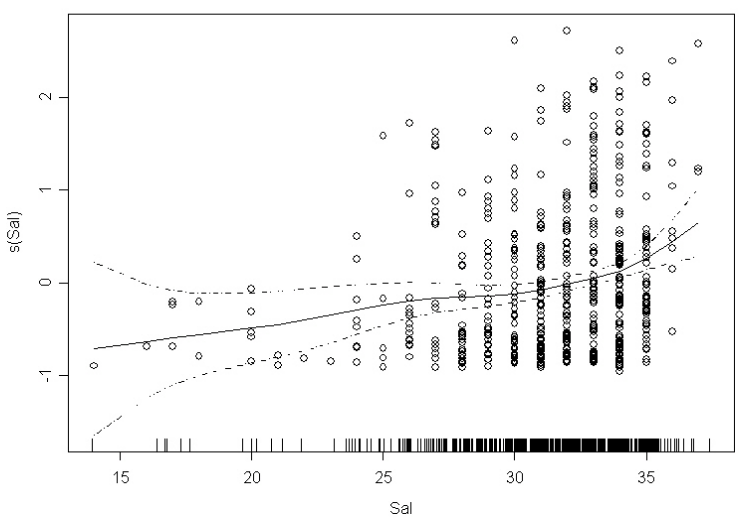

Figure 8. Generalized additive model function of juvenile blacktip shark CPUE in relation to turbidity/water clarity for sets made in northwest Florida GULFSPAN FY03-08. Turbidity/water clarity is measured as the depth of the photic zone using a secchi disk (turbidity, in cm). The model is significant at p=0.002 and shows high correlation in CPUE with turbidity/water clarity 150-300 cm.

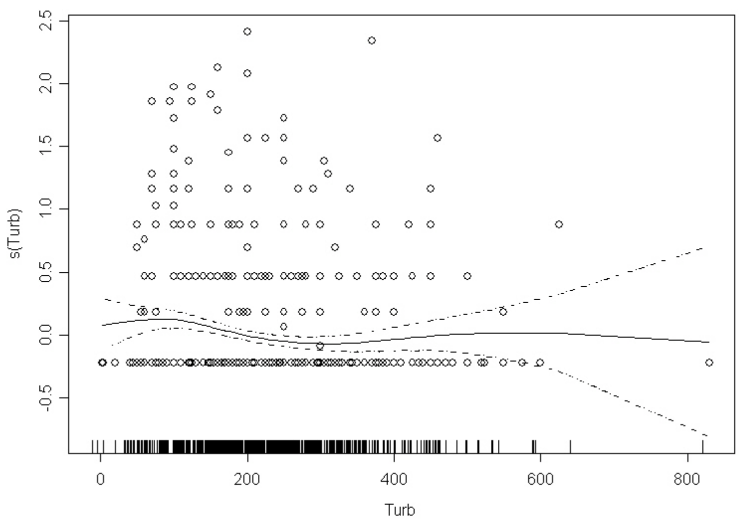

Figure 9. Generalized additive model function of bonnethead shark CPUE (life stages combined) in relation to salinity for sets made in northwest Florida GULFSPAN FY03-08. Salinity is measured using an YSI environmeter. The model is significant at p=0.032 and shows high correlation in CPUE with salinity 32-35.

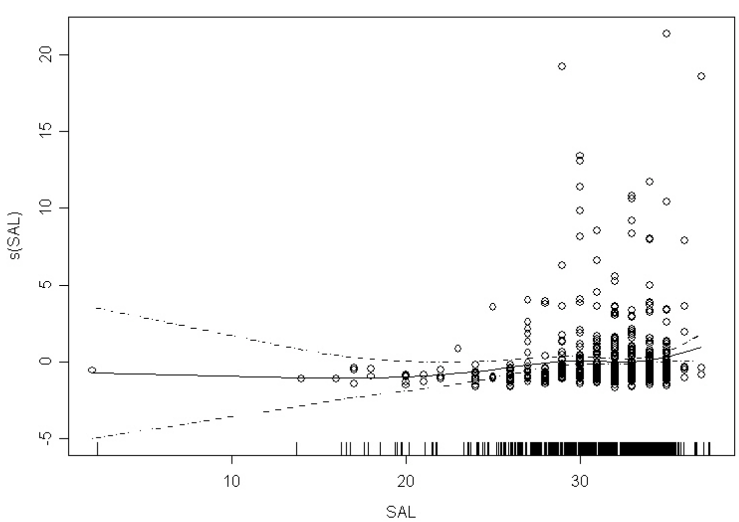

Figure 10. Generalized additive model function of scalloped hammerhead CPUE (life stages combined) in relation to turbidity/water clarity for sets made in northwest Florida GULFSPAN FY03-08. Turbidity/water clarity is measured as the depth of the photic zone using a secchi disk (turbidity, in cm). The model is significant at p=0.042 and shows high correlation in CPUE with turbidity/water clarity 150-250 cm.

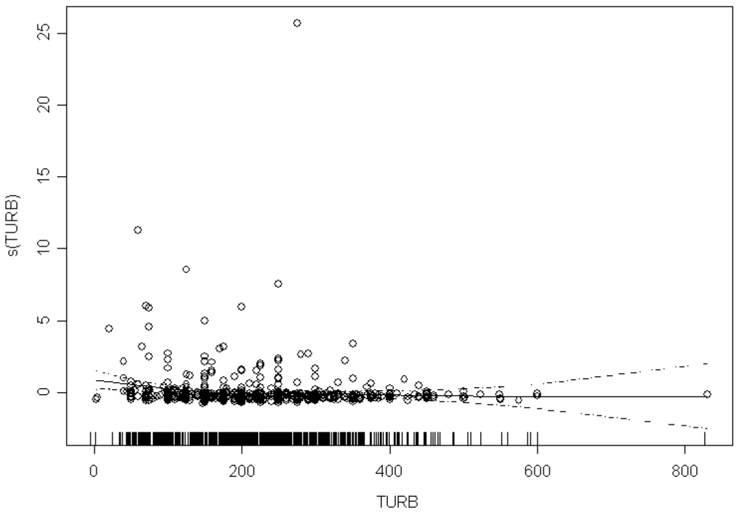

Figure 11. Locations of gillnet (N=25) and longline (N=11) sets in FY-08 in the area of St. George Sound.

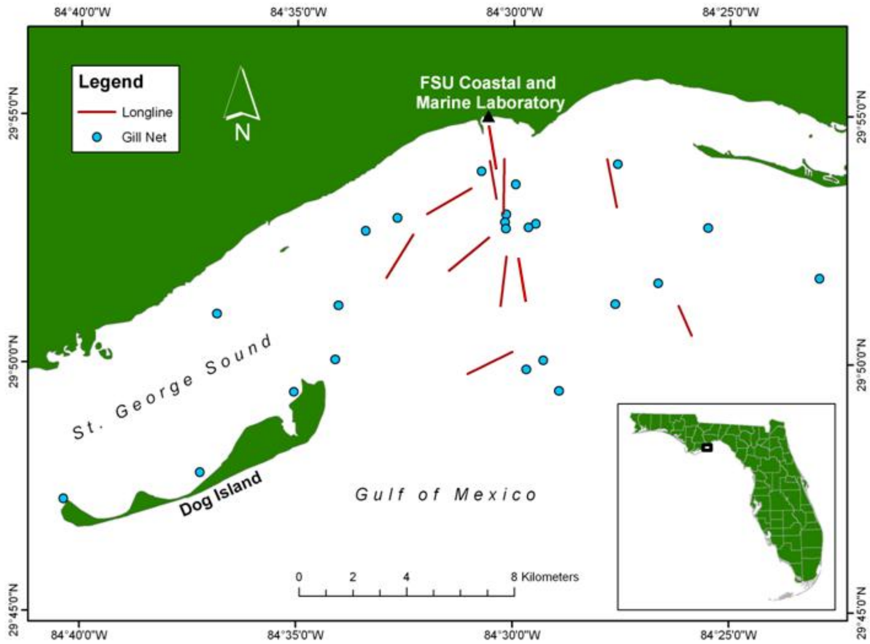

Figure 12. Cedar Key Region station map for FY-08 with the Suwannee Sound, Cedar Key, and Waccasassa Bay regions delineated.

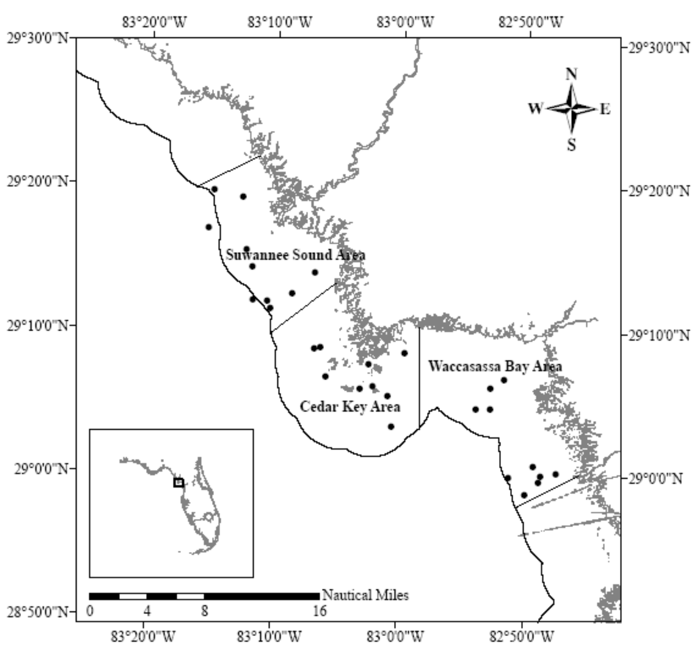

Figure 13. Locations of sets (n=94) made in Alabama coastal waters, FY-08.

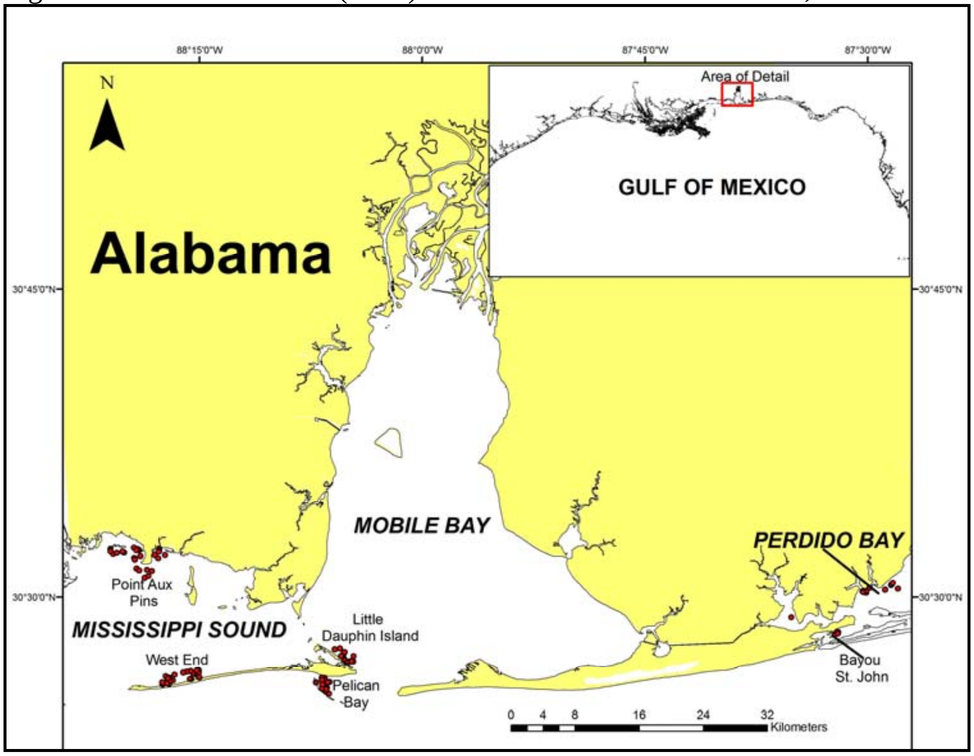

Figure 14. Locations of sets (n=44) made in Mississippi coastal waters, FY-08.

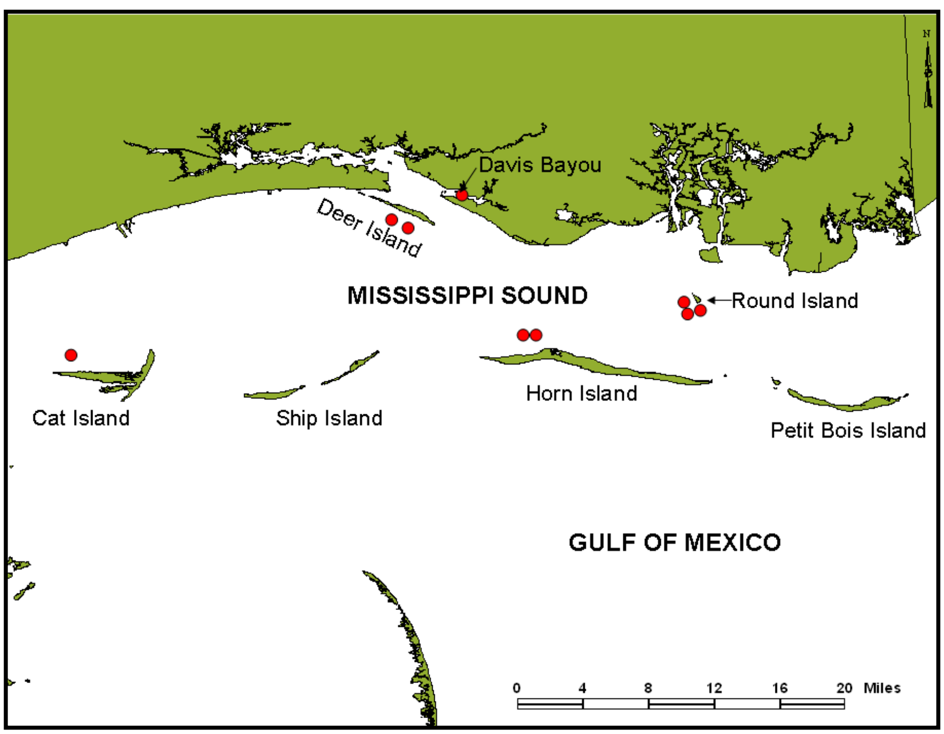

Figure 15. Locations of sets (n=9) made in Louisiana coastal waters, FY-08.