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SHARK NURSERY GROUNDS AND ESSENTIAL FISH HABITAT STUDIES

Report on 2022 Field Activities in the Gulf of Mexico Shark Pupping and Nursery Survey (GULFSPAN)

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INTRODUCTION

This report describes results from the cooperative Gulf of Mexico Shark Pupping and Nursery (GULFSPAN) survey for 2022. The GULFPSAN survey began in 2003 to examine the distribution and abundance of juvenile sharks in coastal areas of the Gulf of Mexico. The ultimate intent of this survey is to continue to describe and further refine shark essential fish habitat as mandated by the Magnuson-Stevens Fishery Conservation and Management Act (US DOC 2007). NOAA Fisheries Panama City Laboratory oversees the survey and provides gillnet gear and tags. Individual collaborators are responsible for collection, storing, and compiling their data as well as writing their section of the year-end report. This year, collaborators included (from west to east): the University of Southern Mississippi Gulf Coast Research Laboratory (Mississippi Sound, Mississippi), NOAA Fisheries Panama City Laboratory (Northwest Florida), Florida State University Coastal and Marine Laboratory (Big Bend of Florida), and New College of Florida (southern Tampa Bay and Sarasota Bay, Florida).

METHODS

The survey was modeled after methods developed by Carlson and Brusher (1999). A monofilament gillnet consisting of six different stretched-mesh size panels was used for sampling in all areas by all institutions. Stretched-mesh sizes ranged from 7.6 centimeters (cm) (3.0 inches [in]) to 14.0 cm (5.5 in) in steps of 1.3 cm (0.5 in). Each panel was 3.0 meters (m) (10 feet [ft]) deep and 30.5 m (100 ft) long. Panel specifics can be found in Baremore et al. (2012). The six panels were strung together and fished as a single gear (i.e. set). Florida State University Coastal and Marine Laboratory and the New College of Florida fished experimental longline sets concurrently with gillnet sets (See Regions 3 and 4 for gear and method specifics). The survey was conducted from April – October in coastal bays, estuaries, and around barrier islands, covering more than 550 kilometers (km) of coastline (out to three nautical miles (nm); Figure 1).

Individual sampling strategies may have differed between institutions; however, in general, sets were chosen randomly and the gear was fished either perpendicular to shore or with the wind. All gillnet sets were made during daylight hours (07:00-18:00). For each set, mid-water temperature (degrees Celsius [°C]), salinity (PPT), and dissolved oxygen (milligrams per liter [mg l^{-1}]) were recorded using an environmental meter (YSI Inc./Xylem Inc.). Average depth (m) was calculated using gear start and end points recorded from the vessel's depth finder, and water clarity (depth of the photic zone, cm) was measured by Secchi disc. At times, not all environmental parameters were recorded due to logistics.

Set soak time was defined from the time the gear entered the water to the time the gear was removed completely from the water. Haul back typically started 0.5-1.0 hours after the gear first entered the water. After haul back, the gear was moved to a different location, beginning a new set. Catch-per-unit-effort (CPUE) was used to assess abundance of each species-life stage in each area and was defined as the number of a species-life stage caught in a geographic area divided by set soak time (standardized

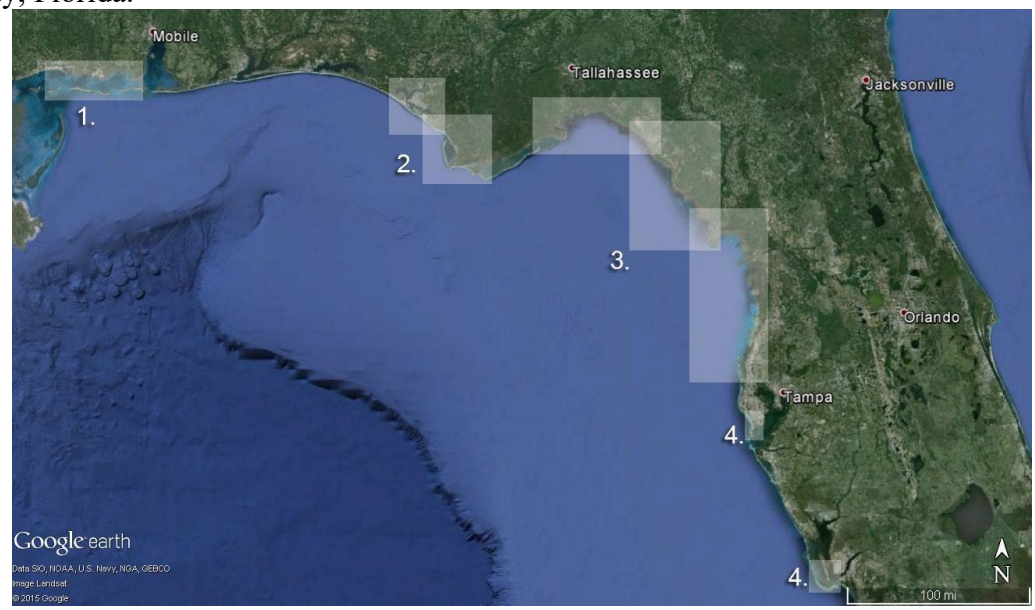
to gillnet hour). CPUE is presented by area and species-life stage for sharks and batoids (e.g., young-of-the-year Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, in Crooked Island Sound).

Elasmobranchs were measured (pre-caudal length (PCL), fork length (FL), and stretch total length (STL), in cm for sharks; disc-width (DW) in cm for batoids; sexed, assigned a life stage, and, if in good condition, tagged externally on the first dorsal fin with either a Roto-tag (Premier 1 Supplies), a plastic-headed streamer dart-tag (sharks <120 cm STL; ©Floy Tag & Mfg., Inc.), a metal-headed streamer dart tag (sharks ≥120 cm STL; ©Floy Tag & Mfg., Inc.), or a plastic coated cinch-loop tag through the spiracle (batoids only; ©Floy Tag & Mfg., Inc.), and released. Elasmobranchs in poor condition were sacrificed for life history studies.

Neonates were defined as having an open umbilical scar and young-of-the-year were defined as having a closed, but visible, umbilical scar. Mature individuals were defined based on macro-analysis or published accounts of 50% size-at-maturity. Captured teleosts were measured (FL and/or STL in cm) and released.

Regions Sampled in the 2022 GULFSPAN Survey

Region 1: Mississippi Sound; Region 2: St. Andrew Bay to St. Vincent Island, Florida; Region 3: The Big Bend of Florida – St. George Sound to Anclote Key, Florida; Region 4: Southern Tampa Bay, Florida and Sarasota Bay, Florida.



REGION 1: MISSISSIPPI SOUND, MISSISSIPPI (UNIVERSITY OF SOUTHERN MISSISSIPPI GULF COAST RESEARCH LABORATORY)

The coastal waters of the Mississippi Sound were divided into three regions (east, central, west). Each region was allotted seven random stations generated in either the 2 - 2.9 m (inshore) or the 3 - 10 m (offshore) depth zone based on proportion present in the region (Figure 1). Three stations from at least two regions were sampled monthly (April to October). Sampling was conducted using a 183 x 3 m gillnet with six, 30.5 m panels of varying mesh sizes (7.6, 8.9, 10.2, 11.4, 12.7, and 14.0 cm stretch length). After the gear fished for one hour, sharks and rays were removed from the net, identified to species, measured [sharks: stretch total length (STL), fork length (FL), and pre-caudal length (PCL); rays: disc width (DW)], weighed (kg), a sex was determined, and were then released at the capture site. Sharks deemed in good condition were tagged with either a 3 inch dart tag (Hallprint) or a Roto tag (Premier 1 Supplies) prior to release. Sharks in poor condition were saved for life history studies. At each station the depth (m) was determined using a depth finder (Garmin), water clarity was measured using a Secchi disc (cm), and bottom water parameters [temperature (°C), salinity, dissolved oxygen (mg l^{-1})] were determined using a YSI-Professional Plus multi-parameter meter (Yellow Springs Instruments). Sampled stations were grouped into one of six regions (west offshore, central offshore, east offshore, west inshore, central inshore, east inshore) for catch analysis.

Results

A total of 21 gillnet sets were conducted in the Mississippi Sound between April and October 2022 (Figure 2). This resulted in the capture of 57 sharks of five species and 17 rays of two species.

Abundance Trends

The Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, (n=17; females: 33.4 – 60.0 cm FL, mean = 38.8 cm FL; males: 33.1 – 66.9 cm FL, mean = 48.1 cm FL; 1 unknown), was the most abundant species encountered, and made up 29.8% of the shark catch. All three life stages (young-of-the-year, juvenile, adult) were encountered which is typical for this species in the region. The bull shark, *Carcharhinus leucas,* (n=16; females: 58.9-97.2 cm FL, mean = 80.9 cm FL; males: 55.4 - 105.5 cm FL, mean = 80.3 cm FL; 4 unknown), was the second most abundant species (28.1% of shark catch). Young-of-the-year and juveniles were encountered. Ten finetooth shark, *Carcharhinus isodon*, (n=10; female: 41.4 - 42.9 cm FL, mean = 42.3 cm FL; male: 42.0-52.7 cm FL, mean = 48.0cm FL; 1 unknown) were caught (17.5% of shark catch). The catch was made up entirely of young-of-the-year. Nine blacktip shark, *Carcharhinus limbatus*, (n=9; females: 89.1 - 96.8 cm FL, mean = 93.0 cm FL; males: 84.5 - 108.5 cm FL, mean = 95.6 cm FL), were caught (15.8% of shark catch). All three life stages of this species were encountered. Bonnethead, *Sphyrna tiburo*, (n = 3; male: 77.9 – 81.0 cm FL, mean = 78.9 cm FL), were caught in the fewest numbers and all were of adult stature.

The majority of the shark catch (n=40, 70.2% of those indicated for maturity) was of juvenile or young-of-the-year stature, which is consistent with the catch from previous years and implies that the Mississippi Sound is an important region for these species as they mature.

Two species of rays were encountered, the cownose ray, *Rhinoptera bonasus,* (n=15; female 38.9 – 83.2 cm DW, mean = 74.5 cm DW; male: 34.3-84.3 cm DW, mean = 69.9 cm DW), and the Brazilian cownose ray, *Rhinoptera brasiliensis* (n = 1; male; 34.3 cm DW). Juveniles and adults were encountered.

Catch-per-unit-effort by area

Sampling in the west offshore region took place in April, July, and September, two miles northeast, four miles southeast, and three miles southwest of Gulfport, respectively (Figure 2). This region is heavily influenced by Pearl River drainage and is characterized by sand, silt, or mud bottom. Catch per unit effort (CPUE) was 2.5 elasmobranchs per net hour (see Figure 3 for individual station CPUEs). Elasmobranch catch occurred at the July and September stations, while the stations conducted in April yielded no elasmobranchs. The July station resulted in the encounter of two juvenile blacktip sharks and seven young-of-the-year Atlantic sharpnose sharks. The September station resulted in the encounter of two juvenile bull sharks and one adult blacktip shark. The juvenile blacktip shark CPUE was 0.45 sharks per net hour, while the adult blacktip CPUE was 0.18 sharks per net hour. The CPUE of Atlantic sharpnose sharks was 1.57 sharks per net hour. The juvenile bull shark CPUE was 0.35 sharks per net hour (Table 1).

Sampling in the central offshore region took place northwest of west Ship Island in April and June, and north of mid-Ship Island in August and October. This region has little riverine influence and is characterized by sand, silt, or mud bottom with sparse grass beds present near the islands. The CPUE was 2.2 elasmobranchs per net hour (see Figure 3 for individual station CPUEs). The April, August, and October stations resulted in the encounter of three species. Four Atlantic sharpnose sharks (one adult, CPUE = 0.22; one juvenile, CPUE = 0.14; one young-of-the-year, CPUE = 0.14; one unknown, CPUE = 0.14) were caught (Table 1). Three adult bonnethead (CPUE = 0.42 sharks per net hour) were encountered at the April station. One cownose ray (one adult, CPUE = 0.21 rays per net hour) was encountered in August. The station conducted in June yielded no elasmobranchs.

The east offshore region was sampled in May, June, July, and October. One station was located north of central Horn Island (May), one station was located north of the east tip of Horn Island (June), and two stations were located north of the western end of Petit Bois Island (July, October). This region has moderate influence from the Pascagoula River and is characterized by mud, silt, and sand bottom, and sparse artificial reef structure. This region had a CPUE of 0.3 elasmobranchs per net hour (see Figure 3 for individual station CPUEs) consisting of one elasmobranch species. One juvenile blacktip shark was encountered in this region in May (CPUE = 0.26 sharks per net hour; Table 1). The other three stations yielded no elasmobranchs.

The west inshore region was sampled south of Waveland in May, southeast of Gulfport in July, southeast of the mouth of St. Louis Bay in August, and south of Long Beach in September. This area is greatly influenced by the Jourdan and Wolf rivers. This region resulted in the greatest CPUE of the regions at 3.8 elasmobranchs per net hour (see Figure 3 for individual station CPUEs). Three species of sharks (finetooth shark, CPUE = 1.22; bull shark, CPUE = 0.82, and Atlantic sharpnose shark, CPUE = 0.67 sharks per net hour), and one ray (cownose ray, CPUE = 0.77 rays per net hour) were encountered in this region. The finetooth shark catch consisted of six young-of-the-year individuals (CPUE = 1.04) and one of unknown maturity (CPUE = 0.19; escaped). Four young-of-the-year (CPUE = 0.28), four juvenile (CPUE = 0.40), and two of unknown maturity (CPUE = 0.14; escaped) bull sharks were encountered. Only young-of-the-year (n = 4, CPUE = 0.67) Atlantic sharpnose sharks were encountered. One cownose ray of unknown maturity (escaped, CPUE = 0.25), and 11 adult Brazilian cownose rays (CPUE = 0.77) were encountered in this region.

The central inshore region was sampled south and southeast of Bellefontaine Coastal Preserve in April and June, and south of Deer Island in August. This area is directly influenced by the riverine outflow from Biloxi Bay and is characterized by mud, silt, fine sand, and oyster reef bottom. The region had a CPUE of 2.5 elasmobranchs per net hour (see Figure 3 for individual station CPUEs). Six species of elasmobranchs were caught. Bull sharks made up the highest CPUE at 0.60 sharks per net hour. Two young-of-the-year finetooth shark (CPUE = 0.42), one blacktip shark of unknown maturity (CPUE = 0.21, escaped), and one young-of-the-year Atlantic sharpnose shark (CPUE = 0.20) were also caught in this region. Juveniles of both species of *Rhinoptera* rays were encountered; two cownose rays (CPUE =0.42) and one Brazilian cownose ray (CPUE = 0.21) were caught (Table 1).

The east inshore region was sampled just south of Grand Bay National Estuarine Research Reserve in May, and south of the Chevron Pascagoula Refinery in September and October. This region has high influence from the Pascagoula River and is usually characterized by a mud and silt bottom. The CPUE was 1.3 elasmobranchs per net hour (see Figure 3 for individual station CPUEs). This region yielded three species. One young-of-the-year finetooth shark yielded a CPUE of 0.16 sharks per net hour. Blacktip sharks of all stages were encountered with a CPUE of 0.90 sharks per net hour; two juvenile at 0.48 sharks per net hour, one young-of-the-year at 0.48 sharks per net hour, and one of unknown maturity at 0.48 sharks per net hour). One adult Atlantic sharpnose shark was encountered at a rate of 0.26 sharks per net hour.

Species Habitat Profiles

Our descriptions of habitat profiles first focus on the shark catch followed by the ray catch. Species descriptions occur in order of descending abundance. Similar to previous years, the Atlantic sharpnose shark was the most commonly encountered shark. All three life stages were encountered, but young-of-the-year individuals dominated the catch at 87%. Young-of-the-year individuals were found both inshore and offshore; however, the catch per unit effort of young-of-the-year individuals in the

offshore stratum was almost twice as great as the inshore stratum. While most young-of-the-year sharpnose sharks were caught in the western and central zones, no adults or juveniles were encountered in the western zones (Table 1a). The majority (84.6%) of Atlantic sharpnose sharks were caught in July, though adults were only caught in October. Environmental parameters associated with the stations of all three life-stages overlapped (Table 5).

The second most abundant species was the bull shark; sixteen individuals were caught (90% juveniles, no adults). Of the sixteen encountered, 88% were caught inshore, in waters less than four meters. As is consistent with prior years, the bull shark catch was primarily in the western zones and inshore central. The greatest catch occurred in the western inshore zone in May with a CPUE of 0.82 sharks per net hour (Table 1b), which included both juvenile and young-of-the-year individuals. The environmental parameters (depth, temperature, salinity, dissolved oxygen) for young-of-the-year and juveniles overlapped.

Ten finetooth sharks were caught, nine of which were young-of-the-year, one of which was not assigned a life stage (escaped). Eighty percent of the finetooth sharks were caught in summer months (July and August), which is consistent with previous years. When finetooth are encountered it is often of multiple individuals of a young-of-the-year cohort all caught at the same time. The CPUE in the western inshore stratum was over twice as great as the CPUE in either of the other two inshore zones (Table 1c). All individuals were caught in waters less than three meters deep (Table 6).

Blacktip sharks were encountered both offshore and inshore, in most of the zones. The young-of-the-year individual was encountered in the eastern inshore stratum, while the adult was encountered in the offshore western stratum (Table 1d). Catch consisted mainly of juveniles (55.6%). While the young-of-the-year individual was encountered in shallower water than the juveniles and adult, the low catch number makes comparisons difficult (Table 4).

Rays were a larger component of the elasmobranch catch than last year. The majority of the catch of the cownose ray and Brazilian cownose ray (94%) was inshore which is also different from prior years (Table 2a, 2b). Only one Brazilian cownose ray was encountered; a juvenile caught in the central inshore stratum. The majority of the cownose ray catch consisted of adults (86.7%). Juveniles were only encountered in the central inshore zone in June. The greatest CPUE (0.77 rays per net hour) of the cownose ray occurred in the western inshore stratum in May (Table 2a). Both species of cownose were absent from the eastern region. They were also absent from the offshore zones except for one adult encountered in the central offshore zone. The juveniles and adults occurred in similar environments, and the one Brazilian cownose ray caught was at a station where a cownose ray was also caught.

Overall, the dominance of juvenile and young-of-the-year individuals suggests the Mississippi Sound may act as an important juvenile habitat for several elasmobranch species. Due to the sampling regime put in place in 2012, the same sites are unable to be sampled monthly. It is therefore important to note that these results are only representative of the conditions at the time of sampling and likely do

not reflect the species assemblage throughout the year. As the Mississippi Sound is a very dynamic environment, seasonal/monthly shifts in abundances and size classes are likely.

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Figure 1. Sampling regions (west, central, east) in Mississippi coastal waters for 2022.

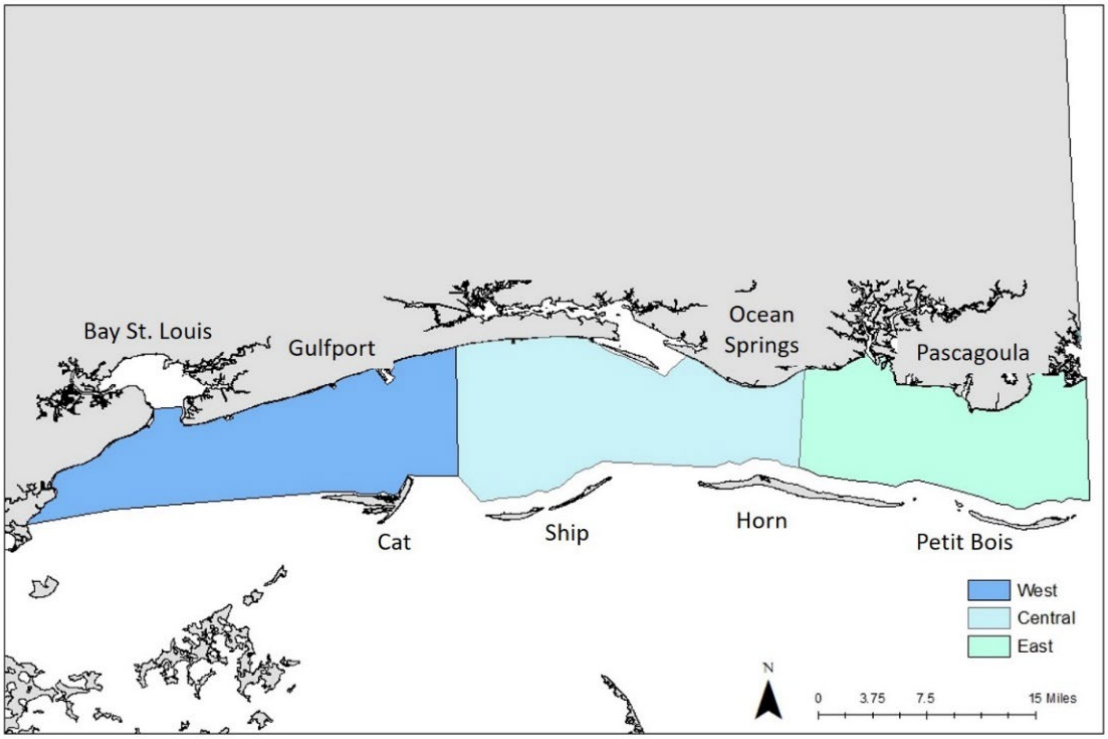


Figure 2. Locations of gillnet sets (n=21) made in Mississippi coastal waters for 2022.

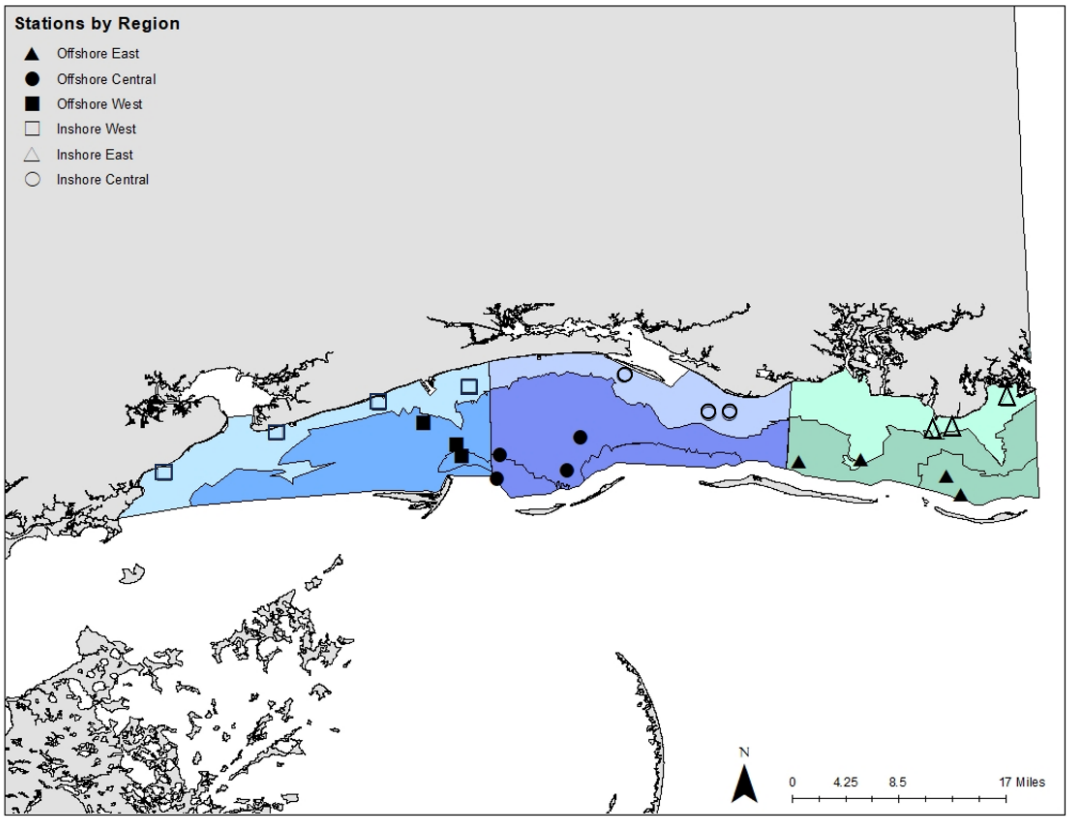


Figure 3. Elasmobranch catch per unit effort (elasmobranchs per net hour) at gillnet sampling sites in Mississippi coastal waters for 2022.

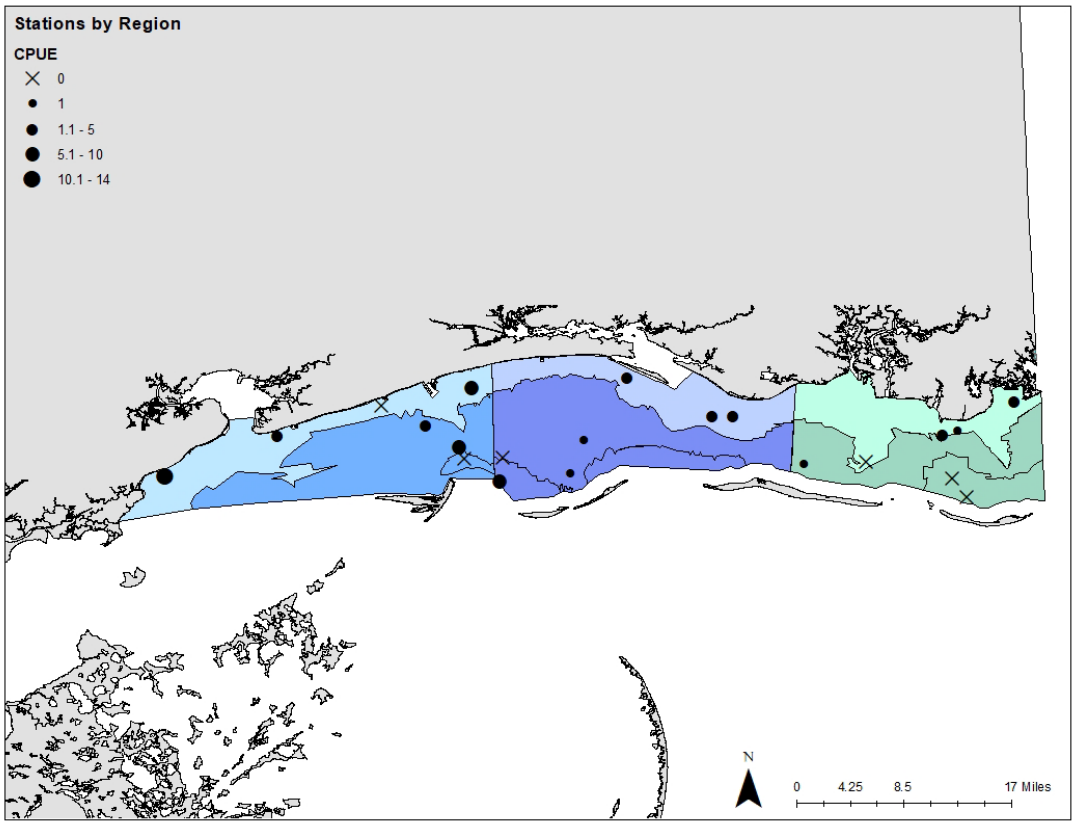


Table 1. Summary of CPUE (number of sharks per net hour) by life history stage and region for sharks caught in Mississippi coastal waters for 2022. Mean values are presented with standard deviation in parentheses. Sexes are combined. Young-of-the-year includes neonates. **Species are listed by abundance caught.**

(a) Atlantic sharpnose shark, *Rhizoprionodon terraenovae (note: 1 shark was not classified by life stage)*

Life stage	West	Central	East	Inshore West	Inshore Central	Inshore East
Young-of-the-year	1.57 (2.72)	0.14 (0.28)	--	0.67 (1.15)	0.20 (0.34)	--
Juveniles	--	0.14 (0.28)	--	--	--	--
Adults	--	0.22 (0.43)	--	--	--	0.26 (0.45)
All	1.57 (2.72)	0.64 (0.81)	--	0.67 (1.15)	0.20 (0.34)	0.26 (0.45)

(b) Bull shark, *Carcharhinus leucas (note: 3 sharks were not classified by life stage)*

Life stage	West	Central	East	Inshore West	Inshore Central	Inshore East
Young-of-the-year	--	--	--	0.28 (0.49)	--	--
Juveniles	0.35 (0.61)	--	--	0.40 (0.40)	0.41 (0.35)	--
Adults	--	--	--	--	--	--
All	0.35 (0.61)	--	--	0.82 (1.04)	0.60 (0.59)	--

(c) Finetooth shark, *Carcharhinus isodon (note:1 shark was not classified by life stage)*

Life stage	West	Central	East	Inshore West	Inshore Central	Inshore East
Young-of-the-year	--	--	--	1.04 (1.12)	0.42 (0.36)	0.16 (0.28)
Juveniles	--	--	--	--	--	--
Adults	--	--	--	--	--	--
All	--	--	--	1.22 (1.23)	0.42 (0.36)	0.16 (0.28)

(d) Blacktip shark, *Carcharhinus limbatus (note: 2 sharks were not classified by life stage)*

Life stage	West	Central	East	Inshore West	Inshore Central	Inshore East
Young-of-the-year	--	--	--	--	--	0.16 (0.28)
Juveniles	0.45 (0.78)	--	0.26 (0.61)	--	--	0.48 (0.42)
Adults	0.18 (0.30)	--	--	--	--	--
All	0.62 (0.68)	--	--	--	0.21 (0.36)	0.90 (0.57)

(e) Bonnethead shark, *Sphyrna tiburo*

Life stage	West	Central	East	Inshore West	Inshore Central	Inshore East
Young-of-the-year	--	--	--	--	--	--
Juveniles	--	--	--	--	--	--
Adults	--	0.42 (0.81)	--	--	--	--
All	--	0.42 (0.81)	--	--	--	--

Table 2. Summary of CPUE (number of rays per net hour) by life history stage and region for rays caught in Mississippi coastal waters for 2022. Mean values are presented with standard deviation in parentheses. Sexes are combined. Young-of-the-year includes neonates. **Species are listed by abundance caught.**

(a) Cownose ray, *Rhinoptera bonasus*

Life stage	West	Central	East	Inshore West	Inshore Central	Inshore East
Young-of-the-year	--	--	--	--	--	--
Juveniles	--	--	--	--	0.21 (0.36)	--
Adults	--	0.21 (0.42)	--	0.77 (1.34)	0.21 (0.36)	--
All	--	--	--	0.77 (1.34)	0.42 (0.36)	--

(b) Brazilian cownose ray, *Rhinoptera brasiliensis*

Life stage	West	Central	East	Inshore West	Inshore Central	Inshore East
Young-of-the-year	--	--	--	--	--	--
Juveniles	--	--	--	--	0.21 (0.36)	--
Adults	--	--	--	--	--	--
All	--	--	--	--	0.21 (0.36)	--

Table 3. Summary of the habitat associations for the bull shark, *Carcharhinus leucas*, by life stage in Mississippi coastal waters for 2022. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance. *(note: 3 sharks were not classified by life stage and do not show up in the analyses below)*

Life stage	Temperature (°C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	27.7	9.62	3.0	37.0	6.94	Mud
n=1	--	--	--	--	--	
Juvenile	29.3	17.3	2.9	71.8	6.3	Mud/Sand/Silt
n=9	(27.7 – 31.0)	(9.6 – 20.7)	(2.1 – 3.5)	(37.0 – 105.0)	(4.1 – 8.4)	
Adult	--	--	--	--	--	--
n=0	--	--	--	--	--	

Table 4. Summary of the habitat associations for the blacktip shark, *Carcharhinus limbatus* by life stage in Mississippi coastal waters for 2022. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance. *(note: 2 sharks were not classified by life stage and do not show up in the analyses below)*

Life stage	Temperature (°C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	26.9	19.2	1.7	61.0	6.2	Mud/Sand
n=1	--	--	--	--	--	
Juvenile	27.4	26.5	3.5	127.1	5.4	Mud/Silt
n=5	(24.4 - 29.5)	(22.3 – 30.0)	(2.8 – 4.3)	(85.0 – 188.0)	(3.5 – 7.4)	
Adult	28.7	17.8	3.5	55	6.5	Mud
n=1	--	--	--	--	--	

Table 5. Summary of the habitat associations for the Atlantic sharpnose shark, *Rhizoprionodon terraenovae,* by life stage in Mississippi coastal waters for 2022. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance. *(note: 1 sharks were not classified by life stage and do not show up in the analyses below)*

Life stage	Temperature (°C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	28.2	21.3	3.7	100.6	5.09	Silt/Mud/Sand
n=13	(23.7 – 30.4)	(17.3 – 26.7)	(2.8 – 4.8)	(85.3 – 119.0)	(3.5 – 8.1)	
Juvenile	23.7	17.1	4.8	119	8.1	Mud/Sand
n=1	--	--	--	--	--	
Adult	24.2	29.5	3.7	168.5	6.8	Mud/Silt
n=2	(23.9 - 24.4)	(29.5 – 30.3)	(2.8 – 4.6)	(149.0 – 188.0)	(6.2 – 7.4)	

Table 6. Summary of the habitat associations for the finetooth shark, *Carcharhinus isodon*, by life stage in Mississippi coastal waters for 2022. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance. *(note: 1 sharks were not classified by life stage and do not show up in the analyses below)*

Life stage	Temperature (°C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	29.3	19.7	2.6	86.9	5.7	Mud/Sand/Silt
n=9	(26.9 – 32.6)	(19.0 – 20.7)	(1.7 – 3.0)	(61.0 – 106.7)	(4.1 – 8.4)	
Juvenile	--	--	--	--	--	--
n=0	--	--	--	--	--	
Adult	--	--	--	--	--	--
n=0	--	--	--	--	--	

Table 7. Summary of the habitat associations for the bonnethead shark, *Sphyrna tiburo*, by life stage in Mississippi coastal waters for 2022. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance.

Life stage	Temperature (°C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	--	--	--	--	--	--
n=0	--	--	--	--	--	
Juvenile	--	--	--	--	--	--
n=0	--	--	--	--	--	
Adult	23.7	17.1	4.8	119.0	8.1	Mud/Sand
n=3	--	--	--	--	--	

Table 8. Summary of the habitat associations for the cownose ray, *Rhinoptera bonasus*, by life stage in Mississippi coastal waters for 2022. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance.

Life stage	Temperature (°C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	--	--	--	--	--	--
n=0	--	--	--	--	--	
Juvenile	31.0	19.0	2.1	105.0	8.4	Mud/Sand
n=2	--	--	--	--	--	
Adult	27.4	19.5	3.5	115.7	5.0	Mud/Silt
n=13	(24.9 – 29.7)	(9.1 – 21.0)	(2.7 – 4.9)	(37.0 – 175.0)	(1.0 – 7.0)	

Table 9. Summary of the habitat associations for the Brazilian cownose ray, *Rhinoptera brasiliensis*, by life stage in Mississippi coastal waters for 2022. Young-of-the-year includes neonate life stage. Means are presented. Ranges are in parentheses. Bottom type is presented in descending predominance.

Life stage	Temperature (°C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the year	--	--	--	--	--	--
n=0	--	--	--	--	--	
Juvenile	31.0	19.0	2.1	105.0	8.4	31.0
n=1	--	--	--	--	--	
Adult	--	--	--	--	--	--
n=0	--	--	--	--	--	

REGION 2: NORTHWEST FLORIDA – ST. ANDREW BAY TO ST. VINCENT ISLAND, FLORIDA (NOAA FISHERIES SEFSC PANAMA CITY LABORATORY)

Information Specific to Region 2

Sampling sites in this region were located in four major areas along the panhandle of Florida: St. Andrew Bay, Crooked Island Sound, St. Joseph Bay, and Apalachicola Bay/St. Vincent Island (Figures 1-4). A total of 49 gillnet sets were made, capturing nine species of shark and rays. This work was permitted under Florida Fish and Wildlife Conservation Commission Special Activity Licenses SAL-22-1292-SRP.

Elasmobranch catch consisted of 30% adult, 25% juvenile, and 42% young-of-the-year, including neonates. Comprising 36% of the total catch, Atlantic sharpnose shark was the most abundant shark encountered overall. Scalloped hammerhead shark was the second-most encountered species overall (27% of total catch) followed by bonnethead shark (17%) (Table 1). Average size for all elasmobranchs captured is in Table 2.

Overall, relative abundance was lowest in St. Andrews Bay and highest in Apalachicola/St. Vincent Island. Only two species were captured in St. Andrews Bay, blacktip shark and bonnethead shark. Seven species were captured in Apalachicola/St. Vincent Island but CPUE was highest in Crooked Island Sound for Atlantic sharpnose shark and scalloped hammerhead (Table 3). Essential fish habitat (EFH) profiles for elasmobranchs collected in northwest Florida from St. Andrews Bay to Apalachicola/St. Vincent Island are summarized in Tables 4-6.

Acknowledgments
We thank our interns Emma Jackson, Hannah Morales and Breanna Philips for their assistance in field work.

Region 2 Tables

Table 1. Percent contribution of total elasmobranchs by species and life stage.

Species	Percent total by species	Percent of adults within species	Percent of juveniles within species	Percent of young-of-the-year within species
Carcharhinus acronotus	0.9	50.0	0.0	50.0
Carcharhinus brevipinna	0.4	0.0	100.0	0.0
Carcharhinus isodon	1.7	75.0	0.0	25.0
Carcharhinus limbatus	14.0	3.0	69.7	27.3
Gymnura micrura	1.3	66.7	0.0	0.0
Rhinoptera bonasus	0.9	0.0	0.0	100.0
Rhizoprionodon terraenovae	36.2	43.5	8.2	44.7
Sphyrna lewini	27.7	20.0	7.7	67.7
Sphyrna tiburo	17.0	35.0	55.0	7.5

Table 2**.** Elasmobranch average size by area. FL = fork length. DW = disc width. Number in parenthesis are standard deviation of the mean.

Area	Species	Sex	Average FL (cm)	Average DW (cm)
Crooked Island Sound	*Carcharhinus acronotus*	M	37.0	
	Carcharhinus isodon	F	106.0	
	Carcharhinus limbatus	F	66.4 (20.0)	
		M	58.0 (2.8)	
	Rhizoprionodon terraenovae	F	42.4 (10.6)	
		M	59.4 (15.4)	
	Sphyrna lewini	F	40.3 (5.2)	
		M	40.5 (6.6)	
	Sphyrna tiburo	F	62.4 (8.1)	
		M	58.2 (5.6)	
Apalachicola Bay/Indian Pass	*Carcharhinus brevipinna*	F	58.0	
	Carcharhinus isodon	M	88.2 (38.8)	
	Carcharhinus limbatus	F	73.3 (19.5)	
		M	95.3 (29.0)	

	Gymnura micrura	M		31.5 (0.7)
	Rhinoptera bonasus	F		38.0
		M		42.0
	Rhizoprionodon terraenovae	M	71.3 (5.4)	
	Sphyrna lewini	F	45.3 (2.2)	
		M	50.8 (20.0)	
St. Andrew Bay	*Carcharhinus limbatus*	F	60.7 (3.2)	
	Sphyrna tiburo	F	69.0	
St. Joe Bay	*Carcharhinus acronotus*	M	88.7	
	Carcharhinus limbatus	F	68.0 (26.4)	
		M	48.1 (8.8)	
	Dasyatis americana	F		48.0 (24.0)
	Rhizoprionodon terraenovae	F	42.2 (7.2)	
		M	67.1 (9.4)	
	Sphyrna lewini	M	42.9 (11.5)	
		F	64.0	

Table 3. Summary of CPUE (number of animals per net hour) for elasmobranchs by life history stage and area sampled in northwest Florida for 2022. Numbers in parenthesis are standard deviations of the mean. 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 scientific name.

(a) *Carcharhinus acronotus*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay/St. Vincent Island
Young-of-the-year	--	0.13 (0.52)	--	--
Juveniles	--	--	--	--
Adults	--	--	0.08 (0.30)	--

(b) *Carcharhinus isodon*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay/St. Vincent Island
Young-of-the-year	--	--	--	0.09 (0.26)
Juveniles	--	--	--	--
Adults	--	--	--	0.38 (0.75)

(c) *Carcharhinus limbatus*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay/St. Vincent Island
Young-of-the-year	--	0.52 (1.24)	--	0.64 (1.41)
Juveniles	0.32 (0.82)	0.32 (0.98)	0.01 (0.42)	0.76 (0.87)
Adults	--	--	--	0.09 (0.26)

(d) *Gymnura micrura*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay/St. Vincent Island
Young-of-the-year	--	--	--	--
Juveniles	--		--	--
Adults	--	--	--	0.50 (0.93)

(e) *Rhinoptera bonasus*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay/St. Vincent Island
Young-of-the-year	--	--	--	0.27 (0.77)
Juveniles	--	--	--	--
Adults	--	--	--	--

(f) *Rhizoprionodon terraenovae*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay/St. Vincent Island
Young-of-the-year	--	4.42 (10.69)	0.15 (0.55)	--
Juveniles	--	0.58 (0.79)	0.15 (0.55)	--
Adults	--	1.68 (3.09)	0.75 (2.75)	1.08 (1.23)

(g) *Sphyrna lewini*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay/St. Vincent Island
Young-of-the-year	--	2.57 (5.89)	0.08 (0.30)	1.77 (4.99)
Juveniles	--	0.25 (0.79)	--	0.22 (0.61)
Adults	--	--	--	0.25 (0.71)

(h) *Sphyrna tiburo*

Life stage	St. Andrew Bay	Crooked Island Sound	St. Joseph Bay	Apalachicola Bay/St. Vincent Island
Young-of-the-year	--	0.33 (0.68)	--	--
Juveniles	0.11 (0.42)	1.08 (2.63)	0.13 (0.47)	--
Adults	--	0.75 (2.51)	--	--

Table 4. Summary of the habitat associations for young-of-the year elasmobranchs. Sexes are combined. Young-of-the-year includes neonate life stage.

Species	Water temperature (ºC)	Salinity (ppt)	Depth (m)	Turbidity (cm)	Dissolved oxygen (mg/L)	Bottom type
Carcharhinus acronotus	30.1	36.7	4.2	420.0	5.6	Seagrass
Carcharhinus isodon	30.3	31.9	3.0	80.0		Mud
Carcharhinus limbatus	28.6	32.8	4.1	200.4	3.2	Mud
Rhinoptera bonasus	28.9	34.2	2.5	85.0		Mud
Rhizoprionodon terraenovae	28.9	33.5	4.0	269.8	5.8	Mud
Sphyrna lewini	28.8	33.6	4.1	229.9	5.6	Mud
Sphyrna tiburo	29.2	34.7	4.1	160.0	4.3	Seagrass

Table 5. Summary of the habitat associations for juvenile elasmobranchs. Sexes are combined.

Species	Water temperature (ºC)	Salinity (ppt)	Depth (m)	Turbidity (cm)	Dissolved oxygen (mg/L)	Bottom type
Carcharhinus limbatus	25.0	32.3	4.0	166.3	4.8	Mud
Rhizoprionodon terraenovae	29.0	34.7	4.4	215.0	5.1	Mud
Sphyrna lewini	27.4	33.7	4.6	164.0	3.2	Mud
Sphyrna tiburo	28.9	33.7	4.5	277.9	3.5	Mud

Table 6. Summary of the habitat associations for adult elasmobranchs. Sexes are combined.

Species	Water temperature (°C)	Salinity (ppt)	Depth (m)	Turbidity (cm)	Dissolved oxygen (mg/L)	Bottom type
Carcharhinus acronotus	25.8	34.1	8.1	240.0	7.1	Seagrass
Carcharhinus isodon	28.9	34.0	3.4	161.7		Mud
Carcharhinus limbatus	30.3	31.9	3.0	80.0		Mud
Gymnura micrura	29.6	31.9	2.6	80.0		Mud
Rhizoprionodon terraenovae	27.8	34.2	4.9	179.7	6.2	Mud
Sphyrna tiburo	28.8	33.5	4.6	309.2	0.9	Mud

Region 2 Figures

Figure 1. Locations of sets made in St. Andrew Bay, Crooked Island Sound, St. Joe Bay and Apalachicola/St. Vincent Island.

REGION 3: BIG BEND OF FLORIDA – ST. GEORGE SOUND TO ANCLOTE KEYS, FLORIDA (FLORIDA STATE UNIVERSITY COASTAL AND MARINE LABORATORY)

Florida's Big Bend: St. George Sound to the Anclote Keys (Florida State University Coastal and Marine Laboratory)

Ashley M. Dawdy, R. Dean Grubbs

GULFSPAN sampling by the FSUCML in 2022 was similar to 2009-2021; covering more than 300 km of Florida's coastline from St. George Sound to the Anclote Keys. The distribution of 64 gillnet and 64 longline sets conducted by FSUCML in 2022 are shown in Region 3 Figure 1. St. George Sound was sampled monthly from January to December 2022 with paired gillnet (n = 12) and longline (n = 12) sets at each of two fixed stations along Turkey Point Shoal and Dog Island Reef; the sampling of which has been conducted by FSUCML since 2008. A spatially balanced sampling design was employed to survey areas from Apalachee Bay to the Anclote Keys. Sampling effort was focused in or adjacent to seagrass habitats. Our goal was to conduct at least 40 paired gillnet/longline sets from June through August 2022 in this region. We completed 17 paired sets north of Cedar Key spanning Apalachee Bay to Suwanee Sound, and 23 paired sets south of Cedar Key spanning Waccasassa Bay to the Anclote Keys.

Experimental longlines designed to capture all size classes of coastal sharks were fished concurrently with all 64 gillnet sets. A standard set in the FSUCML longline survey included 100 demersal gangions spaced at 10-meter intervals along a mainline of 4.0 mm monofilament. Each end of the mainline is anchored and marked with a large buoy bearing the FWC Special Activity License number permitted for the project. Each line consisted of four 25-hook sections separated by buoys, with a unique hook size deployed within each section. The total length of a standard set was approximately 1,500 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 to the largest adult sharks. Each gangion began with a stainless-steel tuna clip attached to two meters of monofilament (136 kg test for 10/0, 12/0 and 14/0 hooks and 318 kg test for the 16/0 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 Spanish mackerel (*Scomberomorus maculatus*). Each set soaked for one to two and a half hours, depending on gillnet haul duration, from first hook in the water until last hooked removed from the water. Temperature, salinity and dissolved oxygen were recorded at top-, mid- and bottom-water column using a YSI ProSolo for each longline and gillnet set. Clarity as well as minimum and maximum depths were recorded for each set via secchi disk and observation of onboard sonar, respectively. When clarity exceeded depth, a clarity measurement could not be precisely obtained by secchi disk. In Region 3 Tables 2-16, the sets for which clarity exceeded depth were included in the calculations by substituting the max depth for clarity in order to minimize underestimation of clarity means and ranges.

In total, 714 elasmobranchs from 15 species were caught. Three species (Atlantic sharpnose sharks, *Rhizoprionodon terraenovae*; blacktip sharks, *Carcharhinus limbatus;* and bonnetheads, *Sphyrna tiburo*) combined for 89.9% of the total. The gillnets captured 393 sharks from 7 species and 5 batoids from 2 species. The longlines captured 194 sharks of 8 species. Of 587 sharks captured, 483 were tagged upon release. Catch per unit of effort summaries are provided for all 15 species of elasmobranchs captured in Region 3 Table 1. Data are reported separately for St. George Sound, Apalachee Bay to Suwanee Sound, and Waccasassa Bay to the Anclote Keys. As in previous years, sampling in 2022 indicated that this region serves as a primary nursery for at least two species of small coastal sharks (Atlantic sharpnose sharks, *R. terraenovae*; blacknose sharks, *C. acronotus*) and one species of large coastal shark (blacktip sharks. *C. limbatus*).

Abundance trends

The overall catch rates across all areas were 8.29 (S.D. = 10.8) sharks per net-hour for the gillnets and 5.85 (S.D. = 5.74) sharks per 100 hooks for the longlines. Of the three dominant shark species captured, catch rates of Atlantic sharpnose sharks were higher in the gill net, catch rates of blacktip sharks were higher across all life stages using longlines, and bonnetheads were only encountered in gillnets.

Atlantic sharpnose sharks and bonnetheads combined for 95% of the shark catch in the gillnets (63.8% and 31.2%, respectively). Lengths of captured Atlantic sharpnose sharks (48.0-78.0 cm FL; mean = 46.7 cm FL) and bonnetheads (39.0-83.0 cm FL; mean = 58.5 cm FL) were relatively similar. Of the Atlantic sharpnose sharks captured, all but one mature individuals were male (n = 40), while juveniles were male dominated (2:1 M:F, n = 43), and young-of-the-year (YOY; n = 164) displayed relatively even sex ratios. Bonnethead catch included juveniles (n = 63) and adults (n = 59) of both sexes. Five other species of sharks were captured in the gillnets: 8 YOY (42.0-51.0 cm FL; mean = 46.6 cm FL, 2:1 M:F), and 1 juvenile female (99.0 cm FL) blacktip shark; 2 YOY (44.0-47.0 cm FL; mean = 45.0 cm FL, 1:1 M:F) and one juvenile male blacknose shark (74.0 cm FL); one juvenile female great hammerhead shark (*Sphyrna mokarran*; 169.0 cm FL); 1 juvenile female narrowfin smooth-hound sharks (*Mustelus norrisi*; 44.0 cm FL); and one juvenile female spinner shark (*Carcharhinus brevpinna*; 54.0 cm FL). Two species of batoids were encountered in the gillnets: 4 Atlantic

stingrays (*Hypanus sabinus*; 20.0-25.0 cm disk width (DW)) of both sexes; and 1 mature female Atlantic guitarfish (*Pseudobatos lentiginosus*).

Blacktip sharks dominated longline shark catch (n = 133; 42.1% of total; 42.0 – 194.0 cm FL, mean = 97.8 cm FL), with both sexes of all life stages captured. Atlantic sharpnose sharks were the second most common species captured on the longlines (n = 122; 38.6% of total; 27.0 – 80.0 cm FL, mean = 47.5 cm FL). YOY and juvenile Atlantic sharpnose of both sexes were captured, but all mature individuals captured were male. Blacknose sharks were the third most common species encountered on the longlines (n = 40; 12.7% of total catch; 3530 – 88.0 cm FL, mean = 55.7 cm FL). Both sexes from each life stage of blacknose sharks were encountered. Tiger sharks were the fourth most common species (*Galeocerdo cuvier*; n = 9; 2.9% of total shark catch), most of which being juvenile females with the exception of two mature female individuals (169.0 – 221.0 cm FL; mean = 199.4 cm FL).

Twelve sharks of five other species were caught on the longlines. These included the following: four nurse sharks (*Ginglymostoma cirratum*), three juvenile great hammerheads of both sexes (*Sphyrna mokarran*; 164.0-197.0 cm FL, mean = 177.0 cm, 2:1 M:F), three juvenile female bull sharks (*Carcharhinus leucas*; 163.0 – 180.0 cm FL, mean = 173.0 cm FL), one juvenile male scalloped hammerhead (*Sphyrna lewini*; 127.0 cm FL), and one mature male sandbar shark (*Carcharhinus plumbeus*; 170.0 cm FL).

Catch-per-unit-effort by area

Shark catch rates varied with latitude. Mean catch rates for the gillnets (sharks per net-hour) were 8.69 (S.D. = 10.1) in St. George Sound, 4.33 (S.D. = 3.30) from Apalachee Bay to Suwanee Sound, and 4.02 (S.D. = 3.66) from Waccasassa Bay to the Anclote Keys. Catch rates on longlines (sharks per 100 hooks) were 3.53 (S.D. = 2.25) in St. George Sound, 3.94 (S.D. = 3.76) from Apalachee Bay to Suwanee Sound, and 2.21 (S.D. = 2.02) from Waccasassa Bay to the Anclote Keys.

Catch rates of young-of-the-year blacktip sharks and blacknose sharks, especially on longlines, were higher in Waccasassa Bay to the Anclote Keys than in St. George Sound or Apalachee Bay to Suwanee Sound (Region 3 Tables 1a and 1d). Large coastal shark species (including *Carcharhinus plumbeus*, sandbar shark; *Galeocerdo cuvier*, tiger shark; *Ginglymostoma cirratum*, nurse shark; *Negaprion brevirostris*, lemon shark; *Sphyrna lewini*, scalloped hammerhead) were only captured via longline, with no gill net captures. Several smaller species (including *Carcharhinus brevipinna*, spinner shark; *Hypanus sabinus*, Atlantic stingray; *Mustelus norrisi*, narrowfin smooth-hound; *Pseudobates lentiginosus*, Atlantic guitarfish*; Sphyrna tiburo*, bonnethead) were only captured via gill net and were not encountered on longlines.

Species essential fish habitat profiles

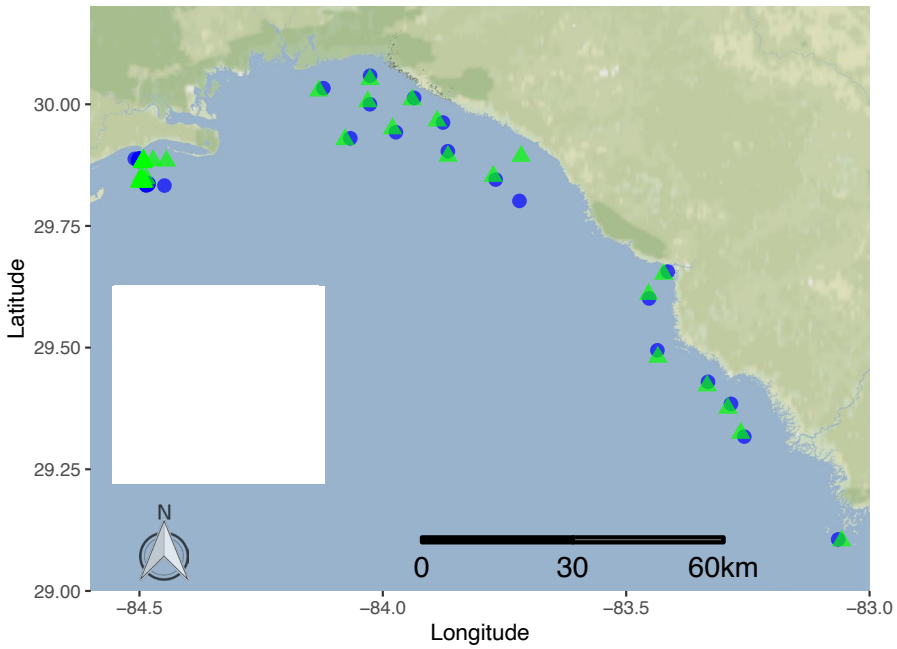
The essential fish habitat profiles for elasmobranchs from St. George Sound to Tarpon Springs are summarized in Region 3 Tables 2-16. This region clearly includes habitats that serve as important primary and secondary nurseries for several species of large coastal and small coastal sharks. Habitats sampled included seagrass (*Thallassia testudinum, Syringodium filiforme, Halodule wrighti*), drift algae dominated bottom, mud bottom, sandy ridges, and hardbottom reefs (dominated by soft corals and sponges). This region primarily consists of seagrass habitats in waters shallower than 4 m; therefore most effort was in this habitat type. All life stages of Atlantic sharpnose sharks, except adult females, were found in all habitats sampled, although very few were captured over hardbottom reefs. Juvenile and adult bonnetheads were most common in seagrass habitats. All life stages of blacktip sharks were typically captured on the edges of muddy channels and sandy ledges adjacent to seagrass habitats. All life stages of blacknose sharks were typically captured in on the edges of muddy channels adjacent to seagrass habitats.

Sampling in St. George Sound occurred from the 12th of January to the 12th of December 2022. Water temperatures ranged from 13.8 to 29.8°C and salinity ranged from 23.6 to 36.9. Sampling from Apalachee Bay to the Cedar Key occurred over June and August 2022 with water temperatures from 28.7 to 30.4°C. Salinity ranged from 20.5 to 30.5. Sampling from Crystal River to Tarpon Springs occurred over June through August 2022 with water temperatures from 29.1 to 32.9°C. Salinity ranged from 20.2 to 36.9 (salinity at most stations was above 25.0).

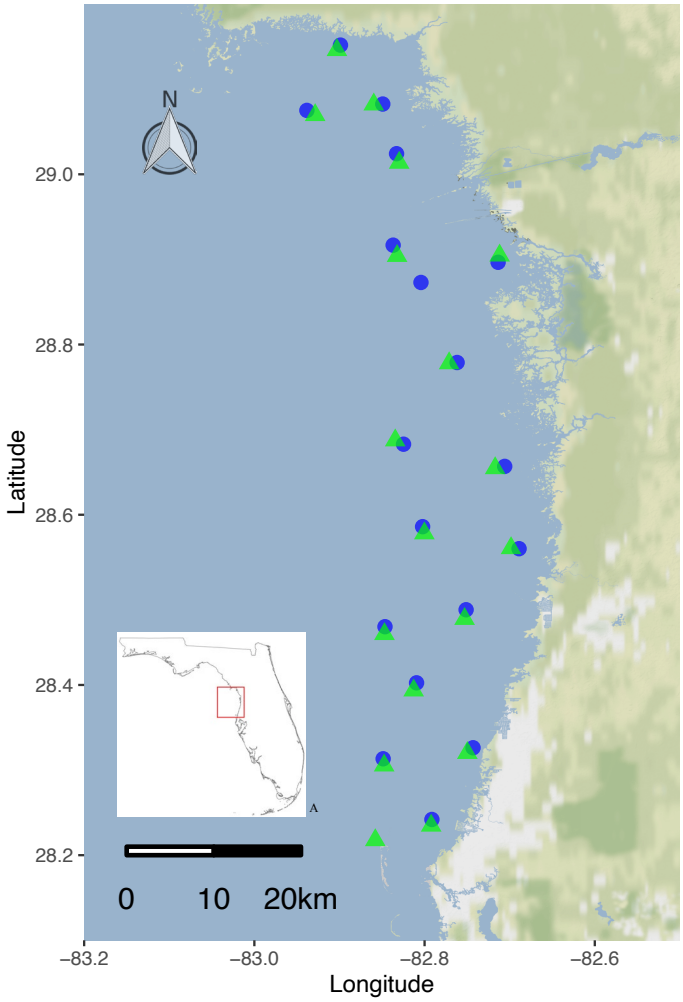
Region 3 Figures

Figure 1. Locations of gillnet (N=64) and longline (N=64) sets in FY-21 a) in St. George Sound and Apalachee Bay to Suwanee Sound and b) Waccasassa Bay to the Anclote Keys. Green triangles represent gill net sets and blue circles represent longline sets.

a)



b)



Region 3 Tables

Table 1. Summary of CPUE in gillnet (number of animals per net-hour) and longline (number of animals per 100 hooks) for elasmobranchs by life history stage sampled in Apalachee Bay, Florida, for FY-22. 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 and listed separately in each table. Species are listed alphabetically by scientific name.

(a) *Carcharhinus acronotus*, blacknose shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0.01 (0.10)	0.03 (0.16)	0.02 (0.12)	0.04 (0.16)	–	0.13 (0.61)
Juveniles	0.01 (0.09)	0.04 (0.29)	–	0.02 (0.16)	–	0.07 (0.32)
Adults	–	0.06 (0.28)	–	–	–	0.02 (0.12)
All	0.03 (0.14)	0.13 (0.42)	0.02 (0.12)	0.07 (0.34)	–	0.22 (0.80)

(b) *Carcharhinus brevipinna*, spinner shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	0.01 (0.09)	–	–	–	–	–
Adults	–	–	–	–	–	–
All	0.01 (0.09)	–	–	–	–	–

(c) *Carcharhinus leucas*, bull shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	–	0.01 (0.07)	–	0.02 (0.08)	–	–
Adults	–	–	–	–	–	–
All	–	0.01 (0.07)	–	0.02 (0.08)	–	–

(d) *Carcharhinus limbatus*, blacktip shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0.01 (0.08)	–	0.04 (0.30)	0.02 (0.17)	0.05 (0.36)	0.08 (0.44)
Juveniles	–	0.15 (0.50)	–	0.41 (1.35)	0.01 (0.10)	0.16 (0.80)
Adults	–	0.12 (0.45)	–	0.12 (0.39)	–	0.04 (0.17)
Unidentified*		0.04 (0.24)		0.05 (0.30)		
All	0.01 (0.08)	0.32 (0.88)	0.04 (0.30)	0.58 (1.93)	0.07 (0.37)	0.28 (1.08)

(e) *Carcharhinus plumbeus*, sandbar shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	–	–	–	–	–	–
Adults	–	0.01 (0.09)	–	–	–	–
All	–	0.01 (0.09)	–	–	–	–

(f) *Galeocerdo cuvier*, tiger shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	–	0.02 (0.12)	–	–	–	0.06 (0.20)
Adults	–	0.01 (0.07)	–	–	–	–
All	–	0.03 (0.14)	–	–	–	0.06 (0.20)

(g) *Ginglymostoma cirratum*, nurse shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	–	–	–	0.01 (0.07)	–	0.01 (0.09)
Adults	–	0.01 (0.06)	–	–	–	0.01 (0.09)
All	–	0.01 (0.06)	–	0.01 (0.07)	–	0.02 (0.12)

(h) *Hypanus sabinus*, Atlantic stingray

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	–	–	–	–	–	–
Adults	–	–	–	–	0.04 (0.21)	–
Unidentified*					0.01 (0.09)	
All	–	–	–	–	0.06 (0.29)	–

(i) *Mustelus norrisi*, narrowfin smooth-hound shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	0.02 (0.12)	–	–	–	–	–
Adults	–	–	–	–	–	–
All	0.02 (0.12)	–	–	–	–	–

(j) *Negaprion brevirostris*, lemon shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	–	–	–	–	–	–
Adults	–	0.02 (0.12)	–	0.01 (0.06)	–	–
All	–	0.02 (0.12)	–	0.01 (0.06)	–	–

(k) *Pseudobates lentiginosus*, Atlantic guitarfish

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	–	–	–	–	–	–
Adults	–	–	–	–	0.02 (0.11)	–
All	–	–	–	–	0.02 (0.11)	–

(l) *Rhizoprionodon terraenovae*, Atlantic sharpnose shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	1.93 (6.93)	0.44 (1.02)	0.24 (0.77)	0.14 (0.81)	0.29 (1.09)	0.18 (0.78)
Juveniles	0.52 (1.08)	0.10 (0.41)	–	0.02 (0.12)	0.09 (0.35)	0.07 (0.24)
Adults	0.24 (0.78)	0.10 (0.32)	0.14 (0.45)	0.09 (0.29)	0.29 (1.09)	0.05 (0.22)
Unidentified*	0.05 (0.18)					
All	2.74 (7.32)	0.69 (1.20)	0.37 (1.09)	0.25 (0.93)	0.67 (1.64)	0.31 (0.87)

(m) *Sphyrna lewini*, scalloped hammerhead shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	–	0.01 (0.08)	–	–	–	–
Adults	–	–	–	–	–	–
All	–	0.01 (0.08)	–	–	–	–

(n) *Sphyrna mokarran*, great hammerhead shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	0.02 (0.14)	0.02 (0.11)	–	0.01 (0.09)	–	–
Adults	–	–	–	–	–	–
All	0.02 (0.14)	0.02 (0.11)	–	0.01 (0.09)	–	–

(o) *Sphyrna tiburo*, bonnethead shark

	St. George Sound		Apalachee Bay to Suwanee Sound		Waccasassa Bay to Anclote Keys	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	–	–	–	–	–	–
Juveniles	0.32 (0.74)	–	0.30 (1.02)	–	0.34 (1.06)	–
Adults	0.28 (0.76)	–	0.24 (0.78)	–	0.35 (1.10)	–
Unidentified*			0.01 (0.10)		0.01 (0.10)	
All	0.61 (1.39)	–	0.55 (1.54)	–	0.70 (1.73)	–

Table 2. Summary of the habitat associations for blacknose shark, *Carcharhinus acronotus*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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	30.5	4.9	305	6.52	
N=20	(29.2-29.6)	(30.4-30.5)	(3.0-5.8)	(200-450)	(5.04-7.26)	Mud/seagrass
Juveniles	28.8	31.3	5.0	450	7.27	
N=9	(28.8-28.8)	(31.3-31.3)	(5.0-5.0)	(450-450)	(7.27-7.27)	Seagrass/mud/algae
Adults	28.9	30.4	3.7	340	6.09	
N=9	(27.4-31.7)	(27.9-34.9)	(2.0-7.2)	(260-500)	(4.85-7.06)	Seagrass/mud/sand

Table 3. Summary of the habitat associations for spinner shark, *Carcharhinus brevipinna*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles						
N=1	29.7	29.8	2.5	200	5.20	Seagrass/algae
Adults						
N=0	–	–	–	–	–	–

Table 4. Summary of the habitat associations for bull shark, *Carcharhinus leucas*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles	26.6	32.5	5.0	242	6.24	
N=3	(19.4-31.7)	(31.5-33.6)	(3.7-6.5)	(50-250)	(5.83-6.80)	Mud/seagrass
Adults						
N=0	–	–	–	–	–	–

Table 5. Summary of the habitat associations for blacktip shark, *Carcharhinus limbatus*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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	29.7	25.2	1.5	159	6.80	
N=20	(28.2-30.8)	(24.2-30.9)	(0.9-2.7)	(150-225)	(4.74-8.12)	Mud/seagrass
Juveniles	29.1	31.9	4.6	250	6.54	
N=81	(17.4-31.7)	(26.4-34.4)	(1.5-6.5)	(50-450)	(4.32-31.7)	Mud/seagrass
Adults	26.8	31.5	5.0	300	6.74	
N=30	(17.4-31.7)	(26.4-34.4)	(2.2-6.5)	(150-500)	(4.32-7.66)	Mud/seagrass

Table 6. Summary of the habitat associations for sandbar shark, *Carcharhinus plumbeus*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles						
N=0	–	–	–	–	–	–
Adults						
N=1	29.8	29.4	4.4	3.0	6.68	Seagrass/mud

Table 7. Summary of the habitat associations for tiger shark, *Galeocerdo cuvier*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles	26.0	32.5	4.7	307	6.54	
N=8	(18.3-30.4)	(29.3-34.0)	(2.5-6.5)	(200-500)	(3.95-7.39)	Seagrass/mud/sand
Adults						
N=1	31.7	34.9_	7.2	350	6.67	Seagrass/sand

Table 8. Summary of the habitat associations for nurse shark, *Ginglyomostoma cirratum*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles	30.6	29.6	1.8	180		
N=2	(30.1-31.0)	(27.9-31.2)	(1.5-2.0)	(150-200)	6.42	Seagrass/sand/algae
Adults	29.9	30.9	4.0	365	6.56	Seagrass/mud/sand/
N=2	(29.6-30.1)	(30.8-30.9)	(2.8-5.2)	(280-450)	(6.49-6.63)	algae

Table 9. Summary of the habitat associations for Atlantic stingray, *Hypanus sabinus*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles						
N=1	28.7	24.2	0.9	150	8.12	Mud
Adults	30.8	24.4	1.3	167	7.49	
N=3	(30.7-30.8)	(24.2-24.7)	(0.9-2.0)	(150-200)	(6.22-8.12)	Mud/sand

Table 10. Summary of the habitat associations for narrowfin smooth-hound shark, *Mustelus norrisi*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles						
N=1	28.7	31.8	5.5	250	5.6	Seagrass/mud
Adults						
N=0	–	–	–	–	–	–

Table 11. Summary of the habitat associations for lemon shark, *Negaprion brevirostris*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles						
N=0	–	–	–	–	–	–
Adults						
N=2	27.4	33.6	4.8	410	7.06	Mud

Table 12. Summary of the habitat associations for Atlantic guitarfish, *Pseudobates lentiginosus*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles						
N=0	–	–	–	–	–	–
Adults						
N=1	30.6	29.2	2.1	210	8.28	Seagrass/sand

Table 13. Summary of the habitat associations for Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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	30.9	3.7	362	6.74	
N=239	(17.2-31.7)	(27.0-33.4)	(1.5-6.0)	(100-500)	(5.6-10.3)	Seagrass/mud/sand
Juveniles	28.7	30.9	2.7	202	7.23	
N=62	(21.6-32.3)	(28.2-36.9)	(1.2-5.5)	(50-260)	(5.2-10.3)	Seagrass/mud/sand
Adults	29.1	30.4	2.4	211	7.44	
N=67	(21.6-32.3)	(23.0-36.9)	(1.2-5.0)	(50-450)	(5.6-10.3)	Seagrass/mud/sand

Table 14. Summary of the habitat associations for the scalloped hammerhead shark, *Sphyrna lewini*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles						
N=1	17.4	34.4	N/A	400	7.66	Mud
Adults						
N=0	–	–	–	–	–	–

Table 15. Summary of the habitat associations for great hammerhead shark, *Sphyrna mokarran*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles	26.2	30.3	4.5	253	6.22	
N=4	(21.5-29.1)	(27.6-31.8)	(2.5-5.9)	(250-260)	(5.49-6.89)	Mud
Adults						
N=0	–	–	–	–	–	–

Table 16. Summary of the habitat associations for bonnethead shark, *Sphyrna tiburo*, by life stage from St. George Sound to Anclote Keys, Florida for FY-22. 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						
N=0	–	–	–	–	–	–
Juveniles	28.7	29.4	2.2	154	6.91	
N=63	(17.2-32.9)	(22.4-36.9)	(0.9-3.9)	(25-400)	(4.74 -10.32)	Seagrass/mud/sand
Adults	28.6	27.6	1.8	159	7.13	
N=59	(17.2-32.9)	(20.2-36.9)	(0.9-3.0)	(100-300)	(4.74-9.95)	Seagrass/mud/sand

REGION 4: SOUTHERN TAMPA BAY, FLORIDA (NEW COLLEGE FLORIDA)

In 2022, New College of Florida conducted GULFSPAN sampling in three areas: Lower Tampa Bay, Terra Ceia Bay, and the Manatee River (Figure 1). As in previous years, sampling was conducted monthly from April to October in all three areas. A total of 106 sets were made, 52 gillnet sets and 54 longline sets, capturing eight shark species and three batoid species. This work was permitted under Florida Fish and Wildlife Conservation Commission Special Activity License SAL-22-1666-SRP.

In all three areas, the survey consisted of paired gillnet/longline sets. The bottom longline gear consisted of a 700m braided nylon rope (8mm) mainline, anchored and marked at either end with a large buoy, with up to 100 demersal gangions spaced at approximately 3-4m intervals. Each gangion consisted of a stainless-steel tuna clip attached to 1m of 5mm braided nylon cord, a 6/0 stainless-steel swivel, 1 m of 1/16" stainless-steel wire, and a Mustad circle hook. A mixture of 12/0, 14/0, and 16/0 hook sizes were used. Hooks were baited primarily with ladyfish, supplemented with Spanish mackerel, bluefish, yellowfin menhaden, striped mullet, and Crevalle jack, to reflect natural prey availability. Longline soak times, calculated from the time the gear first entered the water until it was completely removed from the water, varied from 1 to 3 hours, depending on the duration of the gillnet set haulback.

In each area, the goal was to complete 3 paired gillnet/long sets monthly from April to October. No sampling was conducted in September, due to Hurricane Ian. Otherwise, this goal was largely accomplished. In Lower Tampa Bay and Terra Ceia Bay, attempts were made to spatially balance these sampling efforts, to the degree possible owing to weather conditions, boat traffic, and the inaccessibility of some areas at either high (due to a low-clearance bridge) or low tides (Figure 1). A total of 16 gillnet set and 18 longline sets were completed in Lower Tampa Bay; 18 gillnet sets and 18 longline sets were completed in Terra Ceia Bay. In the Manatee River, the goal in 2022, as in prior years, was to conduct paired gillnet/longline sets across a range of different salinity levels (low, moderate, and high) each month. Salinity in the estuarine portion of the river is highly dynamic, sections of the river are extremely shallow, and in some areas, spatial constraints precluded deploying a gillnet (insufficient space outside the navigation channel). A total of 18 gillnet sets and 18 longline sets were accomplished. For the purposes of data analyses, as in prior years, the Manatee River was divided into a western portion and an eastern portion (Figure 1).

***Abundance trends*:** A total of 203 elasmobranchs from 11 species were caught, 58% of which were immature animals. Of the immature animals, 39% were young-of-the-year (YOY) and 61% were age 1+. Twenty-two neonates were caught: 21 blacktip sharks and 1 Atlantic sharpnose shark. Less than 5% of the catch was not assigned a life stage.

Abundance and size trends differed slightly by area (Tables 1-3). The blacktip shark, *Carcharhinus limbatus*, was the most abundant elasmobranch species encountered overall, comprising 25% of the total elasmobranch catch. Catch of this species was composed primarily of YOY animals of both sexes. The

bonnethead, *Sphyrna tiburo*, was the second most abundant elasmobranch species encountered overall, comprising 21% of the total elasmobranch catch. Catch of this species was primarily female, with equal numbers of immature and mature animals. The males encountered this year were predominantly mature. The cownose ray, *Rhinoptera bonasus*, was the third most abundant species encountered overall, comprising 16% of the total elasmobranch catch. Catch of this species was primarily males, most of which were immature. The blacknose shark, *Carcharhinus acronotus*, was the fourth most abundant species encountered overall, at 14% of the total elasmobranch catch. Catch of this species was predominantly mature animals of both sexes. The Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, was the fifth most abundant species, at 11% of the catch. Catch of this species was consisted primarily of mature males. The bull shark, *Carcharhinus leucas*, was the sixth most abundant species, at 6% of the catch. Catch of this species consisted of an approximately equal mix of males and females, all of which were immature. Elasmobranchs encountered in low abundance (<4% of the catch) included the great hammerhead, *Sphyrna mokarran*, the nurse shark, *Ginglymostoma* cirratum, the Atlantic stingray, *Hypanus sabinus*, the bluntnose stingray, *Hypanus say*, and the scalloped hammerhead, *Sphyrna lewini*. Among the five most abundant elasmobranch species, catches of bonnetheads were much greater using gillnets (only one individual was caught using longlines) and cownose rays were only caught using gillnets. Blacktip sharks were caught approximately equally using longlines and gillnets, while catches of Atlantic sharpnose sharks, blacknose sharks, and bull sharks were greater using longlines than gillnets.

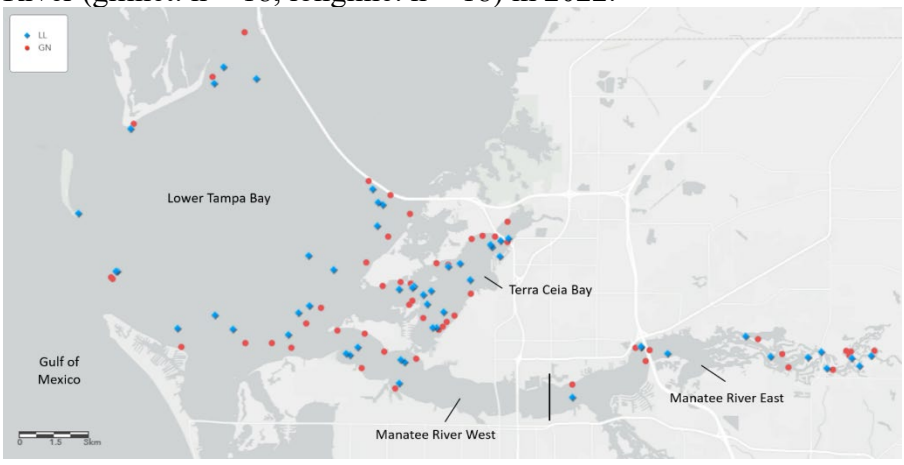
Catch-per-unit-effort by area: Mean catch rates varied by location (Table 4). Elasmobranch abundance was highest overall in the western portion of the Manatee River, 2.53 (S.D. 2.99) elasmobranchs per net-hour and 2.32 (S.D. = 1.34) elasmobranchs per 100 hooks, followed by Terra Ceia Bay, 1.96 (S.D. = 2.88) elasmobranchs per net hour and 1.15 (S.D. = 1.41) elasmobranchs per 100 hooks. Mean catch rates were lower in Lower Tampa Bay, 0.53 (S.D. = 0.82) elasmobranchs per net-hour and 1.03 (S.D. = 1.59) elasmobranchs per 100 hooks, and the eastern portion of the Manatee River, 0.48 (S.D. = 0.74) elasmobranchs per net-hour and 1.47 (S.D. 2.78) elasmobranchs per 100 hooks. The relative abundance of sharks was highest in the western portion of the Manatee River, 0.63 (S.D. = 1.30) sharks per net-hour and 2.32 (S.D. = 1.34) sharks per 100 hooks, followed by the eastern portion of the Manatee River, 0.24 (S.D. = 0.57) sharks per net-hour and 1.47 (S.D. = 2.78) sharks per 100 hooks, Terra Ceia Bay, 1.38 (S.D. = 2.90) sharks per net-hour and 1.15 (S.D. = 1.41) sharks per 100 hooks, and Lower Tampa Bay, 0.53 (S.D. = 0.82) sharks per net-hour and 1.03 (S.D. = 1.59) sharks per 100 hooks. The abundance of batoids was much higher in the western portion of the Manatee River, 1.90 (S.D. = 3.16) batoids per net-hour, compared with other areas, Terra Ceia Bay: 0.59 (S.D. = 1.23) batoids per net-hour, and the eastern portion of the Manatee River: 0.24 (S.D. = 0.59) batoids per net-hour and no batoids were captured in Lower Tampa Bay. Unlike prior years, no batoids were captured on longlines in the study area in 2022.

***Essential Fish Habitat Profiles*:** The three systems differed in abiotic profiles. Salinity in the Manatee River was highly dynamic, particularly in the eastern portion of the river (Tables 5-8). The essential habitat profiles for Terra Ceia Bay and Sarasota Bay are summarized in Tables 9-19. These data suggest that these systems serve as primary and secondary nursery areas for several species of sharks and rays. Habitats sampled included seagrass (*Syringodium filiforme*, *Thalassia testudinium*, *Halodule wrightii*, and *Halophila* sp.), sand, and mud dominated bottom types, as well as a mix of all three. A few areas included patchy oyster beds.

Bonnetheads and Atlantic sharpnose sharks were associated with the widest range of temperatures and were captured across the entire range of temperatures sampled. Bonnetheads were mostly associated with shallower areas and a mixture of seagrass and sand habitat, whereas Atlantic sharpnose sharks were primarily caught in deeper areas and sandy/muddy bottom (Tables 16 and 19). Blacktip sharks were also encountered across a wide range of temperatures, typically in areas of sandy/muddy bottom (Table 11). Bull sharks were associated with the widest range of salinities. They were primarily encountered over sandy/muddy bottom in the Manatee River and were caught across the entire range of temperatures sampled in that area (Table 10). Cownose range were also associated with a fairly broad range of salinities, compared with other species, but were only caught in warmer waters (Table 15). Blacknose sharks were captured across the greatest range of depths and a wide range of temperatures, but were only found at high salinities (> 30ppt; Table 9).

Figures:

Figure 1. Locations of gillnet and longline sets made in the Southern Tampa Bay region: Lower Tampa Bay (gillnet: n=16, longline: n = 18), Terra Ceia Bay (gillnet: n=18, longline: n = 18) and the Manatee River (gillnet: n = 18, longline: n = 18) in 2022.



Tables:

Table 1. Species table for Terra Ceia Bay. Species are listed in order of abundance. NM = not measured

Species	Common Name	Sex	Count	Mean (SD) FL/DW (cm)	Minimum FL (cm)	Maximum FL (cm)
Carcharhinus limbatus	Blacktip shark	F	22	63.8 (28)	43	138
		M	17	55.5 (17.3)	43	112
		U	1	NM		
Sphyrna tiburo	Bonnethead	F	18	64.9 (10.1)	42	81
		M	10	57.1 (4)	53	66
Rhinoptera bonasus	Cownose ray	F	4	52.2 (17.7)	37	69
		M	10	56.6 (13.6)	37	74
		U	2	NM		
Carcharhinus acronotus	Blacknose shark	F	3	82 (27.8)	50	100
		M	2	83.5 (7.8)	78	89
Rhizoprionodon terraenovae	Atlantic sharpnose shark	M	4	67.5 (5.7)	63	75
Hypanus say	Bluntnose stingray	F	1	46		
		M	1	45		
Sphyrna mokarran	Great hammerhead	F	2	132.5 (10.6)	125	140
Carcharhinus leucas	Bull shark	M	1	134		
Hypanus sabinus	Atlantic stingray	M	1	23		
Sphyrna lewini	Scalloped hammerhead	F	1	59		

Table 2. Species diversity table for the Manatee River. Species are listed in order of abundance. NM = not measured.

Species	Common Name	Sex	Count	Mean (SD) FL/DW (cm)	Minimum FL (cm)	Maximum FL (cm)
Rhinoptera bonasus	Cownose ray	F	7	68.3 (13.2)	56	84
		M	7	63.6 (7.9)	49	71
		U	3	NM		
Carcharhinus leucas	Bull shark	F	5	86.4 (20.5)	75	123
		M	6	79.7 (3.7)	74	85
		U	1	NM		
Rhizoprionodon terraenovae	Atlantic sharpnose shark	M	8	68 (3.5)	63	73
		U	1	NM		
Sphyrna tiburo	Bonnethead	F	4	53.2 (10.5)	47	69
		M	3	50 (4)	46	54
Carcharhinus limbatus	Blacktip shark	F	1	68		
		M	1	64		
Ginglymostoma cirratum	Nurse shark	M	1	NM		
Hypanus sabinus	Atlantic stingray	M	1	NM		

Table 3. Species diversity table for Lower Tampa Bay. Species are listed in order of abundance. NM = not measured.

Species	Common Name	Sex	Count	Mean (SD) FL/DW (cm)	Minimum FL (cm)	Maximum FL (cm)
Carcharhinus acronotus	Blacknose shark	F	11	84.5 (17)	49	102
		M	13	84.8 (7.1)	71	94
Rhizoprionodon terraenovae	Atlantic sharpnose shark	F	1	30		
		M	8	76.6 (4.5)	70	83
Carcharhinus limbatus	Blacktip shark	F	7	95.4 (16.5)	77	118
		M	1	78		
Sphyrna tiburo	Bonnethead	F	4	67.2 (9.5)	54	75
		M	3	57.7 (1.5)	56	59
Ginglymostoma cirratum	Nurse shark	M	1	NM		
		U	2	NM		
Sphyrna mokarran	Great hammerhead	F	2	168.5 (72.8)	117	220
		U	1	NM		

Table 4. Summary of CPUE (number of animals per net hour) for elasmobranchs by life history stage and area sampled in southern Tampa Bay for 2022. Means (SD) are presented. Young-of-the-year includes neonate life stage. Sexes are combined. Specimens with an undetermined life stage are included in the total CPUE calculation. Species are listed alphabetically by scientific name.

(a) *Carcharhinus acronotus*, blacknose shark

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0.08 (0.34)	0.24 (0.88)	0	0.06 (0.31)
Juveniles	0	0	0	0	0	0.28 (0.83)	0	0
Adults	0	0	0	0	0.09 (0.36)	0.70 (1.80)	0	0.25 (0.96)
All	0	0	0	0	0.16 (0.48)	1.22 (1.95)	0	0.31 (1.00)

(b) *Carcharhinus leucas*, bull shark

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0.39 (1.42)	0	0	0	0	0	0
Juveniles	0.24 (0.57)	1.08 (2.58)	0	0.11 (0.37)	0	0	0	0.06 (0.31)
Adults	0	0	0	0	0	0	0	0
All	0.24 (0.57)	1.47 (2.78)	0	0.11 (0.37)	0	0	0	0.06 (0.31)

(c) *Carcharhinus limbatus*, blacktip shark

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0	0	0.47 (2.75)	0.19 (0.51)
Juveniles	0	0	0	0.43 (1.48)	0	0.31 (1.00)	0.06 (0.24)	0.28 (1.07)
Adults	0	0	0	0	0	0.07 (0.40)	0	0.23 (0.63)
All	0	0	0	0.43 (1.48)	0	0.38 (1.06)	0.53 (2.75)	0.76 (1.21)

(d) *Ginglymostoma cirratum*, nurse shark

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0	0	0	0
Juveniles	0	0	0	0	0	0	0	0
Adults	0	0	0	0.15 (0.52)	0	0.05 (0.28)	0	0
All	0	0	0	0.15 (0.52)	0	0.15 (0.65)	0	0

(e) *Hypanus sabinus*, Atlantic stingray

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0	0	0	0
Juveniles	0	0	0	0	0	0	0	0
Adults	0.08 (0.29)	0	0	0	0	0	0.04 (0.24)	0
All	0.08 (0.29)	0	0	0	0	0	0.04 (0.24)	0

(f) *Hypanus say*, bluntnose stingray

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0	0	0	0
Juveniles	0	0	0	0	0	0	0.04 (0.22)	0
Adults	0	0	0	0	0	0	0.02 (0.13)	0
All	0	0	0	0	0	0	0.06 (0.25)	0

(g) *Rhinoptera bonasus*, cownose ray

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0	0	0.17 (0.98)	0
Juveniles	0	0	0.95 (2.86)	0	0	0	0.16 (0.55)	0
Adults	0.16 (0.54)	0	0.60 (1.79)	0	0	0	0.07 (0.41)	0
All	0.16 (0.54)	0	1.90 (3.16)	0	0	0	0.49 (1.22)	0

(h) *Rhizoprionodon terraenovae*, Atlantic sharpnose shark

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0	0.05 (0.30)	0	0
Juveniles	0	0	0	0.70 (1.30)	0	0	0	0.20 (0.97)
Adults	0	0	0	0.58 (1.16)	0.07 (0.30)	0.33 (1.21)	0	0.07 (0.32)
All	0	0	0	1.42 (1.42)	0.07 (0.30)	0.38 (1.24)	0	0.26 (1.01)

(i) *Sphyrna lewini*, scalloped hammerhead

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0	0	0.02 (0.10)	0
Juveniles	0	0	0	0	0	0	0	0
Adults	0	0	0	0	0	0	0	0
All	0	0	0	0	0	0	0.02 (0.10)	0

(j) *Sphyrna mokarran*, great hammerhead

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0	0	0	0	0	0
Juveniles	0	0	0	0	0	0.12 (0.46)	0.02 (0.13)	0.06 (0.30)
Adults	0	0	0	0	0	0	0	0
All	0	0	0	0	0.08 (0.33)	0.12 (0.46)	0.02 (0.13)	0.06 (0.30)

(k) *Sphyrna tiburo*, bonnethead

	Manatee River East		Manatee River West		Tampa Bay		Terra Ceia Bay	
Life Stage	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline	Gillnet	Longline
Young-of-the-year	0	0	0.11 (0.33)	0	0	0	0.02 (0.13)	0
Juveniles	0	0	0.44 (1.31)	0	0.13 (0.40)	0	0.22 (0.57)	0
Adults	0	0	0.08 (0.25)	0.21 (0.74)	0.25 (0.72)	0	0.57 (1.33)	0
All	0	0	0.63 (1.30)	0.21 (0.74)	0.38 (0.78)	0	0.81 (1.35)	0

Table 5. Means ± standard deviation (ranges) of monthly abiotic measurements for Lower Tampa Bay in 2022. NM: not measured.

Month	Temperature (C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	D.O. (mg/L)
Apr	21.2 ± 0.4 (20.8-21.9)	33.8 ± 0.9 (32.6-34.9)	2.5 ± 1.2 (1.5-4.5)	214 ± 48 (150-280)	7.04 ± 0.16 (6.83-7.20)
May	28.4 ± 0.8 (27.6-29.3)	34.9 ± 0.6 (34.3-35.6)	2.3 ± 1.1 (1.0-3.8)	276 ± 117 (144-444)	6.50 ± 0.34 (6.11-6.88)
Jun	29.8 ± 0.5 (29.2-30.3)	34.4 ± 0.2 (34.2-34.7)	2.6 ± 1.4 (0.8-4.7)	257 ± 82 (102-327)	6.33 ± 0.47 (5.78-6.82)
Jul	31.1 ± 0.4 (30.8-31.5)	33.6 ± 1.4 (32.4-35.7)	3.0 ± 0.7 (1.9-3.9)	237 ± 22 (200-250)	6.27 ± 0.23 (6.09-6.52)
Aug	30.6 ± 0.2 (30.2-30.7)	32.9 ± 1.3 (32.0-34.7)	2.8 ± 1.0 (1.2-3.9)	327 ± 129 (174-492)	5.83 ± 0.27 (5.30-6.02)
Sep	NM	NM	NM	NM	NM
Oct	22.9 ± 0.4 (22.5-23.4)	31.5 ± 1.2 (29.7-32.6)	3.8 ± 2.6 (1.6-7.7)	223 ± 75 (150-350)	6.77 ± 0.33 (6.44-7.19)

Table 6. Means ± standard deviation (ranges) of monthly abiotic measurements for Terra Ceia Bay in 2022. NM: not measured.

Month	Temperature (C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	D.O. (mg/L)
Apr	22.1 ± 0.3 (21.8-22.6)	33.3 ± 0.6 (32.6-34.0)	1.8 ± 0.5 (1.3-2.6)	207 ± 86 (125-350)	7.10 ± 0.17 (6.90-7.26)
May	28.6 ± 0.3 (28.3-29.0)	33.9 ± 0.2 (33.6-34.1)	1.9 ± 0.6 (1.1-2.8)	167 ± 52 (100-200)	6.53 ± 1.06 (5.34-7.72)
Jun	30.1 ± 0.4 (29.7-30.7)	31.6 ± 1.0 (30.5-32.8)	1.9 ± 0.8 (1.3-3.5)	193 ± 50 (140-250)	5.98 ± 0.49 (5.57-6.52)
Jul	30.7 ± 0.5 (30.1-31.5)	31.3 ± 0.3 (31.0-31.6)	2.2 ± 0.8 (1.4-3.5)	236 ± 37 (189-300)	5.05 ± 0.80 (3.65-5.79)
Aug	30.7 ± 0.4 (30.3-31.2)	30.1 ± 1.2 (28.9-31.5)	2.3 ± 0.9 (1.3-3.8)	191 ± 80 (120-325)	5.90 ± 0.85 (4.61-6.79)
Sep	NM	NM	NM	NM	NM
Oct	23.4 ± 0.3 (23.1-23.8)	28.5 ± 0.8 (27.6-29.6)	2.0 ± 0.6 (1.5-2.7)	203 ± 7 (200-216)	6.20 ± 0.51 (5.63-6.75)

Table 7. Means ± standard deviation (ranges) of monthly abiotic measurements for the western portion of the Manatee River in 2022. NM: not measured.

Month	Temperature (C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	D.O. (mg/L)
Apr	22.4 ± 0.1 (22.4-22.5)	32.6 ± 0.0 (32.6-32.6)	2.7 ± 1.8 (1.5-4.0)	212 ± 18 (200-225)	6.71 ± 0.06 (6.67-6.75)
May	28.4 ± 0.0 (28.4-28.4)	33.1 ± 0.0 (33.1-33.1)	2.4 ± 1.3 (1.5-3.3)	150 ± 0 (150-150)	5.66 ± 0.00 (5.66-5.66)
Jun	29.7 ± 0.4 (29.4-30.0)	30.3 ± 0.5 (30.0-30.7)	2.8 ± 1.5 (1.8-3.9)	200 ± 177 (75-325)	5.47 ± 0.11 (5.40-5.55)
Jul	31.9 ± 0.0 (31.9-31.9)	29.1 ± 0.2 (28.9-29.2)	2.7 ± 2.1 (1.2-4.2)	188 ± 24 (171-205)	5.85 ± 0.18 (5.72-5.98)
Aug	31.0 ± 0.2 (30.9-31.2)	30.6 ± 1.0 (29.9-31.3)	3.0 ± 2.0 (1.5-4.4)	200 ± 0 (200-200)	4.92 ± 0.21 (4.77-5.07)
Sep	NM	NM	NM	NM	NM
Oct	21.7 ± 0.1 (21.6-21.8)	24.4 ± 0.2 (24.3-24.6)	2.0 ± 1.2 (1.1-2.8)	136 ± 23 (120-153)	6.82 ± 0.16 (6.71-6.94)

Table 8. Means ± standard deviation (ranges) of monthly abiotic measurements for the eastern portion of the Manatee River Bay in 2022. NM: not measured.

Month	Temperature (C)	Salinity (ppt)	Depth (m)	Water clarity (cm)	D.O. (mg/L)
Apr	24.9 ± 0.5 (24.5-25.3)	18.2 ± 5.1 (13.8-22.6)	1.7 ± 0.6 (1.1-2.3)	191 ± 80 (118-270)	6.12 ± 0.73 (5.49-6.75)
May	29.3 ± 0.0 (29.3-29.4)	21.5 ± 2.8 (18.7-24.0)	1.8 ± 0.5 (1.2-2.4)	75 ± 29 (50-100)	5.03 ± 0.49 (4.40-5.42)
Jun	31.0 ± 0.4 (30.5-31.3)	16.4 ± 7.6 (9.7-23.5)	1.9 ± 0.5 (1.2-2.5)	123 ± 17 (110-147)	5.32 ± 0.43 (4.68-5.63)
Jul	31.6 ± 0.1 (31.5-31.6)	11.7 ± 4.0 (8.2-15.2)	1.8 ± 0.8 (1.1-3.0)	75 ± 0 (75- 75)	5.32 ± 0.97 (4.48-6.16)
Aug	31.3 ± 0.2 (31.2-31.6)	16.1 ± 8.3 (8.3-23.4)	2.3 ± 0.7 (1.7-3.2)	125 ± 0 (125-125)	4.51 ± 0.60 (3.89-5.05)
Sep	NM	NM	NM	NM	NM
Oct	23.3 ± 0.4 (23.0-23.8)	12.3 ± 6.0 (5.4-17.3)	1.8 ± 0.5 (1.1-2.1)	90 ± 20 (60-100)	6.49 ± 0.34 (6.10-6.78)

Table 9. Summary of habitat associations for the blacknose shark, *Carcharhinus acronotus*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=6)	29.6 (28.4-30.6)	33.4 (30.1-34.8)	3.1 (2.1-3.8)	366 (237-477)	6.39 (5.87-6.88)	Sand/seagrass
Juveniles (N=5)	27.2 (21.9-29.8)	34.9 (34.3-35.6)	3.7 (2.9-4.7)	333 (280-444)	6.34 (5.78-6.88)	Sand/seagrass
Adults (N=18)	27.0 (21.9-30.9)	34.4 (31.6-35.7)	3.1 (0.8-6.5)	291 (102-444)	6.54 (5.78-7.26)	Sand/seagrass

Table 10. Summary of habitat associations for the bull shark, *Carcharhinus leucas*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=2)	29.3	24	1.8	100	5.42	Sand/mud
Juveniles (N=11)	29.1 (23.0-31.6)	18.6 (13.8-30.1)	2.1 (1.1-4.4)	122 (75-325)	5.90 (4.77-6.78)	Mud/sand
Adults (N=0)						

Table 11. Summary of habitat associations for the blacktip shark, *Carcharhinus limbatus*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=30)	28.3 (23.5-31.2)	33.2 (27.9-33.6)	1.9 (1.8-3.8)	108 (100-225)	5.44 (5.34-6.79)	Mud/sand
Juveniles (N=15)	26.5 (21.8-31.9)	32.1 (29.2-35.7)	2.8 (1.1-4.7)	177 (100-327)	6.42 (5.34-7.72)	Sand/mud/sea grass
Adults (N=4)	25.3 (22.1-28.6)	34.0 (33.1-34.8)	2.4 (1.8-3.0)	288 (200-357)	7.13 (6.50-7.72)	Sand/seagrass

Table 12. Summary of habitat associations for the nurse shark, *Ginglymostoma cirratum*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=0)						
Juveniles (N=0)						
Adults (N=2)	30.1 (30.0-30.3)	32.5 (30.7-34.4)	3.8 (3.6-3.9)	300 (275-325)	5.97 (5.55-6.40)	Sand/mud

Table 13. Summary of habitat associations for the Atlantic stingray, *Hypanus sabinus*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=0)						
Juveniles (N=0)						
Adults (N=2)	28.0 (25.3-30.7)	26.6 (22.6-30.5)	1.2 (1.1-1.4)	205 (140-270)	6.75	Mud

Table 14. Summary of habitat associations for the bluntnose stingray, *Hypanus say*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=0)						
Juveniles (N=1)	28.6	34.1	1.1	200	7.72	Sand/mud
Adults (N=1)	30	31.7	1.4	204	6.52	Sand/seagrass

Table 14. Summary of habitat associations for the cownose ray, *Rhinoptera bonasus*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=4)	30.7	30.5	1.4	140		Mud
Juveniles (N=14)	29.5 (28.3-31.2)	30.6 (28.9-33.6)	1.8 (1.4-2.0)	91 (75-140)	5.60 (5.34-6.79)	Sand/mud
Adults (N=10)	29.1 (28.3-31.2)	30.7 (23.1-33.6)	1.8 (1.8-1.9)	90 (75-125)	5.34 (4.99-5.40)	Sand/mud

Table 16. Summary of habitat associations for the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=1)	29.8	34.7	4.7	300	5.78	Sand/seagrass
Juveniles (N=7)	26.7 (22.2-31.9)	31.9 (29.2-33.1)	3.3 (2.6-4.2)	294 (150-350)	6.27 (5.55-7.04)	Sand/mud
Adults (N=13)	25.3 (20.9-30.9)	31.2 (27.9-35.6)	3.0 (1.4-4.4)	207 (150-325)	6.29 (4.77-6.96)	Sand/mud/sea grass

Table 17. Summary of habitat associations for the scalloped hammerhead, *Sphyrna lewini*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=1)	28.3	33.6	1.8	100	5.34	Mud/sand
Juveniles (N=0)						
Adults (N=0)						

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Table 18. Summary of habitat associations for the great hammerhead, *Sphyrna mokarran*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=0)						
Juveniles (N=4)	30.1 (29.3-30.8)	32.3 (31.0-34.3)	2.8 (1.4-3.8)	281 (204-444)	6.22 (5.37-6.88)	Sand/seagrass
Adults (N=0)						

Table 19. Summary of habitat associations for the bonnethead, *Sphyrna tiburo*, by life stage in southern Tampa Bay. 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 (ppt)	Depth (m)	Water clarity (cm)	Dissolved oxygen (mg l^{-1})	Bottom type
Young-of-the-year (N=2)	30.6 (30.0-31.2)	31.5 (31.3-31.7)	1.5 (1.4-1.5)	202 (200-204)	5.80 (5.07-6.52)	Sand/seagrass
Juveniles (N=15)	28.6 (20.8-31.2)	32.4 (29.3-34.8)	1.5 (1.0-1.8)	173 (100-234)	5.68 (3.65-7.72)	Sand/seagrass /mud
Adults (N=25)	26.7 (22.1-31.9)	31.6 (28.0-34.8)	1.6 (1.0-4.2)	180 (100-246)	5.75 (3.65-7.26)	Seagrass/sand /mud

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