Shark Nursery Areas of Louisiana's Nearshore Coastal Waters: A Preliminary Review

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Scope

In an effort to gain more insight into the role that Louisiana's nearshore coastal waters function as nursery habitat for sharks in the north central Gulf of Mexico, a three-year study was initiated in late 1998. This study was funded by the Coypu Foundation and conducted by researchers at the Coastal Fisheries Institute, Louisiana State University (LSU). A total of 1002 sharks representing eight species were caught in Louisiana's coastal waters from 1999 to 2001. Two hundred and fifty-eight of the sharks sampled were tagged and released.

Sampling Materials and Methods

Sampling locations were haphazardly randomly chosen, using both the historical data from the Tulane Museum of Natural History and the Louisiana Department of Wildlife and Fisheries (LDWF), and the physio-chemical and biological characteristics that would make a suitable nursery habitat, such as low freshwater input, and the presence of barrier islands or bait fish. Selection of sampling locations was limited by shallow water depth, boat traffic, and underwater obstructions.

The primary goal of the experimental gillnet sampling in 1999 was to locate areas where sharks congregated within Terrebonne/Timbalier Bay system in central Louisiana (Figure 1). Sampling was conducted primarily during daylight hours, with sets being conducted within the bay and Gulf of Mexico (Figure 2). Sampling trips were conducted once in May, approximately every two weeks June through August, and then once a month September through November. Duration of fishing ranged from 1 hour 40 minutes to over six hours, with most sets falling within the 2 - 4 hour range. A minimum set time of three hours was attempted but was not always possible due to time or weather constraints.

For the 2000 sampling season, we expanded our spatial coverage of the Timbalier and Terrebonne Bay complex (Figure 3). One sampling trip was conducted in March, April, and September, two trips were conducted in May, and three trips per month were conducted June through August. From July through August a small-scale temporal component was added to the sampling protocol. The sampling day was divided into 5 time periods: Dawn, Day AM (before noon), Day PM (after noon), Dusk, and Night for both Bay and Gulf locations. The target set duration was three hours and soak times ranged from 1 hour 15 minutes to six hours, with most sets lasting between 2.5 and 4.5 hours.

The sampling protocol for the 2001 season closely followed that used the previous year. Two modifications were instituted at the start of the season. The first was the establishment of two

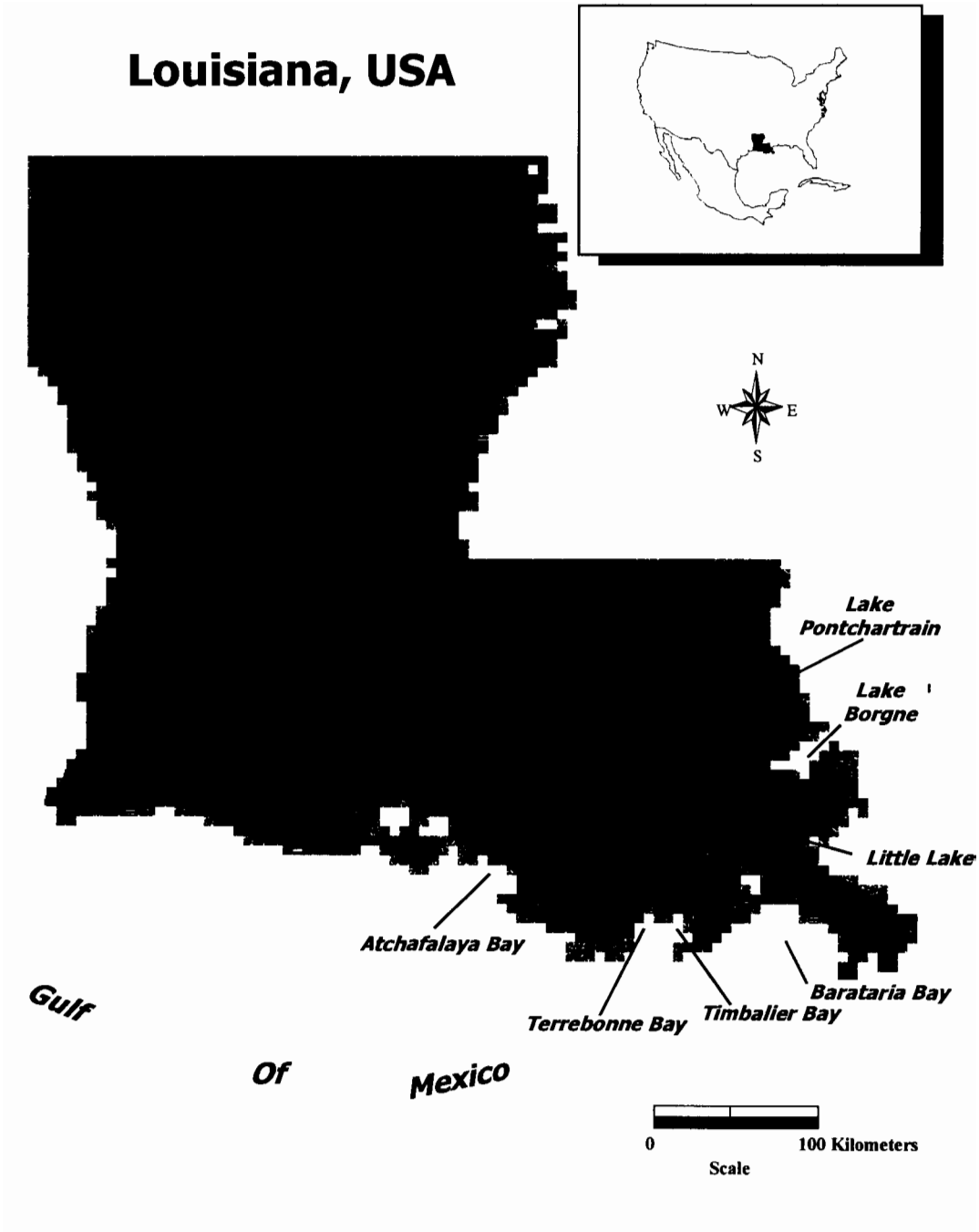

Figure 1. The state of Louisiana, with many of the major water systems indicated.

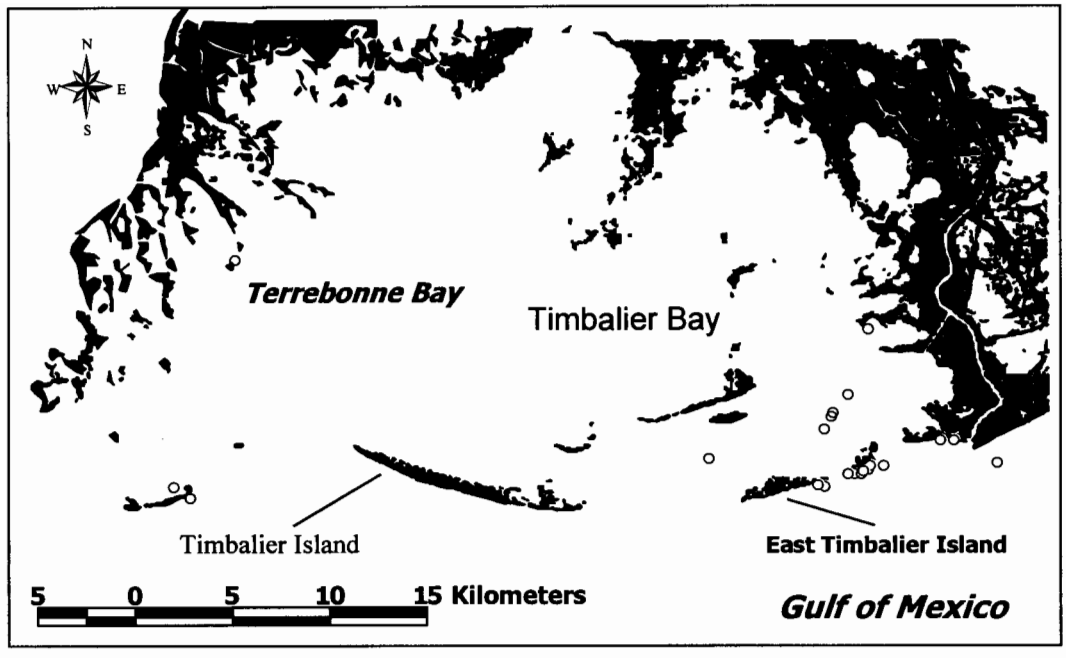

Figure 2. **1999 experimental gillnet sampling stations.**

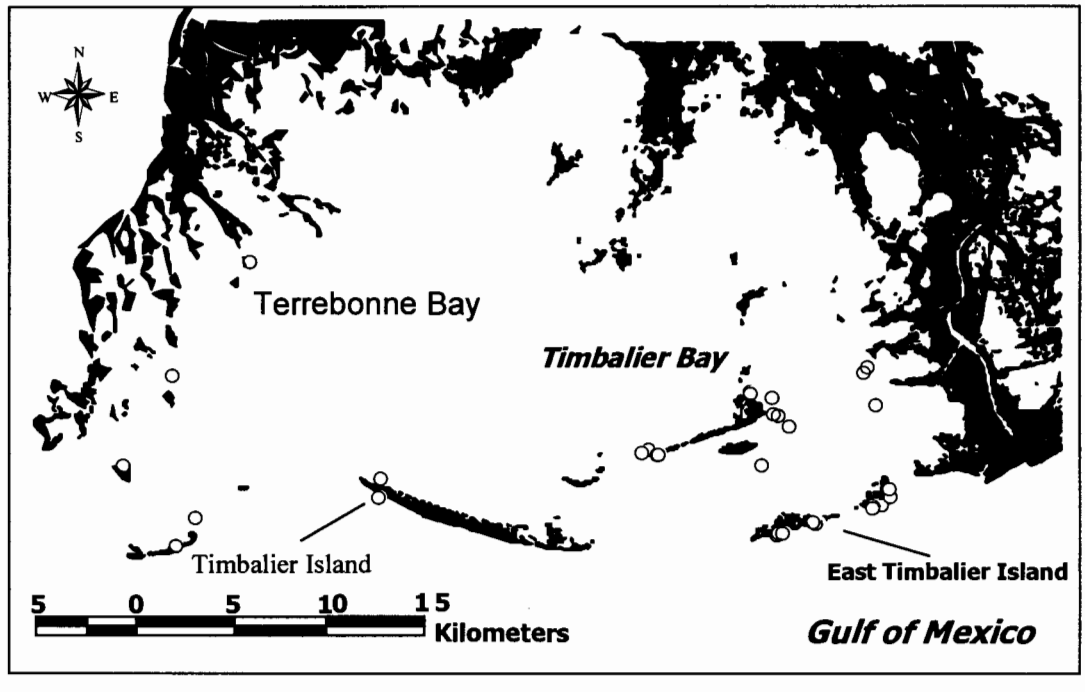

Figure 3. **2000 experimental gillnet sampling stations.**

permanent stations that were to be sampled every trip (Figure 4). These stations were established in order to allow examination of both inter- and intra-annual species trends. The second change was within the small-scale temporal component to the sampling, with the Night period being divided up into Night PM (before midnight) and Night AM (after midnight). The target set duration was again three hours and soak times ranged from 1 hour 15 minutes to six hours 57 minutes, with most sets lasting between 3 and 3.5 hours. Sampling trips were conducted approximately every two weeks from May through August, with one additional trip in September.

A 186 m long gillnet with six panels was utilized for sampling. Individual panels were 30.4 m long and 1.8 m deep, with a hanging coefficient of 0.5. The floatline was made of ½" (1.27 cm) polyfoam with a buoyancy of 1.42 kg of lead per 30.4 m. The bottom line consisted of a braided synthetic cover over a lead core, 11.025 kg of lead per 30.4 m. Stretched mesh (SM) sizes ranged from 8.9 cm (3.5 in) to 14.0 cm (5.5 in) in steps of 1.27 cm (0.5 in), with an additional size of 20.3 cm (8.0 in) in 1999. During the 2000 sampling season, SM sizes ranged from 10.18 cm (4 in) to 15.27 cm (6 in) in steps of 1.27 cm (0.5 in), with an additional size of 20.3 cm (8.0 in). Webbing for all panels, except for the 20.3 cm SM, were of clear monofilament, double knotted and double selvaged. The webbing of the 20.3 cm SM panel was made of #18 multifilament nylon (353 kg break strength), single knotted and double selvaged. Panels were tied together sequentially to make one continuous net. Empty five-gallon containers were painted fluorescent orange and attached to the floatline between each of the panels and at both ends. The net was anchored at both ends using 22.05 kg anchors attached to the net using 4.6 m bridles.

The net was deployed over the bow of the boat, secured, and environmental parameters recorded. Latitude and longitude of each set was determined with a handheld GPS unit. Water temperature, salinity, dissolved oxygen, and conductivity were recorded using a hand held YSI 85. Depth was recorded from the depth finder on the boat and turbidity was determined for all daylight sets using a Secchi disk. Bottom type was determined by examining the sediments on the net anchors. Additionally, weather information such as Beaufort state, wind direction, and cloud cover was recorded starting in 2000 (Table 1). The net was checked approximately every hour while in the water. The net was walked either along the side of the boat or over the bow, depending on weather conditions. For all sharks and bycatch encountered, the mesh size was recorded and the animal removed from the net. The sex, precaudal length, fork length, total length (1999 only), stretched total length, and maturity level (based on umbilical scar condition and clasper information for males) was recorded for all elasmobranchs. Sharks were classified as neonates (open umbilical scar), young-of-the-year (healed scar), juvenile (no scar), adult, or unknown. All live sharks were tagged with a LSU Floy plastic barbed tag in 1999 or a tag provided by the Shark Population Assessment Group at the NMFS facility in Panama City, Florida in 2000 and released. In 2001, a portion of the live blacktip and Atlantic sharpnose shark catches were sacrificed for an ongoing feeding study. The remaining live sharks were tagged using the NMFS tags used in 2000 sampling season. If in poor condition or dead, the shark was retained for further biological sampling in a laboratory setting. Laboratory processing included measuring and weighing all animals and a more thorough reproductive examination. Vertebrae were collected for all sharks and rays examined in the laboratory during all sampling seasons, and during the 2000 and 2001 sampling seasons, stomachs were also collected.

In addition to our independent sampling program, we also collected specimens in cooperation with Louisiana Department of Wildlife and Fisheries (LDWF) personnel, other scientists and recreational fishers. These additional specimens were helpful in broadening our understanding of sharks in Louisiana waters.

Description of Study Area

Present and past lobes of the Mississippi Delta dominate the current coastline of Louisiana and an understanding of this relationship is important to understanding the fish dynamics that occur here. The Mississippi River has built six major delta complexes over the last 7000 years (Frazier 1967). The barrier island systems observed today developed due to delta abandonment when the river

Figure 4. **2001 experimental gillnet sampling stations.**

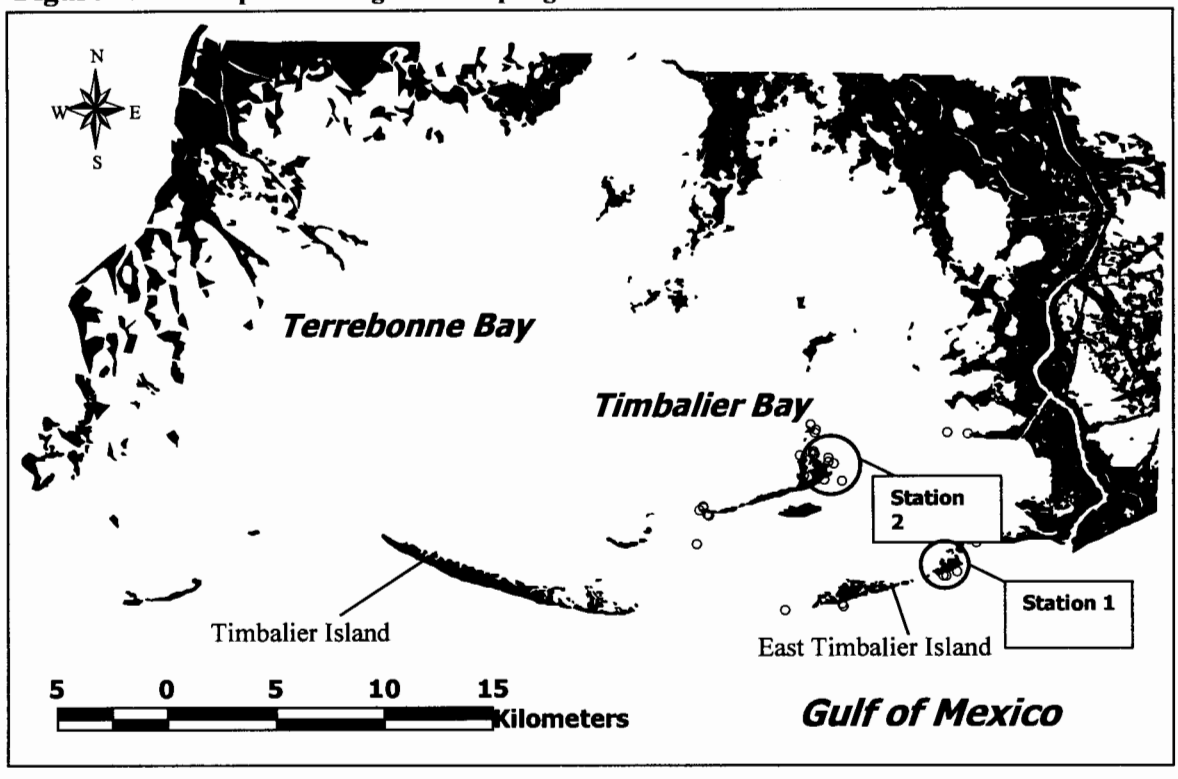

Table 1. **Environmental parameters collected during experimental gillnet sampling. Values listed represent the minimum and maximum observed for that parameter.**

Parameter	1999	2000	2001
Temperature (°C)	22.2 - 31.4	22.5 - 32.4	26.4 - 32.1
Dissolved Oxygen (%)	58.4 - 108.0	64.9 - 127.8	45.6 - 137.6
Dissolved Oxygen (mg/L)	3.80 - 8.12	4.09 - 8.24	2.89 - 9.61
Conductivity (mS)	---	38.99 - 56.20	29.32 - 47.10
Salinity (ppt)	11.0 - 33.8	24.7 - 37.3	18.0 - 31.5
Depth (m)	1.2 - 5.2	1.5 - 4.9	0.9 - 4.4
Turbidity (m)	0.1 - 2.0	0.3 - >2	0.3 - 1.4
Beaufort State	---	0 - 3	0 - 3
Cloud Cover	---	0.01 - 0.90	0.0 - 0.9

switched courses (Kolb and Van Lopik 1966). The Isles Dernieres and Bayou Lafourche barrier island systems are both transgressive island arcs and the creation and evolution of these barrier island systems follows the three-stage model as described in Penland et al (1985). Currently, Louisiana's barrier islands are experiencing landward migration, land loss, and island narrowing (McBride and Byrnes 1997). This is a consequence of a complex interaction of global sea level rise, wave and storm processes, compactional subsidence, inadequate sediment supply and significant human disturbance (van Heeden and DeRouen 1997). Many of the barrier islands along the Louisiana coast are currently undergoing beach renourishment and island restoration and stabilization projects (Louisiana Coastal Wetlands Conservation and Restoration Task Force (undated), Williams 1998). The potential impacts these activities may have on the shark nursery habitat of this region are unknown.

Our sampling was confined primarily to the Terrebonne/Timbalier Bay system in central Louisiana (Figure 1). This system is typical of most central Louisiana nearshore coastal zones, consisting mainly of shallow, turbid waters protected from the Gulf of Mexico on its southernmost edge by the barrier islands of Timbalier Island, East Timbalier Island, and the Isles Dernieres barrier island chain. The bottom type of the region is predominantly mud or a mud-shell composite. It is a microtidal habitat (< 50 cm), with local predominant winds often having more dominant effects than the tidal cycle due to the shallowness (< 2 m) of most of the region (Marmer 1954). Water temperatures ranged from 22.2 – 32.4 °C during our sampling, with the salinity ranging from 11.0 – 37.3 ppt.

Results and Discussion

A total of 219 sharks, representing six species, were observed in 1999 (Tables 2 and 3). Twenty-six gillnet sets were conducted between May and November for a total fishing time of 93.25 hours. The catch per unit effort (defined as sharks/net hour) for all species combined was 2.35 sharks/net hour. Blacktip sharks were the most numerically abundant, followed by spinner, bull, finetooth, Atlantic sharpnose, and lemon sharks. Catch per unit effort by species is shown in Table 4.

The tagging component to the 1999 season was not successful as we had extreme difficulty with the tags breaking during tagging. A total of 47 sharks were tagged with LSU Floy barb tags. No recaptured sharks have been reported.

During the 2000 survey season, a total of 576 sharks representing six species were observed (Tables 2 and 3). Thirty gillnet sets were conducted between March and September for a total fishing time of 107.75 hours. The catch per unit effort for all species combined was 5.35 sharks/net hour. Blacktip sharks were again the most numerically abundant, followed by Atlantic sharpnose, bull, finetooth, bonnethead, and scalloped hammerhead sharks. Catch per unit effort by species is shown in Table 4.

A total of 214 sharks were tagged during the 2000 sampling season using National Marine Fisheries Service streamer tags. Unfortunately, 17 of those animals were recaptured dead during the same sampling set that they were initially tagged.

Two hundred and seven sharks were caught in the experimental gillnets during the 2001 sampling season. Thirty-two gillnet sets were conducted between May and September for a total fishing time of 119.65 hours. The catch per unit effort for all species combined was 1.73 sharks/net hour. Blacktip sharks were the most numerically abundant, followed by bull, Atlantic sharpnose, finetooth, bonnethead, and scalloped hammerhead sharks. Catch per unit effort by species is shown in Table 4.

Only 14 additional sharks were tagged during the 2001 sampling season using NMFS streamer tags: nine bull sharks, three blacktip sharks, one bonnethead shark and one Atlantic sharpnose shark. Currently, there are 158 tagged sharks at large. No recaptured sharks have been reported at this time.

Species Profiles

Blacktip shark, *Carcharhinus limbatus*

Blacktip sharks were the most abundant shark species captured in our gillnet samples, with 65 sharks encountered in eight of 26 sets in 1999. Fifteen sharks were determined to be neonates, with

Table 2. Comparison of shark species caught in the experimental gillnet surveys in all survey years (1999 - 2001).

Species	Sampling Year	MALES Number observed	MALES Size Range (FL, cm)	MALES Maturity Stages Observed	FEMALES Number observed	FEMALES Size Range (FL, cm)	FEMALES Maturity Stages Observed
Carcharhinus limbatus Blacktip shark	1999	26	51 - 96	neonate, YOY, juvenile	38	50 - 103.5	neonate, YOY, juvenile
	2000	155	45.6 - 109.5	neonate, YOY, juvenile	188	45.8 - 108.7	neonate, YOY, juvenile
	2001	62	45.7 - 104.7	neonate, YOY, juvenile, adult	76	43.9 - 110.8	neonate, YOY, juvenile, adult
	* 1 additional specimen of unknown sex collected in 1999, 11 collected in 2000, and 7 collected in 2001						
Carcharhinus leucas Bull shark	1999	20	60 - 104	neonate, YOY, juvenile	11	79.5 - 101.5	YOY, juvenile
	2000	14	89.5 - 116.3	YOY, juvenile	13	88.8 - 110.0	YOY, juvenile
	2001	8	96.1 - 117.6	juvenile	12	91.9 - 120.0	juvenile
	* 8 additional specimens of unknown sex collected in 1999, 16 collected in 2000, and 13 collected in 2001						
Carcharhinus isodon Finetooth shark	1999	15	73 - 103.5	juvenile, adult	23	72 - 117.9	juvenile, adult
	2000	16	49.2 - 108.8	YOY, juvenile, adult	13	40.8 - 89.0	neonate, juvenile
	2001	2	54.5 - 99.1	juvenile, adult	2	44.2 - 48.6	YOY
	* 1 additional specimen of unknown sex collected in 2000						
Rhizoprionodon terraenovae Atlantic sharpnose shark	1999	14	39 - 82.6	YOY, juvenile, adult	8	35.5 - 42	YOY
	2000	87	33.1 - 83.8	neonate, YOY, juvenile, adult	22	29.8 - 54.1	YOY, juvenile
	2001	19	29.8 - 82.6	neonate, YOY, juvenile, adult	1	39.1	juvenile
	* 1 additional specimen of unknown sex collected in 1999, and 6 collected in 2000						

Table 3. Summary of shark species caught in the experimental gillnet surveys in only one or two of the survey years.

Species	Sampling Year	MALES Number observed	MALES Size Range (FL, cm)	MALES Maturity Stages Observed	FEMALES Number observed	FEMALES Size Range (FL, cm)	FEMALES Maturity Stages Observed
Carcharhinus brevipinna Spinner shark	1999	26	55 - 67.5	YOY, juvenile	21	50 - 103.5	neonate, YOY, juvenile
	2000	-	-	-	-	-	-
	2001	-	-	-	-	-	-
	* 1 additional specimen of unknown sex collected in 1999, 11 collected in 2000, and 7 collected in 2001						
Negaprion brevirostris Lemon shark	1999	-	-	-	1	1830**	adult
	2000	-	-	-	-	-	-
	2001	-	-	-	-	-	-
	* 8 additional specimens of unknown sex collected in 1999, 16 collected in 2000, and 13 collected in 2001						
Sphyrna tiburo Bonnethead shark	1999	-	-	-	-	-	-
	2000	10	47.9 - 56.7	juvenile	7	45.5 - 60.2	juvenile
	2001	3	55.5 - 71.5	juvenile	-	-	-
	* 1 additional specimen of unknown sex collected in 2000						
Sphyrna lewini Scalloped hammerhead shark	1999	-	-	-	-	-	-
	2000	3	36.8 - 44.3	neonate, juvenile	22	41.8	juvenile
	2001	1	38.8	YOY	-	-	-
	* 1 additional specimen of unknown sex collected in 1999, and 6 collected in 2000						

** estimated total length of specimen

Table 4. Species specific catch per unit effort (defined as sharks per net hour) for sharks collected in the experimental gillnet sampling.

Species	1999 Number observed	1999 CPUE (sharks/ net hour)	2000 Number observed	2000 CPUE (sharks/ net hour)	2001 Number observed	2001 CPUE (sharks/ net hour)
Carcharhinus limbatus Blacktip shark	65	0.70	354	3.29	145	1.21
Carcharhinus brevipinna Spinner shark	44	0.47	-	-	-	-
Carcharhinus leucas Bull shark	39	0.42	43	0.40	33	0.28
Carcharhinus isodon Finetooth shark	38	0.41	34	0.32	4	0.03
Rhizoprionodon terraenovae Atlantic sharpnose shark	23	0.25	117	1.09	20	0.17
Negaprion brevirostris Lemon shark	1	0.01	-	-	-	-
Sphyrna lewini Scalloped hammerhead shark	-	-	4	0.04	1	0.01
Sphyrna tiburo Bonnethead shark	-	-	17	0.16	3	0.03

the remaining 50 animals split between young-of-the-year and juvenile individuals. Sizes of the sharks observed were 51.0 - 103.5 cm FL. Blacktips were collected June through September, and additionally in November, from depths ranging between 1.2 and 5.2 m. Water temperatures at collection ranged from 23.6 - 31.4 °C, with salinities between 18 - 33.8 ppt.

In 2000 blacktip sharks were again the most abundant shark species captured in our gillnet samples, with 354 sharks encountered in 20 of 30 sets. Forty-five sharks were determined to be neonates, 62 were juveniles, and the remaining sharks (247) were classified as young-of-the-year individuals. The size of the sharks observed ranged from 45.6 - 109.5 cm FL. Blacktip sharks were collected April through August, from depths ranging between 1.5 and 4.9 m. Water temperatures at collection ranged from 22.6 - 32.4 °C, with salinities between 25.2 - 34.7 ppt.

One hundred forty-five blacktip sharks were captured in our 2001 gillnet samples. The species occurred from May through September in 20 of 32 sets. One adult male was collected, along with 28 neonates. The remaining sharks were split between young-of-the-year and juvenile individuals. Sizes of the sharks ranged from 43.9 - 109.9 cm FL. Blacktips were collected May through September from depths ranging between 1.2 and 4.4 m. Water temperatures at collection ranged from 26.4 - 32.1 °C, with salinities between 18 - 30.1 ppt.

LDWF personnel provided four neonate blacktip sharks to us in 1999. The sharks had been captured in June 1997 and were all males, ranging in size from 55 - 61 cm FL. Nine additional blacktip sharks were given to project personnel during the 2000 season. Two neonate blacktip sharks (48.5 and 50.5 cm FL) were collected in April by another LSU researcher while trawling in Terrebonne Bay. One neonate (46.2 cm FL) was collected in May and a young-of-the-year individual (62.1 cm FL) in August by LDWF scientists. LDWF personnel collected five additional blacktip sharks (67.4 - 74 cm FL); unfortunately no capture information is available at this time.

Spinner shark, *Carcharhinus brevipinna*

In 1999 forty-four spinner sharks were captured in four of the 26 gillnet sets. Spinner sharks were captured in August and September, when the water temperature ranged between 28.2 and 30.3 °C. The sharks were collected in 4.6 to 5.2 m of water, with salinities ranging from 24 to 29 ppt. All spinner sharks were determined to be young-of-the-year and juveniles, ranging in size from 55 .0 – 67.5 cm FL.

One additional spinner shark was collected by hook and line in 1999. The male young of the year individual was captured in September off one of the barrier islands. It measured 56.2 cm FL.

While no spinner sharks were collected in the directed gillnet sampling in 2000, six specimens were received from LDWF personnel. One neonate spinner shark (54.2 cm FL) was collected in July, while three sharks ranging in size from 57.4 - 59.7 cm FL were collected in August. Two additional neonate sharks (51.1 and 53.3 cm FL) were also collected. All sharks were collected from the Grand Isle/Grand Terre Beach. No additional spinner sharks were encountered in the 2001 sampling season.

Bull shark, *Carcharhinus leucas*

Bull sharks were collected in June, July, and September of 1999, in 1.5 -5.2 m of water. The sharks ranged in size from 79.5 - 104.0 cm FL. Four sharks were classified as neonate, three as young-of-the-year, and the remaining 32 as juveniles. Bull sharks were observed in 8 of the 26 gillnet sets, with salinities ranging from 11 - 29 ppt, and water temperatures between 28.1 - 29.9 °C.

Louisiana Department of Wildlife and Fisheries scientists collected forty-one bull sharks for our study in 1999. Sharks were collected in June, July, and August, most caught using a gillnet left set overnight in Little Lake, one of the inland lakes. The collected sharks ranged in size from 60.0 - 96.0 cm FL. All were determined to be juveniles except one female (60 cm FL) collected in July, who was classified as a neonate.

Forty-three bull sharks were collected in March, June, July, and August of 2000, in 1.5 –4.6 m of water. The sharks ranged in size from 88.8 – 116.3 cm FL, and were classified as young-of-the-year individuals and juveniles. Bull sharks were observed in seven of the 30 gillnet sets, with salinities ranging from 25 – 32.4 ppt, and water temperatures between 22.5 - 32 °C.

LDWF scientists collected fifty-three bull sharks for our study in 2000. Fifty of these sharks were collected in March in upper Barataria Bay using gillnets as part of a water diversion study. Sharks ranged in size from 70.0 - 99.2 cm FL, with seven neonates represented in the catch. Three additional juvenile bull sharks were collected in June, July, and November 2000.

A total of 33 bull sharks were encountered during the 2001 sampling season. The sharks were observed in May - September, in 1.5 - 4.4 m of water. Bull sharks were caught in nine of the 32 gillnet sets, with salinities ranging from 20.3 - 28 ppt, and water temperatures between 27.1 - 31 °C. The sharks ranged in size from 89.5 – 120.0 cm FL, and were classified as young-of-the-year individuals and juveniles.

Scientists at the Louisiana Department of Wildlife and Fisheries collected 38 bull sharks for our study in 2001. All of these sharks were collected in May in upper Barataria Bay using gillnets as part of a water diversion study. Sharks ranged in size from 62.4 - 117.0 cm FL, with three neonates represented in the catch.

Finetooth shark, *Carcharhinus isodon*

Thirty-eight finetooth sharks were observed in the 1999 gillnet sampling, ranging in size from 72.0 - 117.9 cm FL. Sharks were collected in waters 0.6 - 1.2 m deep in June, August, and September. Finetooth sharks were collected in four of the 26 sets. Salinities at collection ranged from 19 - 29 ppt and water temperatures were 28.2 - 31.4 °C. Both juveniles and adults were observed in the catch.

Thirty finetooth sharks were observed in the 2000 gillnet sampling, ranging in size from 40.8 - 108.8 cm FL. Sharks were collected in waters 1.5 – 4.9 m deep in May, June, July, and August. Finetooth sharks were collected in seven of the 30 sets. Salinities at collection ranged from 25 – 34.3 ppt and water temperatures were 25.3 - 32 °C. Four adults and one neonate were observed in the catch, with the remaining sharks being either young-of-the-year individuals or juveniles.

LDWF personnel at the Grand Terre lab collected two additional finetooth sharks in 2000. Both specimens were adults, the male being 107.1 cm FL, and the female 117.1 cm FL. Collection date information is unavailable.

Four finetooth sharks were caught in the 2001 gillnet sampling. These sharks ranged in size from 42.9 - 97.7 cm FL, and were collected in June and July. Sharks were collected in three of the 32 gillnet sets, in waters 1.7 - 4.3 m deep. Salinities at collection ranged from 22.9 – 30.1 ppt and water temperatures were 29.0 - 32.1 °C. Three of the sharks were determined to be juveniles, with the remaining shark an adult.

Atlantic sharpnose shark, *Rhizoprionodon terraenovae*

In 1999 Atlantic sharpnose sharks were encountered in six of the 26 gillnet samples. Sharks were observed May - August when water temperatures were between 23.7 - 30.3 °C. Nine adults, four juveniles, and 11 young-of-the-year individuals were collected from water depths of 1.8 - 4.6 m. Salinity ranged from 23 - 27.5 ppt on date of capture. Sizes ranged from 35.5 to 82.6 cm FL.

Eight additional Atlantic sharpnose shark samples with a size range of 58.5 - 75.7 cm FL were collected using hook and line in 1999. Four sharks were obtained by LSU personnel in July at the Grand Isle Fishing Rodeo, and three additional sharks were caught off Elmers Island Beach in August. The two remaining sharks were collected in November 1998 on a SEAMAP cruise.

One hundred seventeen Atlantic sharpnose sharks were encountered in 19 of the 30 gillnet samples 2000. Sharks were observed April - August when water temperatures were between 22.6 - 32.4 °C. Shark sizes ranged from 29.8 – 83.8 cm FL, with all age classes represented in the catch (neonates, young-of-the-year, juveniles, and adults). Individuals were collected from water depths of 1.5 - 4.9 m. Salinity ranged from 28.9 – 37.3 ppt on date of capture.

Louisiana Department of Wildlife and Fisheries personnel collected twenty-one additional Atlantic sharpnose sharks using hook and line in 2000. Two of the individuals were collected in June from Grand Isle Beach. Ten sharks were collected in July from SEAMAP Station D812. The July specimens were all adult females, with six containing very early term embryos. These sharks ranged in size from 73.4 - 81.9 cm FL. One 57.0 cm FL male was collected from SEAMAP Station D824 in October. We also obtained seven adult

females from an additional SEAMAP cruise in November 2000. These sharks ranged in size from 67.6 - 83.3 cm FL and were pregnant. The final Atlantic sharpnose shark collected by LDWF in 2000 was a 32.6 cm FL female.

A total of 20 Atlantic sharpnose sharks were collected during the 2001 sampling season. The sharks occurred in seven of the 32 gillnet sets and ranged in size from 29.8 to 82.6 cm FL. All age classes (neonates, young-of-the-year, juveniles, and adults) were represented in the catch. Sharks were observed May - August when water temperatures were between 26.4 - 32.1 °C. Salinities at collection ranged from 23.7 - 30.1 ppt and individuals were collected from water depths of 1.2 - 4.3 m.

Lemon shark, *Negaprion brevirostris*

One mature lemon shark (~183 cm TL) was collected in August 1999. The shark was captured at a water temperature of 30.5 °C and a depth of 4 m. The female shark was released without a tag in good condition. Information from archived museum specimens indicate that young lemon sharks are known to congregate around the barrier islands off the Louisiana coast.

LDWF scientists gave two lemon shark specimens to the project. One shark was collected from Raccoon Point in June 1997 and was a female with a fork length of 77.4 cm. The second shark was also a female and was collected November 1999 with a fork length of 62.4 cm. Capture location data is unavailable for the second shark. No lemon sharks were collected in the directed gillnet sampling in 2000.

Although no lemon sharks were encountered during the 2001 directed gillnet survey, three were acquired from other sources during the year. One female shark was collected in July by LDWF personnel, and measured 88.8 cm FL. Project personnel collected a second shark during a sampling trip to gather blood samples of bull sharks. The shark was a 112.5 cm FL female collected via gillnet. The final lemon shark was also a female, 56.6 cm FL, and was captured on rod and reel by project personnel. Both gillnet and rod and reel sharks were collected in September. Salinities at collection ranged from 26.0 – 28.6 ppt and water temperatures were 29.0 - 32.0 °C.

Scalloped hammerhead shark, *Sphyrna lewini*

In 2000 a total of four scalloped hammerhead sharks were collected in three of 30 gillnet sets, ranging in size from 36.8 – 44.3 cm FL. One shark was determined to be a neonate and the remaining three young-of-the-year individuals. These sharks were collected in June and July from depths between 1.5 – 2.4 m. Water temperatures at capture were 28.4 – 32.4 °C and salinities ranged from 29.5 – 34.3 ppt.

One scalloped hammerhead shark was collected in July 2001. The shark was a juvenile male and measured 39.5 cm FL. It was collected in waters 1.2 m deep. The water temperature at capture was 30.1 °C and salinity was 20.1 ppt.

Bonnethead shark, *Sphynra tiburo*

Seventeen juvenile bonnethead sharks were captured in six of the 30 gillnet sets in 2000. They ranged in size from 45.5 – 60.2 cm FL. Sharks were captured May through August from water depths of 1.8 – 2.4 m. Salinities at collection ranged from 29.1 – 34.3 ppt and water temperatures were 28.4 - 31.4 °C.

A total of three bonnethead sharks were observed in the 2001 sampling season. The sharks ranged in size from 55.5 to 71.5 cm FL and were all juvenile males. One of the sharks was collected in May, with the remaining two sharks being captured in August. Bonnethead sharks occurred in two of the 32 gillnet sets, in 1.8 m of water. Water temperatures at collection were 28.7 - 29.7 °C and salinities ranged from 25.3 – 29.6 ppt.

Preliminary Findings

Louisiana's nearshore coastal waters appear to be important pupping and nursery areas for several species of small and large coastal sharks. A total of 1002 sharks were captured in our 320.42 hours of gillnet sampling, for an overall CPUE of 3.13 sharks/net hour. We encountered eight species of sharks, with four of those species occurring in our gillnet samples in all three years: blacktip, bull, finetooth, and Atlantic sharpnose sharks (Table 2). Two species of sharks, bonnethead and scalloped hammerhead sharks, occurred in both the 2000 and 2001 sampling seasons (Table 3). The two

remaining shark species, spinner and lemon sharks, only occurred in our gillnet sets during the 1999 sampling season (Table 3). The vast majority (~ 80%) of the sharks observed were neonate and young-of-the-year individuals, with the remaining 20% of the catch dominated by young juveniles.

Utilization of the nearshore area varied temporally for several species (Figure 5). Blacktip sharks regularly frequent these areas in June and July, while spinner sharks were only encountered in August and September. Finetooth sharks were encountered most frequently in the mid to late summer months, with pregnant females being collected in September. One neonate finetooth shark was collected in May, so they may use these areas for pupping in early spring as well. Bull sharks were encountered in fairly consistent numbers throughout the summer months, as were Atlantic sharpnose sharks.

The assemblage of sharks encountered also varied temporally (Figure 6). Blacktip sharks were the most frequently encountered and consistent member of the nearshore assemblage, being collected May through September. Atlantic sharpnose sharks were the second main component, occurring May through August in all sampling years. Bull sharks made up the last main component to the assemblage encountered. Although rarely present in large numbers, they were a common species captured in almost all months sampled. As stated above spinner and finetooth sharks appear in the catch in August and September. The remaining members of the assemblage varied by month, with one or two additional species collected per month. Bonnethead, scalloped hammerhead, and lemon sharks showed no discernable trend, most likely due to the small sample sizes encountered for each species.

Published records of shark nursery areas in Louisiana are limited, focusing mainly on bull sharks. Caillouet et al. (1969) and Hoese (1976) discuss the presence of immature bull sharks (*Carcharhinus leucas*) from the Vermillion/Atchafalaya Bay region, and Thompson and Verret (1980) discuss the collection of immature bull sharks from Lake Pontchartrain, but little other historical information is available. Our sampling encountered a much more diverse assemblage of sharks. These findings, along with those of de Silva *et al.* (2001), indicate that Louisiana's coastal waters and barrier island systems are important nursery habitat for a variety of shark species.

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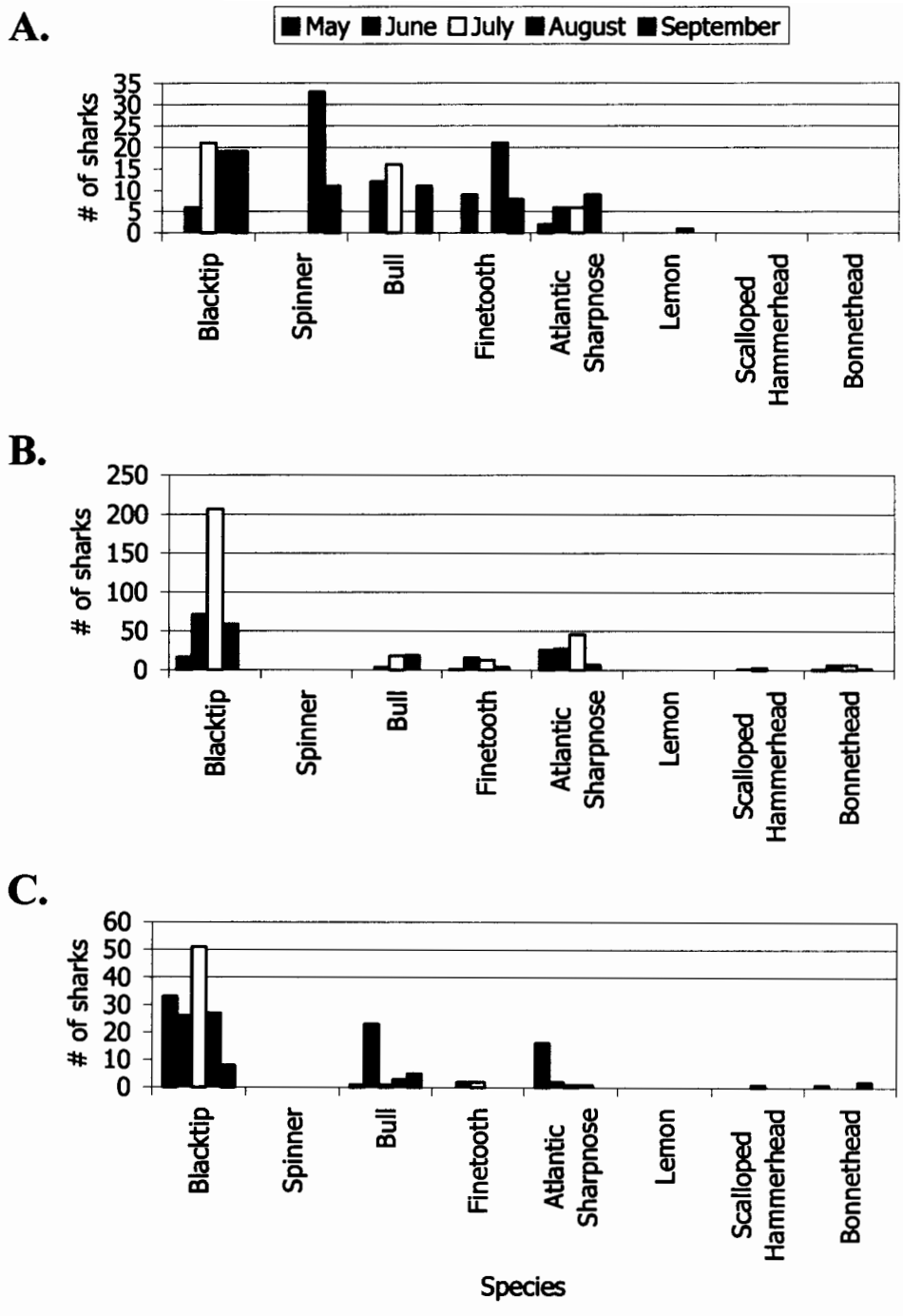

Figure 5. Monthly species-specific shark abundance encountered in the experimental gillnet sampling. A. 1999 sampling season B. 2000 sampling season C. 2001 sampling season. Please note differing scales on y-axes.

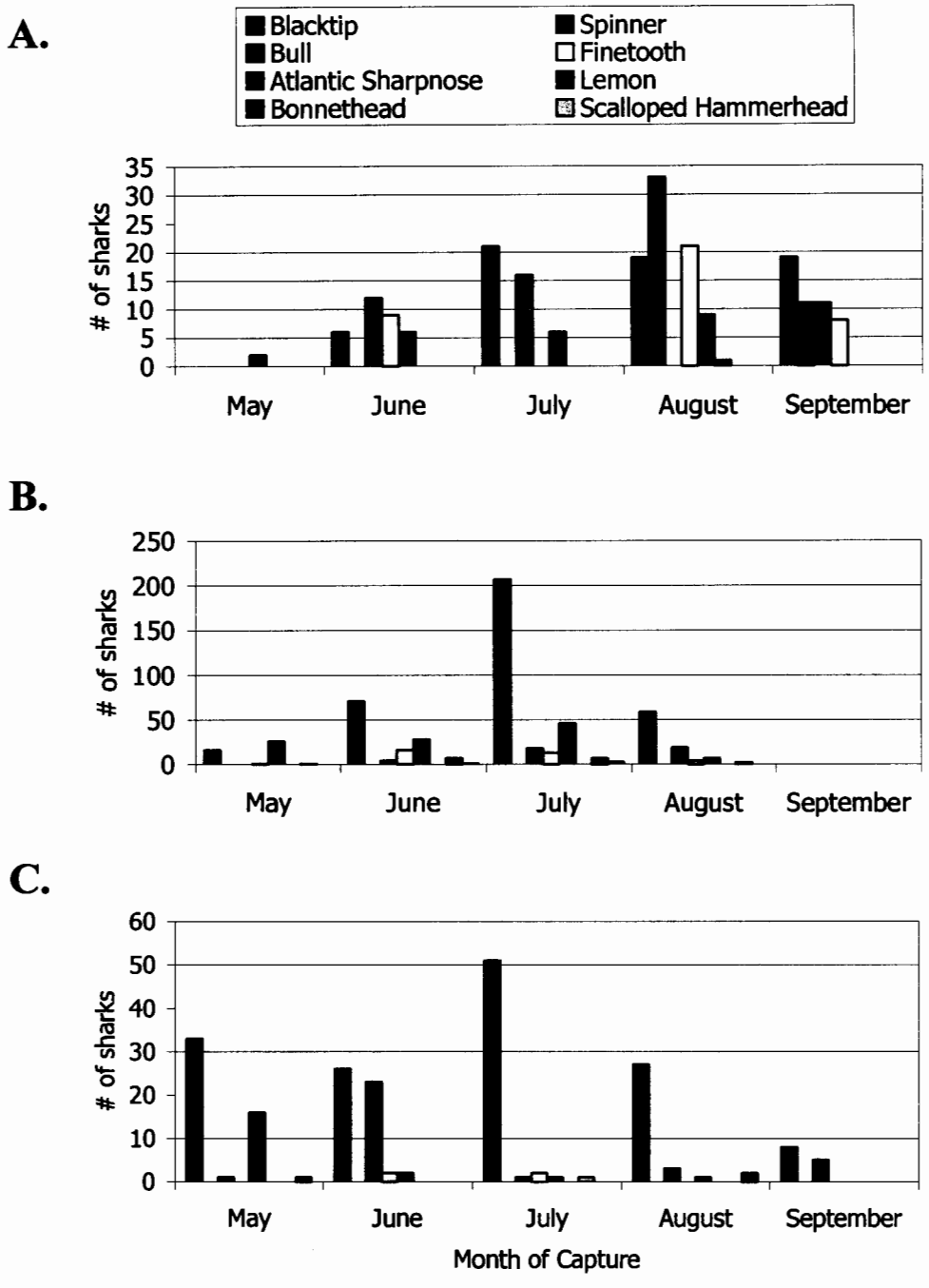

Figure 6. **Species assemblages encountered by month in the experimental gillnet sampling. A. 1999 sampling season B. 2000 sampling season C. 2001 sampling season. Please note differing scales on y-axes.**

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Appendix I

Species	Conversion Equation	R^2	n
C. isodon	FL = 1.0972*(PCL) + 8.6441	0.9991	73
C. limbatus	FL = 1.1072*(PCL) + 1	0.9921	304
C. leucas	FL = 1.0918*(PCL) + 16.769	0.9934	161
R. terraenovae	FL = 1.0725*(PCL) + 9.38	0.999	87
S. tiburo	FL = 1.099*(PCL) - 4.8325	0.9958	13

FL = fork length (mm)
PCL = precaudal length (mm)

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