



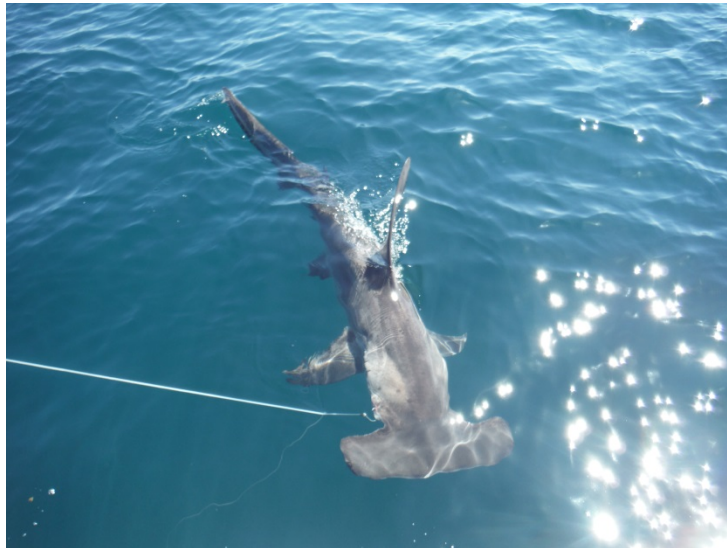
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CHARACTERIZATION OF THE SHARK BOTTOM LONGLINE FISHERY: 2015

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Introduction

Observations of the shark-directed bottom longline fishery in the Atlantic Ocean and Gulf of Mexico have been conducted since 1994 (Morgan et al. 2009, Enzenauer et al. 2015 and references therein). Currently about 210 U.S. fishers are permitted to target sharks (excluding dogfish) in the Atlantic Ocean and Gulf of Mexico, and an additional 254 fishers are permitted to land sharks incidentally. Amendments to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan implemented a shark research fishery, which allows NMFS to select a limited number of commercial shark vessels on an annual basis to collect life history data and catch data for future stock assessments (NMFS, 2007). Specifically, only commercial shark fishers participating in the research fishery are allowed to land sandbar sharks, *Carcharhinus plumbeus*, and must carry an observer on 100% of all trips (compared to a target coverage level of 5-10% outside the research fishery). Outside the research fishery, fishers are permitted to land other large coastal sharks (e.g. blacktip shark, *Carcharhinus limbatus*, and bull shark, *Carcharhinus leucas*,). Herein, we report on observed fishing activities in the shark bottom longline fishery for the 2015 fishing season, including coverage of the 2015 Shark Research Fishery.

Methods

In October 2014, NMFS announced its request for applications for the Shark Research Fishery from commercial shark fishers with a directed or incidental permit for 2015. Commercial shark fishers submitted applications to the Highly Migratory Species (HMS) Management Division. The HMS Management Division provided a list of qualified applicants to the Panama City Laboratory and based on the temporal and spatial needs of the research objectives, the

availability of qualified applicants, available funding and the available quota, seven (7) qualified applicants were selected for observer coverage. These vessels carried observers on 100% of trips. Observer coverage outside the shark research fishery depended on the time of year, available funding, and fishing seasons. Vessels were randomly selected for coverage if they possessed a valid directed shark permit, and reported fishing with longline gear in the previous year. Target observer coverage for these vessels is 5-10% of trips. There are three fishing zones designated for observer coverage: northern Atlantic, southern Atlantic and Gulf of Mexico. References to the “northern Atlantic” refer to the coastal waters off the eastern U.S. states from Maine to Virginia, the “southern Atlantic” refers to the coastline from North Carolina to Florida, and the “Gulf of Mexico” refers to the coastline from the Florida Keys to Texas. Because no vessels fished the previous year in the northern Atlantic, vessels were selected from two fishing zones: southern Atlantic and Gulf of Mexico.

Selection letters requiring observer coverage were issued to the permit holder via U.S. Certified mail approximately one month prior to the upcoming fishing season. Once the permit holder receives the selection letter, he or she is required to make contact with the observer coordinator and indicate intent to fish during the upcoming fishing season. If the permit holder intended to fish, the observer coordinator deployed an observer to the port of departure. Vessels were required to pass a Coast Guard Vessel Safety Examination as well as a safety evaluation by the observer prior to coverage.

While onboard the vessel, the observer completes three data forms: Longline Gear Log, Longline Haul Log, and Animal Log. The Longline Gear Log is used to record gear characteristics. The Longline Haul Log is used to record the information on set and haulback, as well as environmental information. The Animal Log records all species caught, condition of the

catch (e.g. alive, dead, damaged, or unknown), and the final disposition of the catch (e.g. kept, released alive, discarded dead, etc.).

In 2012, HMS Management Division changed the regulations for Shark Research Fishery trips to minimize unnecessary discard of dead sharks. Participants were allowed to harvest all non-prohibited species of sharks, including sandbar sharks only when an authorized sampler was onboard and the fishery was open. Fishers were required to land all catch of shark species that were legal under a directed shark permit (including sandbar shark, which is otherwise prohibited) unless they could be released alive. In 2015, HMS continued the 2012 amended model which allows one 150 hook ‘feeler’ set with a soak time of no more than two hours and one 300 hook set with no soak limit. The number of hooks permitted on board was also increased to account for any lost hooks during a feeler set and provide fishers flexibility to use different types of hooks while fishing for non-HMS species within the same trip. In 2013, four fishing regions were assigned by HMS to help manage interactions of dusky shark, *Carcharhinus obscurus*, throughout the research fishery (Figure 1). A bycatch quota of three (3) dead dusky shark interactions per region was implemented for each of the four fishing regions with the exception of the southern Florida region allowing six (6) due to the number of vessels based in that region. Every vessel had the option to move between regions to allow some flexibility for the fisherman to avoid seasonal dusky shark areas where catches were high. If the total allowable number of dead dusky sharks in a specified region is observed, new guidelines are enforced to decrease dusky shark mortality. The new guidelines limit all permit holders to one 300 hook set per trip with a soak time no more than 3 hours. If three additional dusky shark interactions (alive or dead) occur, the region would be completely closed to fishing for the remainder of the year unless otherwise permitted by HMS.

Observers continued to opportunistically sample sharks for biological samples, ideally a systematically sampling of each nth specimen would occur. Observer discretion is advised as n might vary based on vessel, catch rates, weather conditions or other situations. These samples are used for updates to life history studies. Vertebrae were collected from sandbar shark, blacktip shark and other select species to maintain time series of age distribution from within the fishery. Increased sampling of vertebrae and reproductive tissue of blacktip sharks occurred to aid with upcoming assessments. Observers were still required to obtain trip weigh out forms which were compared to shark dealer reports by quota monitoring personnel to manage the sandbar shark quota within the research fishery.

Results and Discussion

From January to December 2015, a total of 83 trips (defined as from the time a vessel leaves the port until the vessel returns to port and lands catch, including multiple hauls therein) on 9 vessels with a total of 116 bottom longline hauls (defined as setting gear, soaking gear for some duration of time, and retrieving gear) were observed (Table 1). The Shark Research Fishery commenced in February with seven participants, however three vessels fulfilled their individual sandbar quotas in the months of May, June and July. These three vessels were unable to make trips the rest of the year. In October, a vessel withdrew from the research fishery forfeiting its remaining quota, which was divided up between the three remaining participants. Gear characteristics varied by area (eastern Gulf of Mexico or southern Atlantic) and target species (non-sandbar large coastal shark, or sandbar shark). For the Shark Research Fishery, if less than three vessels fished in each area then the observed data were summarized for the eastern Gulf of Mexico and southern Atlantic to protect vessel confidentiality. The data were grouped into two groups: a) Shark Bottom Longline Fishery trips in the southern Atlantic, and b)

Shark Research Fishery trips in the Gulf of Mexico and southern Atlantic (Figure 2). No trips were observed in the northern Atlantic region.

a) Shark Bottom Longline Fishery - southern Atlantic

i) Gear and haul characteristics

There were 16 hauls on 11 trips observed targeting coastal sharks in the southern Atlantic. Trips averaged 1.5 days in length. The mainline length ranged from 0.9 to 14.0 km with an average of 4.8 km. The bottom depth fished ranged from 11.0 to 62.0 m with an average of 24.6 m, and the number of hooks ranged from 45 to 500 hooks with an average of 210 hooks fished. The most commonly used hook was the 16.0 circle hook (75.0%). There were four hauls (25.0%) that employed a 3.0 J hook and a 16.0 circle hook. The predominant bait used was eel (37.5%). The average soak duration was 7.5 hr.

ii) Catch and bycatch

There were 629 individual animals caught on observed bottom longline hauls in the southern Atlantic (Table 2). Sharks comprised 96.5% of the catch, teleost 3.2%, and batoids 0.3%. Large coastal shark species (excluding sandbar shark) comprised 62.9% of the shark catch, small coastal shark species comprised 32.3%. Prohibited shark species were also caught including sandbar sharks (2.5%) and sand tiger shark, *Carcharias taurus*, (2.2%). Red snapper, *Lutjanus campechanus*, was the most frequent species of teleost caught (1.4%) and blacktip shark was the most frequently caught species of shark (44.5%). Length frequencies of shark species are presented in Figure 3.

iii) Protected species interactions

No protected species were observed caught in the Shark Bottom Longline Fishery.

b) Shark Research Fishery

i) Gear and haul characteristics

There were 99 hauls on 73 trips observed in the Shark Research Fishery in the eastern Gulf of Mexico and the southern Atlantic. Trips averaged 1.4 days in length. The mainline length ranged from 2.6 to 20.4 km with an average of 8.3 km. The bottom depth fished ranged from 12.0 to 120.0 m with an average of 31.9 m, and the number of hooks ranged from 99 to 300 hooks with an average of 242 hooks fished. The most commonly used hook was the 18.0 circle hook (42.4%) and the second most common hook was the 9.0 J hooks (27.2%). There were 19 hauls (19.2%) that employed two different types of hooks, with 18.0 circle hooks used most commonly as the second hook (47.4%). Other hook types used were 16.0 circle hooks, 12.0 J hooks, 8.0 J hooks and 20.0 circle hooks. The predominant bait used was little tunny (21.1%). The average soak duration was 5.6 hr.

ii) Catch and bycatch

There were 5,648 individual animals caught on observed bottom longline hauls (Table 3). Sharks comprised 98.3% of the catch, followed by teleost (1.3%), invertebrates (0.2%), batoids (0.1%) and turtles (0.1%). Sandbar shark comprised 67.9% of the shark catch, other large coastal shark species comprised 20.8% of the shark catch and small coastal shark species comprised 6.1%. Prohibited shark species were also caught including dusky shark (4.5% of shark catch), and the sand tiger shark (0.5%). Red grouper, *Epinephelus morio*, was the most frequently caught species of teleost (0.3 %) and sandbar shark was the most frequently caught species of shark (66.7%). Length frequencies of shark species are presented in Figure 4.

iii) Protected species interactions

Interactions with protected resources were observed for bottom longline vessels fishing in the Gulf of Mexico and southern Atlantic (Table 3). Four (4) loggerhead sea turtles, *Caretta caretta*, were caught and released alive. Two (2) smalltooth sawfish, *Pristis pectinata* were caught and released alive. There were no sea bird or marine mammal interactions observed.

In August, HMS implemented amendment 6 to the 2006 Consolidated HMS Fishery Management Plan which reduced the sandbar shark research fishery quota from 116.6 mt dw (257,056 lb dw) to 90.7 mt dw (199,943 lb dw). This reduction was reallocated outside the research fishery to account for dead discards of sandbar sharks since the large coastal shark retention limits increased from 36 to 55 head per trip, with a default of 45 (NMFS 2015). Some minor adjustments to the regional dusky shark quota were examined and implemented as needed. The regional dusky catch limit was designed to reduce the impact of this fishery on the dusky shark. In 2013, the new regulation did produce a decline in interactions (24 sharks from 93 hauls; 0.7% of the shark catch), but resulted in a loss of fishing activity from all months in all regions (Gulak et al. 2014). This year the dusky shark quota did not reduce dusky shark catch similar to 2013 as dusky sharks accounted for 4.5% of shark catch, the same as in 2014. While amending the original permits, HMS decided to reallocate dead dusky takes from regions that experienced no dusky shark take and decreasing fishing effort to regions that exhibited dead dusky take with increasing fishing effort. All three (3) dusky sharks from the Florida Keys region were reallocated, Two (2) to the southern Atlantic and one (1) to the North Carolina regions. However, no region exceeded the dead dusky cap to limit soak time or regional closures throughout the entire year and did not affect fishing opportunity.

To prevent dusky shark mortality, the North Carolina region has a limited soak time while any fishing is conducted within the closed area. While fishing is permitted, research is also being conducted to evaluate the importance of the closed area off North Carolina and

determine post-release survivorship for dusky sharks. Sampling in this area allowed for one (1) dusky shark to be tagged with a satellite pop-up archival transmitting (PAT) tag. In addition, thirty-four (34) conventional dart tags were deployed on dusky sharks. This research is scheduled to continue in 2016.

The Shark Bottom Longline Observer Program collects and provides vital data on temporal and spatial catch, release mortality, bycatch species, and updates to quota monitoring. Continued observer funding will permit the program to maintain this important time series.

Acknowledgments

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Literature Cited

- Gulak, S.J.B., M.P. Enzenauer, and J.K. Carlson. 2014. Characterization of the shark and reef fish bottom longline fisheries: 2013. NOAA Technical Memorandum NMFS-SEFSC-658, 22 p.
- Enzenauer, M.P., B.M. Deacy and J.K. Carlson. 2015. Characterization of the shark bottom longline fishery, 2014. NOAA Technical Memorandum NMFS-SEFSC-677, 24p.
- Morgan, A., P. Cooper, T. Curtis and G. Burgess. 2009. Overview of the U.S. East Coast bottom longline shark fishery, 1994–2003. *Marine Fisheries Review* 71:23–38
- National Marine Fisheries Service (NMFS). 2007. Amendment 2 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan. NOAA/NMFS, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. 726 p.
- National Marine Fisheries Service (NMFS). 2015. Amendment 6 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan. NOAA/NMFS, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. 726 p.

Table 1. Number of vessels, trips, hauls, and hook hours observed in the Gulf of Mexico and south Atlantic Ocean. Vessels observed total in parenthesis are unique vessels.

Fishery	Vessels Observed	Trips Observed	Hauls Observed	Hook Hours
Shark Bottom Longline Fishery	4	11	16	25649.2
Shark Research Fishery	7	73	99	153120.6
Total	11 (9)	83	116	178769.8

Table 2. Number caught (n) and disposition of catch in percentage for all observed hauls in the Shark Bottom Longline Fishery. Disposition of catch is divided into kept (K), discard dead (DD), discard alive (DA), and unknown (U).updated

Scientific name	Common Name	n	% K	% DD	% DA	% U
<i>Carcharhinus limbatus</i>	Blacktip shark	280	91.8	6.8	1.1	0.4
<i>Rhizoprionodon terraenovae</i>	Atlantic sharpnose shark	142	7.0	83.1	9.9	0.0
<i>Carcharhinus acronotus</i>	Blacknose shark	53	0.0	88.7	11.3	0.0
<i>Carcharhinus leucas</i>	Bull shark	37	86.5	0.0	10.8	2.7
<i>Sphyrna lewini</i>	Scalloped hammerhead shark	34	61.8	38.2	0.0	0.0
<i>Carcharhinus brevipinna</i>	Spinner shark	16	62.5	31.3	6.3	0.0
<i>Carcharhinus plumbeus</i>	Sandbar shark	15	0.0	6.7	93.3	0.0
<i>Carcharias taurus</i>	Sand tiger shark	14	0.0	0.0	100.0	0.0
<i>Lutjanus campechanus</i>	Red snapper	9	0.0	44.4	55.6	0.0
<i>Negaprion brevirostris</i>	Lemon shark	7	100.0	0.0	0.0	0.0
<i>Ophichthus rex</i>	King snake eel	6	0.0	100.0	0.0	0.0
<i>Galeocerdo cuvier</i>	Tiger shark	4	75.0	0.0	25.0	0.0
<i>Sphyrna mokarran</i>	Great hammerhead shark	4	100.0	0.0	0.0	0.0
<i>Epinephelus itajara</i>	Goliath grouper	2	0.0	0.0	100.0	0.0
<i>Mobula hypostoma</i>	Devil ray	2	0.0	0.0	100.0	0.0
<i>Sciaenops ocellatus</i>	Red drum	2	0.0	0.0	100.0	0.0
<i>Epinephelus nigritus</i>	Warsaw grouper	1	0.0	100.0	0.0	0.0
<i>Sphyrna tiburo</i>	Bonnethead shark	1	0.0	100.0	0.0	0.0

Table 3. Number caught (n) and disposition of catch in percentage for all observed hauls in the Shark Research Fishery. Disposition of catch is divided into kept (K), discard dead (DD), discard alive (DA), and unknown (U). updated

Scientific Name	Common Name	n	% K	% DD	% DA	% U
<i>Carcharhinus plumbeus</i>	Sandbar shark	3771	98.4	0.1	0.2	1.3
<i>Galeocerdo cuvier</i>	Tiger shark	325	52.0	0.9	45.8	1.2
<i>Rhizoprionodon terraenovae</i>	Atlantic sharpnose shark	268	17.5	71.6	10.8	0.0
<i>Carcharhinus obscurus</i>	Dusky shark	248	0.0	8.9	91.1	0.0
<i>Carcharhinus limbatus</i>	Blacktip shark	243	96.3	2.9	0.0	0.8
<i>Sphyrna lewini</i>	Scalloped hammerhead shark	138	89.1	2.9	7.2	0.7
<i>Sphyrna mokarran</i>	Great hammerhead shark	117	88.0	0.9	8.5	2.6
<i>Ginglymostoma cirratum</i>	Nurse shark	86	0.0	0.0	100.0	0.0
<i>Carcharhinus leucas</i>	Bull shark	84	94.0	0.0	0.0	6.0
<i>Carcharhinus brevipinna</i>	Spinner shark	74	98.6	1.4	0.0	0.0
<i>Carcharhinus acronotus</i>	Blacknose shark	69	33.3	49.3	17.4	0.0
<i>Negaprion brevirostris</i>	Lemon shark	65	95.4	0.0	1.5	3.1
<i>Carcharhias taurus</i>	Sand tiger shark	30	0.0	0.0	93.3	6.7
<i>Epinephelus morio</i>	Red grouper	28	25.0	25.0	50.0	0.0
<i>Carcharhinus falciformis</i>	Silky shark	19	78.9	10.5	10.5	0.0
<i>Seriola dumerili</i>	Greater amberjack	14	78.6	7.1	14.3	0.0
<i>Batrachoididae</i>	Toadfish family	8	0.0	0.0	100.0	0.0
<i>Porifera</i>	Sponges	7	0.0	14.3	14.3	71.4
<i>Sphyrna sp.</i>	Hammerhead sharks	5	0.0	20.0	40.0	40.0
<i>Carcharhinidae</i>	Requiem shark family	4	0.0	0.0	75.0	25.0
<i>Caretta caretta</i>	Loggerhead sea turtle	4	0.0	0.0	100.0	0.0
<i>Seriola fasciata</i>	Lesser amberjack	4	0.0	100.0	0.0	0.0
<i>Anthozoa</i>	Coral	4	0.0	50.0	0.0	50.0
<i>Lutjanus campechanus</i>	Red snapper	3	0.0	0.0	100.0	0.0
<i>Mycteroperca microlepis</i>	Gag grouper	3	33.3	0.0	66.7	0.0
<i>Carcharhinus isodon</i>	Finetooth shark	2	100.0	0.0	0.0	0.0
<i>Dasyatis sp.</i>	Stingrays	2	0.0	0.0	100.0	0.0
<i>Echeneis naucrates</i>	Sharksucker	2	0.0	0.0	100.0	0.0
<i>Epinephelus itajara</i>	Goliath grouper	2	0.0	0.0	100.0	0.0
<i>Pristis pectinata</i>	Smalltooth sawfish	2	0.0	0.0	100.0	0.0
<i>Seriola rivoliana</i>	Almaco jack	2	100.0	0.0	0.0	0.0
<i>Sphyraenidae</i>	Barracuda family	2	50.0	50.0	0.0	0.0
<i>Asteroidea</i>	Sea stars	1	0.0	0.0	100.0	0.0
<i>Carcharodon carcharias</i>	Great white shark	1	0.0	100.0	0.0	0.0
<i>Centropristis striata</i>	Black seabass	1	100.0	0.0	0.0	0.0
<i>Coryphaena hippurus</i>	Dolphinfish	1	100.0	0.0	0.0	0.0
<i>Dasyatis americana</i>	Southern stingray	1	0.0	0.0	100.0	0.0
<i>Dasyatis centroura</i>	Roughtail stingray	1	0.0	0.0	100.0	0.0

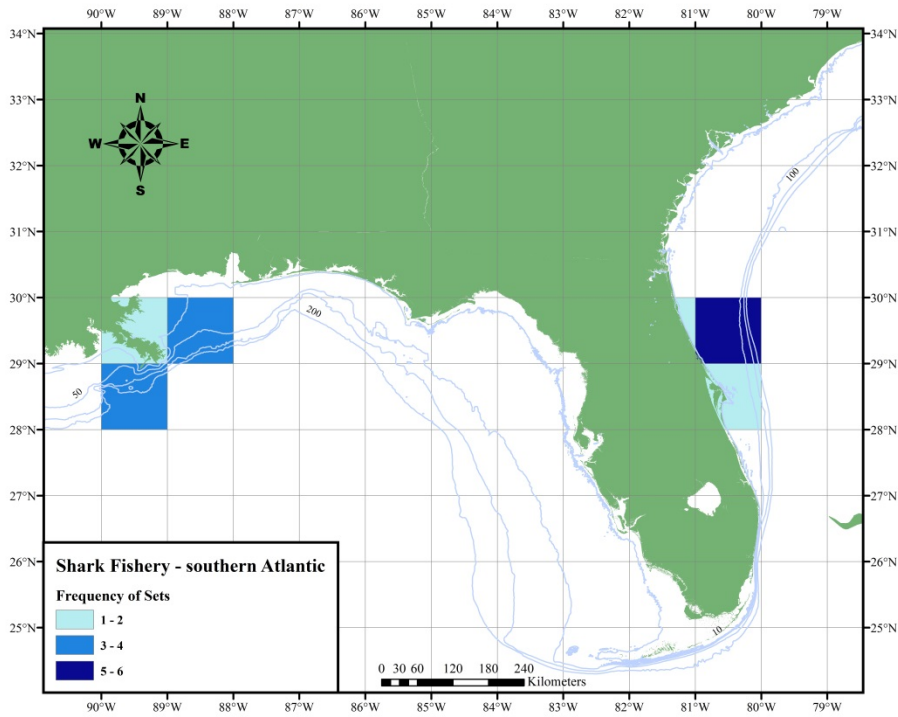
<i>Elasmobranchii</i>	Sharks	1	0.0	100.0	0.0	0.0
<i>Muraenidae</i>	Moray eel family	1	0.0	100.0	0.0	0.0
<i>Octopoda</i>	Octopus	1	0.0	0.0	0.0	100.0
<i>Opsanus pardus</i>	Leopard toadfish	1	0.0	0.0	100.0	0.0
<i>Raja eglanteria</i>	Clearnose skate	1	0.0	100.0	0.0	0.0
<i>Sciaenops ocellatus</i>	Red drum	1	0.0	0.0	100.0	0.0
<i>Triakidae</i>	Houndsharks	1	100.0	0.0	0.0	0.0

Figure 1. The designated dusky shark bycatch quota regions are: North Carolina (north of 33.51 N lat.), South Atlantic (south of 33.50 N lat. and north of 26.0 N lat.), the Florida Keys (south of 26.0 N lat. and east of 85 W longitude), and the Gulf of Mexico (north of 26.0 N lat).



Figure 2. Distribution of all observed hauls by target in 2015. (a) Distribution of effort for the Shark Bottom Longline Fishery, (b) distribution of effort for the Shark Research Fishery.

(a)



(b)

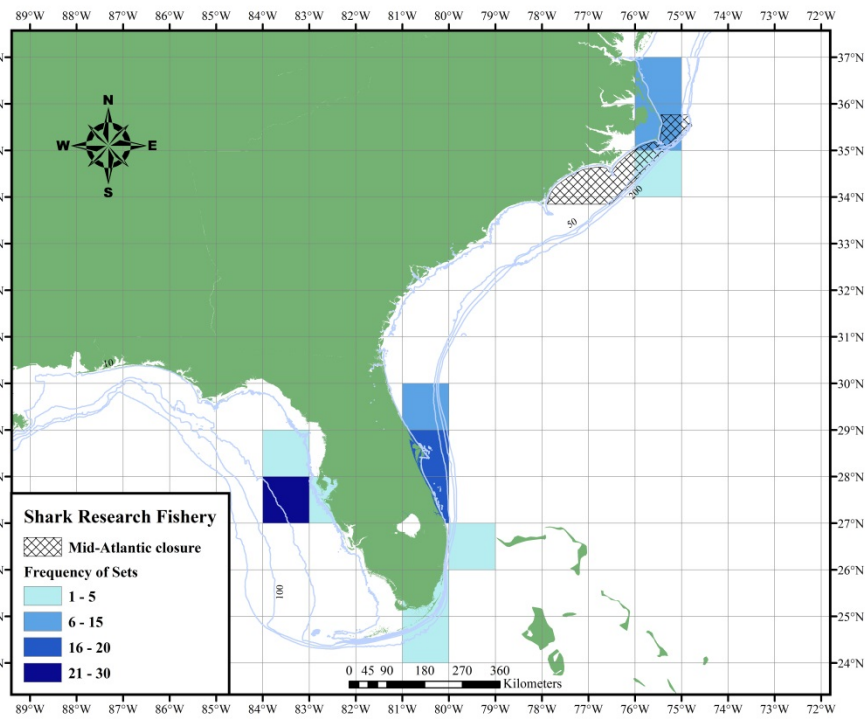
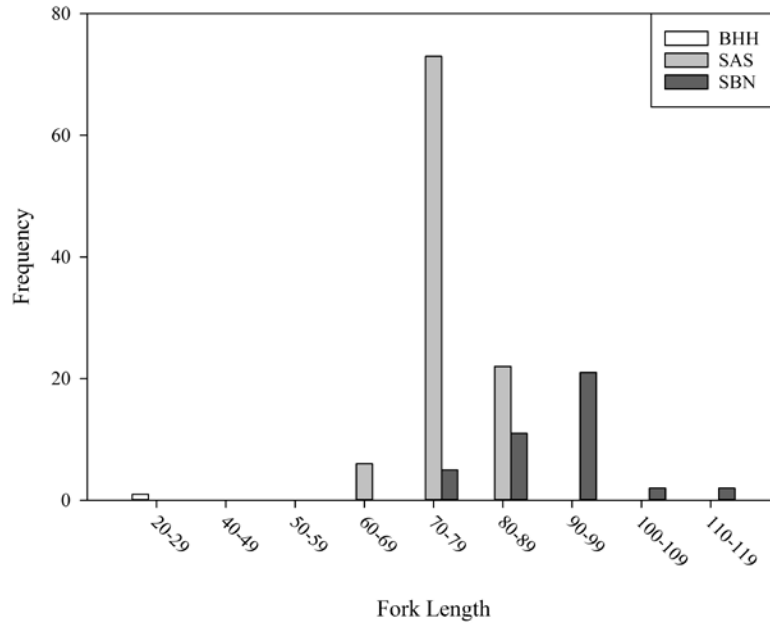


Figure 3. Length frequency (cm fork length) of (a) bonnethead (BHH), Atlantic sharpnose (SAS) and blacknose (SBN) sharks, (b) great hammerhead (GHH), lemon (LEM), bull (SBU) and scalloped hammerhead (SPL) sharks observed caught on bottom longline sets in the Shark Bottom Longline Fishery.

(a)



(b)

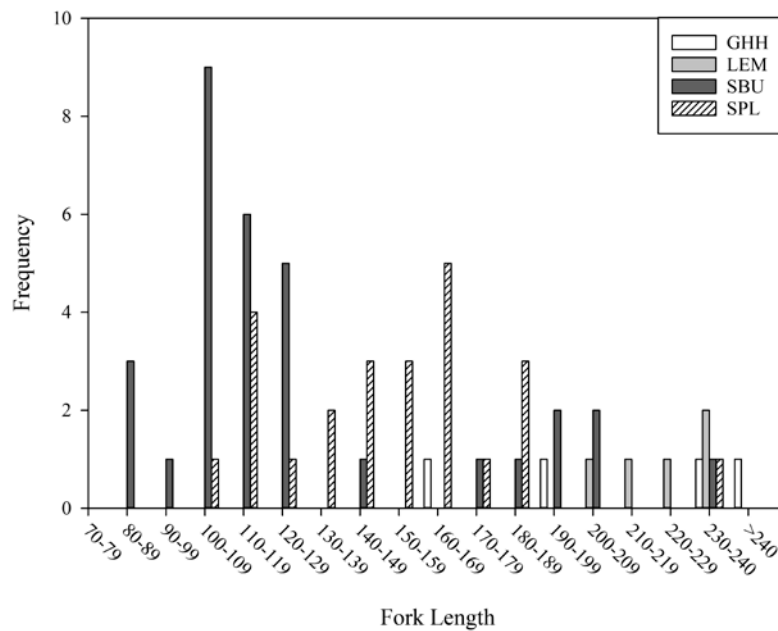
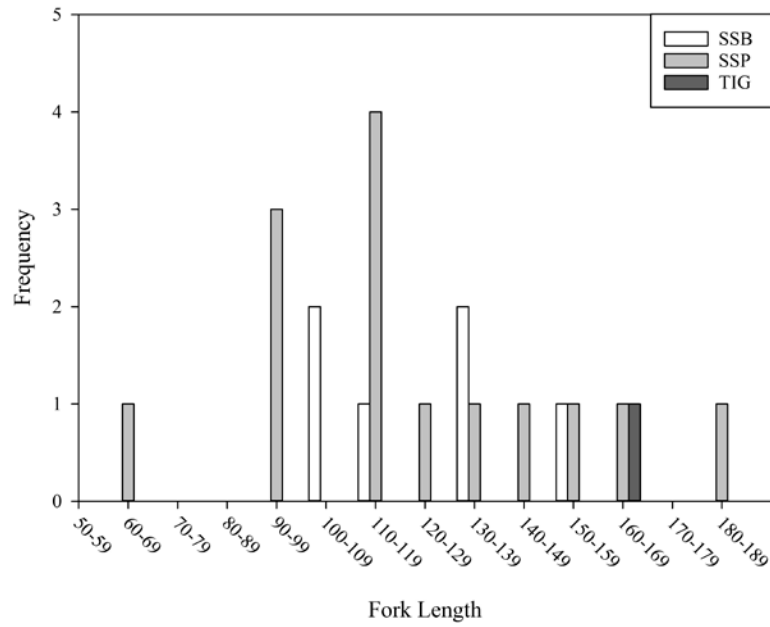


Figure 3 cont'd. Length frequency (cm fork length) of (c) sandbar (SSB), spinner (SSP) and tiger (TIG) sharks, (d) blacktip (SBK) sharks observed caught on bottom longline sets in the Shark Bottom Longline Fishery.

(c)



(d)

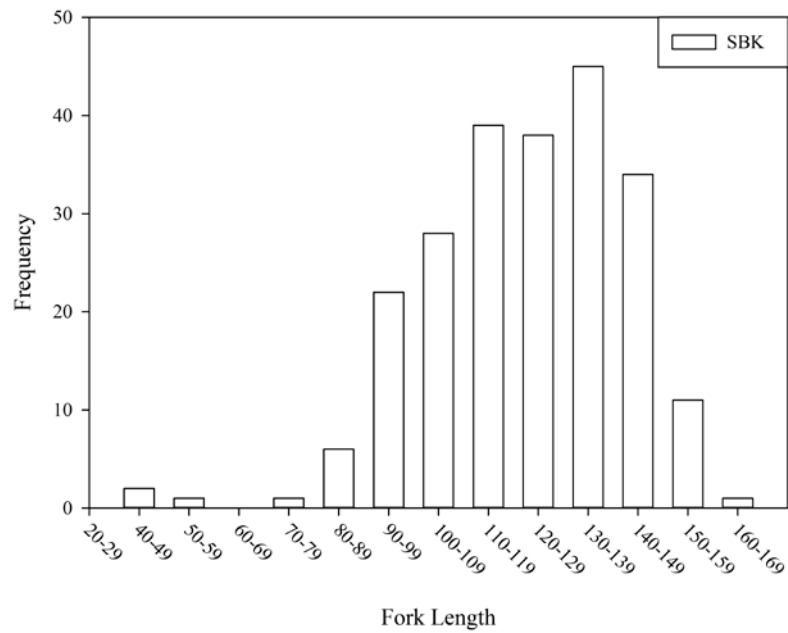
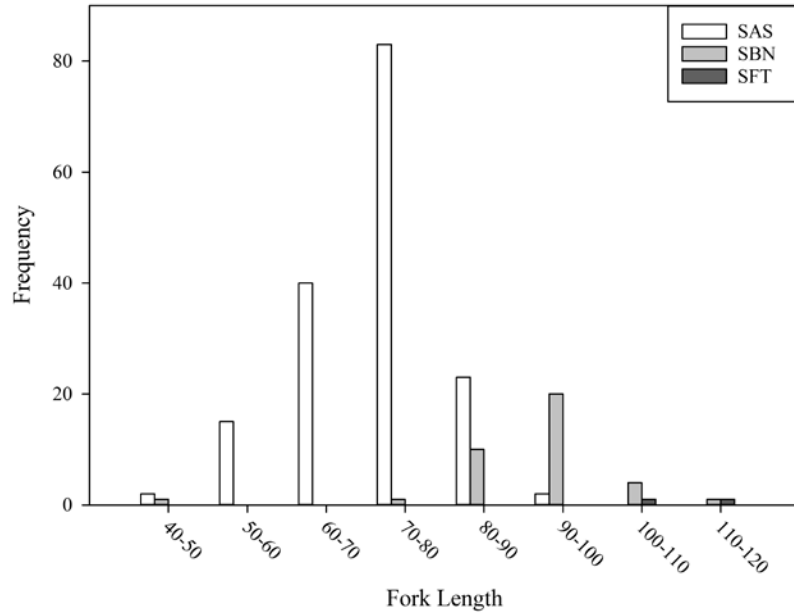


Figure 4. Length frequency (cm fork length) of (a) Atlantic sharpnose (SAS), blacknose (SBN) and finetooth (SFT) sharks, (b) dusky (DUS), silky (FAL) and tiger (TIG) sharks observed caught on bottom longline sets in the Shark Research Fishery.

(a)



(b)

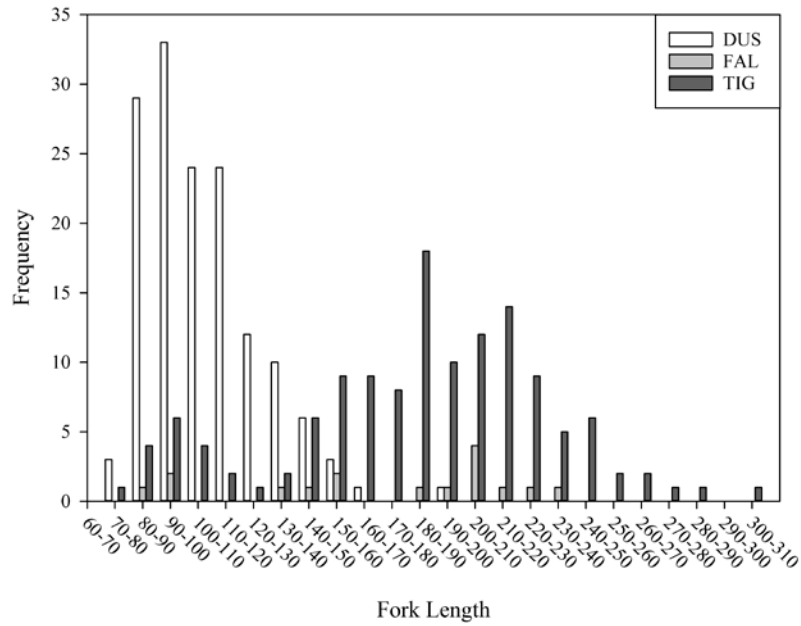
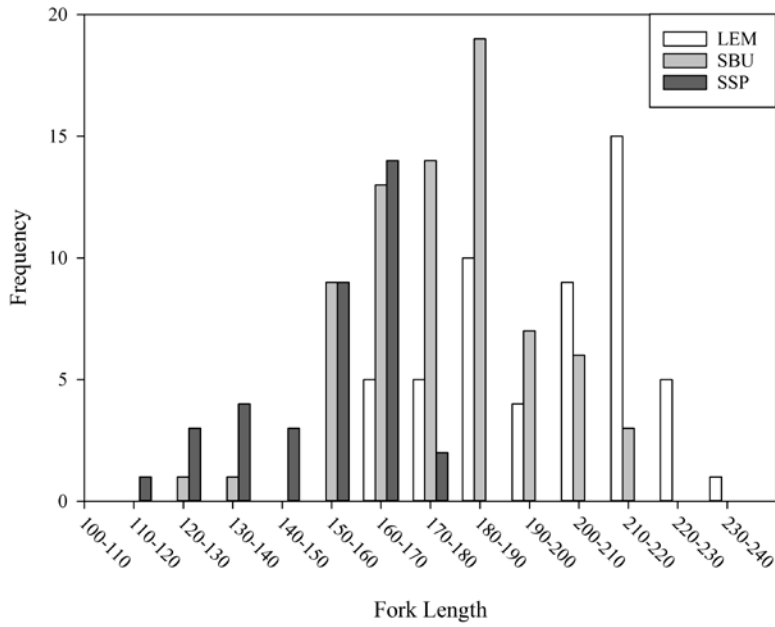


Figure 4 cont'd. Length frequency (cm fork length) of (c) lemon (LEM), bull (SBU) and spinner (SSP) sharks, (d) great hammerhead (GHH) and scalloped hammerhead (SPL) sharks observed caught on bottom longline sets in the Shark Research Fishery.

(c)



(d)

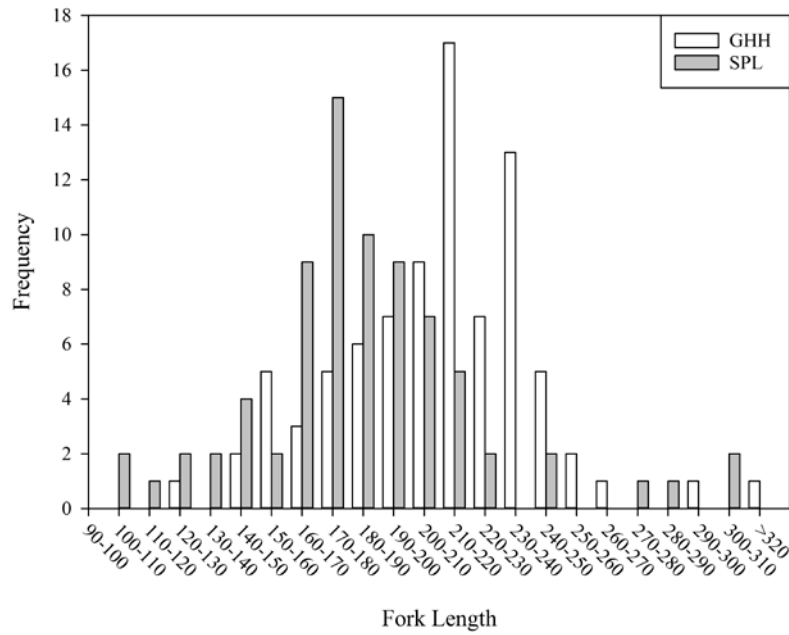
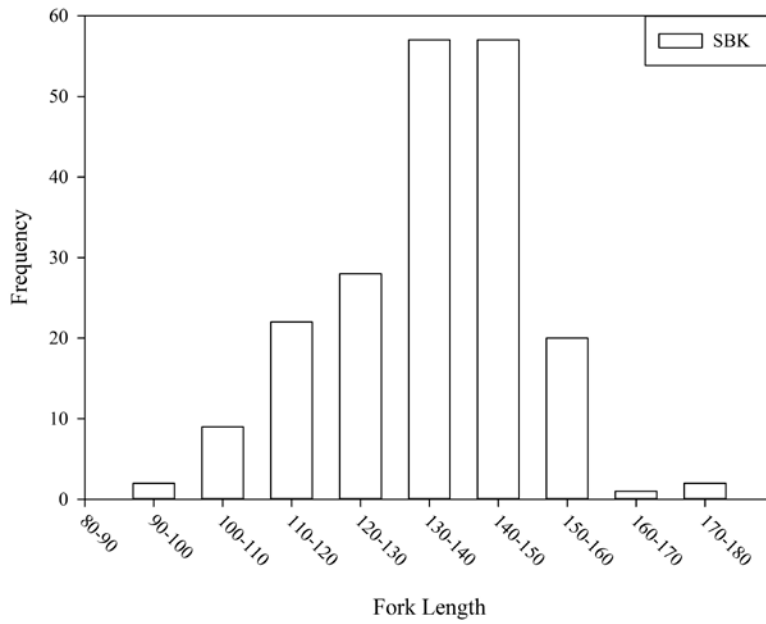


Figure 4 cont'd. Length frequency (cm fork length) of (e) blacktip (SBK) sharks, (f) sandbar (SSB) sharks observed caught on bottom longline sets in the Shark Research Fishery.

(e)



(f)

