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CHARACTERIZATION OF THE SHARK BOTTOM LONGLINE FISHERY: 2019

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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, Mathers et al. 2018 and references therein). Currently about 217 U.S. fishers are permitted to target sharks in the Atlantic Ocean and Gulf of Mexico, and an additional 256 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% for the shark targeted bottom longline 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 2019 fishing season, including coverage of the 2019 Shark Research Fishery.

Methods

In November 2018, NMFS announced its request for applications for the Shark Research Fishery from commercial shark fishers with a directed or incidental permit for 2019. 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. Based on the temporal and spatial needs of the research objectives, the

availability of qualified applicants, available funding and the available quota, five (5) qualified applicants were selected for observer coverage. These vessels carried observers on 100% of trips. In 2019 there were five (5) regions for the Research Fishery: North Carolina, South Atlantic, Florida Keys, and Gulf of Mexico.

Shark targeted bottom longline observer coverage not related to 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. There are three fishing zones designated for shark targeted bottom longline 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. Upon receipt of the selection letter, the permit holder 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 haul back, 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. 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 2019, HMS amended the 2012 amended model which allows one 150 hook ‘feeler’ set (a short set that allows the fisher to get a ‘feel’ for what the catch will be like) with a soak time of no more than two hours. Additionally, fishers had the choice to set one 300 hook set, two 150 hook sets, or three 100 hook sets, with no soak limit, and not to be set concurrently. This model was created to reduce catch of dusky shark, *Carcharhinus obscurus*, which is prohibited. The five fishing regions are also used to help manage interactions of dusky shark throughout the research fishery. A bycatch quota of at least three (3) dead dusky shark interactions for the Gulf of Mexico, Florida Keys, and North Carolina regions was implemented, with six (6) dead dusky shark interactions for the South Atlantic 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 was observed, new guidelines to reduce soak times to less than 3 hours were enforced to decrease dusky shark mortality. If three (3) additional dusky shark interactions (alive or dead) or six (6) occurred for the regions described above, respectively, the region would be completely closed to fishing for the remainder of the year, unless otherwise permitted by HMS. The number of hooks permitted on board remained at 500

hooks total, which accounted for any lost hooks during a feeler set and provided fishers flexibility to use different types of hooks while fishing for non-HMS species within the same trip.

Observers continued to opportunistically sample sharks for biological samples, ideally systematically sampling each n^{th} specimen. 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 scalloped and great hammerhead 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 and large coastal shark quotas within the research fishery.

Results and Discussion

From January to December 2019, a total of 74 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 7 vessels with a total of 134 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 March with five participants. Gear characteristics varied by area (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, the observed data were summarized by area to protect vessel confidentiality. The data were grouped into two groups: a) Shark Bottom Longline Fishery trips in the southern Atlantic and the Gulf of Mexico, and b) Shark Research Fishery trips in the southern Atlantic and the Gulf of Mexico.

a) Shark Bottom Longline Fishery

i) Gear and haul characteristics

There were 34 hauls on 14 trips observed targeting sharks in the southern Atlantic and Gulf of Mexico. Trips averaged 1.9 days in length. The mainline length ranged from 0.3 to 9.9 km, with an average of 3.8 km. The bottom depth fished ranged from 4.6 to 21.9 m, with an average of 15.4 m. The number of hooks ranged from 12 to 540 hooks, with an average of 195 hooks fished. The most commonly used hook was both the 16/0 and 20/0 circle hook (41.2 %). The next commonly used hook was the 14/0 circle hook (11.8 %), followed by the 15/0 circle hook (5.9 %). The predominant bait used was ladyfish, *Elops saurus* (44.1 %). The average soak duration was 2.8 hr.

ii) Catch and bycatch

There were 835 individual animals caught on observed bottom longline hauls in the Gulf of Mexico and southern Atlantic (Table 2). Sharks comprised 99.8 % of the catch, and both unknown animals and batoids 1.1 % of the catch. Large coastal shark species (excluding sandbar shark) comprised 43.8 % of the shark catch and small coastal shark species comprised 37.2 %. Prohibited shark species were also caught, including sandbar shark (6.8 %). Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, was the most frequently caught species of shark (28.9 %).

iii) Protected resources interactions

There were no interactions with protected resources observed for bottom longline vessels fishing in the Gulf of Mexico and southern Atlantic.

b) Shark Research Fishery

i) Gear and haul characteristics

There were 100 hauls on 60 trips observed in the Shark Research Fishery in the Gulf of Mexico and southern Atlantic. Trips averaged 1.9 days in length. The mainline length ranged from 1.2 to 11.7 km with an average of 5.0 km. The bottom depth fished ranged from 10.7 to 88.7 m with an average of 29.6 m, and the number of hooks ranged from 125 to 300 hooks with an average of 226 hooks fished. The most commonly used hook was the 20/0 circle hook (64.0 %) and the second most common hook was the 16/0 circle hook (23.0 %), followed by the 18/0 circle hook (13.0 %). The predominant bait used was skates and rays, *Rajiformes* (25.0 %). The average soak duration was 6.1 hr.

ii) Catch and bycatch

There were 5,145 individual animals caught on observed bottom longline hauls within the Research Fishery (Table 3). Sharks comprised 99.2 % of the catch, followed by teleosts (0.5 %), batoids (0.2 %), unknown species (0.1 %), and turtles (0.04 %). Sandbar shark comprised 66.2 % of the catch, other large coastal shark species comprised 26.9 % of the catch, and small coastal shark species comprised 4.3 %. Prohibited shark species were also caught including dusky shark (1.5 %), sand tiger shark, *Carcharhias taurus* (0.9 %), and white shark, *Carcharodon carcharias* (0.1 %). Red grouper, *Epinephelus morio*, was the most frequently caught species of teleost (0.2 %). Length frequencies of shark species are presented in Figure 4.

iii) Protected resources interactions

Interactions with protected resources were observed for the research fishery (Table 3). Two (2) loggerhead sea turtles, *Caretta caretta*, were caught, with 100.0 % released alive. There were no other protected resource interactions observed.

In August 2015, 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 landed per trip, with a default of 45 (NMFS 2015). The sandbar quota remained in effect through the 2019 fishing season. The regional dusky catch limit, which was implemented in 2013, was designed to reduce the impact of this fishery on the dusky shark. In 2013, the 2012 HMS regulations produced 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). In 2019 the dusky shark catch remained low, at 1.5 %.

To prevent dusky shark mortality, the North Carolina region has a limited soak time while any fishing is conducted within the Mid-Atlantic closed area. The Mid-Atlantic closed area is an area off of North Carolina that is closed from January 1- July 31 to bottom longline fishing. This area is a nursery and pupping site for sandbar and dusky sharks. While fishing is permitted, research is also being conducted to evaluate the importance of the closed area and determine post-release survivorship for dusky sharks. Sampling in this area allowed for four (4) dusky sharks to be tagged with a satellite pop-up archival transmitting (SPAT) tag. One SPAT was deployed on a dusky shark in the Gulf of Mexico region. This research is scheduled to continue in 2020.

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.

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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	3	14	34	22422.33
Shark Research Fishery	5	60	100	159145.3
Total	8 (7)	97	159	181567.63

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).

Scientific Name	Common Name	n	%K	%DA	%DD	%U
<i>Rhizoprionodon terraenovae</i>	Atlantic Sharpnose Shark	264	97.0	0.8	1.9	0.4
<i>Carcharhinus limbatus</i>	Blacktip Shark	148	91.2	0.7	7.4	0.7
<i>Carcharhinidae</i>	Requiem Shark	94	89.4	2.1	8.5	0.0
<i>Ginglymostoma cirratum</i>	Nurse Shark	83	4.8	95.2	0.0	0.0
<i>Carcharhinus acronotus</i>	Blacknose Shark	71	29.6	36.6	33.8	0.0
<i>Galeocerdo cuvier</i>	Tiger Shark	67	50.8	46.3	3.0	0.0
<i>Carcharhinus plumbeus</i>	Sandbar Shark	62	0.0	100.0	0.0	0.0
<i>Carcharhinus leucas</i>	Bull Shark	34	100.0	0.0	0.0	0.0
<i>Sphyrna mokarran</i>	Great Hammerhead Shark	28	85.7	3.6	7.1	3.6
<i>Negaprion brevirostris</i>	Lemon Shark	25	96.0	4.0	0.0	0.0
<i>Elasmobranchii</i>	Sharks	17	0.0	23.5	76.5	0.0
<i>Sphyrna lewini</i>	Scalloped Hammerhead Shark	8	75.0	12.5	12.5	0.0
<i>Carcharhinus brevipinna</i>	Spinner Shark	7	100.0	0.0	0.0	0.0
<i>Carcharhinus isodon</i>	Finetooth Shark	5	100.0	0.0	0.0	0.0
<i>Dasyatis</i>	Stingrays	1	0.0	100.0	0.0	0.0
Unknown animal	Unknown Animal	1	0.0	0.0	0.0	100.0

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).

Scientific Name	Common Name	Total Caught	%K	%DA	%DD	%U
<i>Carcharhinus plumbeus</i>	Sandbar Shark	3377	98.4	0.0	0.3	1.2
<i>Carcharhinus limbatus</i>	Blacktip Shark	563	96.8	0.9	1.8	0.5
<i>Galeocerdo cuvier</i>	Tiger Shark	312	27.9	69.6	1.9	0.6
<i>Ginglymostoma cirratum</i>	Nurse Shark	174	2.9	97.1	0.0	0.0
<i>Rhizoprionodon terraenovae</i>	Atlantic Sharpnose Shark	150	57.3	0.7	41.3	0.7
<i>Carcharhinus leucas</i>	Bull Shark	111	91.9	1.8	0.0	6.3
<i>Carcharhinus obscurus</i>	Dusky Shark	79	0.0	77.2	22.8	0.0
<i>Sphyrna mokarran</i>	Great Hammerhead Shark	73	76.7	19.2	4.1	0.0
<i>Carcharhinus acronotus</i>	Blacknose Shark	71	15.5	31.0	53.5	0.0
<i>Sphyrna lewini</i>	Scalloped Hammerhead Shark	62	62.9	27.4	4.8	4.8
<i>Negaprion brevirostris</i>	Lemon Shark	52	92.3	3.9	0.0	3.9
<i>Carcharias taurus</i>	Sand Tiger Shark	48	0.0	100.0	0.0	0.0
<i>Carcharhinus brevipinna</i>	Spinner Shark	20	90.0	5.0	5.0	0.0
<i>Epinephelus morio</i>	Red Grouper	10	10.0	70.0	20.0	0.0
<i>Hypanus americanus</i>	Southern Stingray	6	0.0	100.0	0.0	0.0
Unknown animal	Unknown Animal	5	0.0	20.0	0.0	80.0
<i>Seriola dumerili</i>	Greater Amberjack	4	100.0	0.0	0.0	0.0
<i>Carcharodon carcharias</i>	Great White Shark	4	0.0	75.0	25.0	0.0
<i>Sphyaena</i>	Barracudas	3	33.3	0.0	66.7	0.0
<i>Epinephelus itajara</i>	Goliath Grouper	3	0.0	100.0	0.0	0.0
<i>Sphyrna</i>	Hammerhead Shark	2	100.0	0.0	0.0	0.0
<i>Caretta caretta</i>	Loggerhead Sea Turtle	2	0.0	100.0	0.0	0.0
<i>Carcharhinus perezii</i>	Caribbean Reef Shark	2	0.0	100.0	0.0	0.0
<i>Carcharhinus falciformis</i>	Silky Shark	2	0.0	100.0	0.0	0.0
<i>Raja eglanteria</i>	Clearnose Skate	2	0.0	0.0	100.0	0.0
<i>Alopias vulpinus</i>	Common Thresher Shark	1	100.0	0.0	0.0	0.0
<i>Sphyrna tiburo</i>	Bonnethead Shark	1	0.0	0.0	100.0	0.0
<i>Elasmobranchii</i>	Sharks	1	0.0	0.0	100.0	0.0
<i>Trichiurus lepturus</i>	Atlantic Cutlassfish	1	100.0	0.0	0.0	0.0
<i>Dasyatis</i>	Stingrays	1	0.0	100.0	0.0	0.0
<i>Centropristis ocyurus</i>	Bank Sea Bass	1	100.0	0.0	0.0	0.0
<i>Tetraodontidae</i>	Puffers	1	100.0	0.0	0.0	0.0
<i>Sciaenops ocellatus</i>	Red Drum	1	0.0	100.0	0.0	0.0