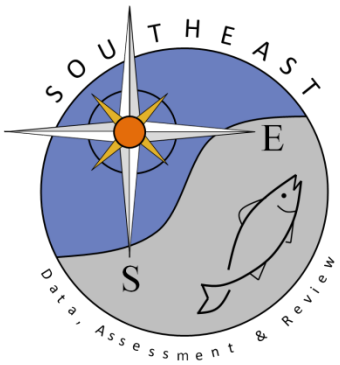
Distribution and Length Data for Blacktip Sharks Captured on the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey in the Western North Atlantic Ocean

Adam G. Pollack[1], William B. Driggers III[2], David S. Hanisko[2] and G. Walter Ingram, Jr.[2]

SEDAR65-DW15

10/29/19



This information is distributed solely for the purpose of pre-dissemination peer review. It does not represent and should not be construed to represent any agency determination or policy.

Please cite this document as:
Pollack, Adam G., William B. Driggers III, David S. Hanisko and G. Walter Ingram, Jr.. 2019. Distribution and Length Data for Blacktip Sharks Captured on the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey in the Western North Atlantic Ocean. SEDAR65-DW15. SEDAR, North Charleston, SC. 16 pp.

Distribution and Length Data for Blacktip Sharks Captured on the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey in the Western North Atlantic Ocean

Adam G. Pollack[1], William B. Driggers III[2], David S. Hanisko[2] and G. Walter Ingram, Jr.[2]

[1] Riverside Technology, Inc.
NOAA Fisheries, Southeast Fisheries Science Center,
Mississippi Laboratories, Pascagoula, MS

[2] NOAA Fisheries, Southeast Fisheries Science Center,
Mississippi Laboratories, Pascagoula, MS

Abstract: *The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Mississippi Laboratories (MSLABS) has conducted standardized bottom longline surveys in the Gulf of Mexico (GOM), Caribbean, and western North Atlantic Ocean since 1995. Data from the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey was examined to determine the feasibility of constructing an index of relative abundance for blacktip sharks (Carcharhinus limbatus) captured in the western North Atlantic Ocean. Although not present in sufficient number to produce an index of relative abundance, this paper provides a record of the distribution and associated length data for blacktip sharks. In addition, length-length and length-weight relationships were developed using data from blacktip sharks collected from the western North Atlantic Ocean and GOM.*

Introduction and Survey Design

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Mississippi Laboratories (MSLABS) has conducted standardized bottom longline (BLL) surveys in the Gulf of Mexico (GOM), Caribbean, and western North Atlantic Ocean (Atlantic) since 1995. The objective of these surveys is to provide fisheries independent data for stock assessment purposes for as many species as possible. The surveys are conducted annually in U.S. waters of the GOM and/or the Atlantic, and are an important source of fisheries independent information on sharks, snappers and groupers.

Over the course of the survey, the survey design has seen changes in both the depths fished and the allocation of stations in addition to the primary objectives. The primary objective of the initial surveys was assessment of the distribution and abundance of large and small coastal sharks across their known or suspected ranges. The fishing depths were selected based on commercial shark fishing log summaries, which indicated that the primary depths of effort were 18-73m (10 to 40 fm). A random stratified sampling design with three depth strata; 18-36 m (10-20 fm), 36-55 m (20-30 fm) and 55-73 m (30-40 fm) was used and uniform effort across contiguous 60 nm sampling zones was achieved. Results of the first two years of the survey, including a detailed description of the protocol and gear, are summarized by Grace and Henwood (1997).

Based on analysis of the first two survey years, the 1997 survey was modified by eliminating depth stratification and changing the survey depths to 10-55 m (5-30 fm). The depth reduction was at the request of SEFSC to ensure that the full range of several coastal sharks was encompassed by the survey. Elimination of depth stratification was to avoid over-sampling strata which represented the least available habitat (the 30-40 fm strata represented very little of the available bottom, but was receiving 33% of the effort). During 1997, the survey was expanded into Mexican waters in an attempt to cover the full geographic range of some of the more important commercial shark species.

In 1998, the survey was conducted in Mexican waters of the Gulf of Mexico, the circumference of Cuba and the circumference of Navassa Island. Station selection based upon proportional allocation was implemented to ensure that the most abundant habitat received the highest levels of effort. Proportional allocation worked well in Mexican waters, but proved difficult in Cuba due to the narrowness of the continental shelf around most of the island. In many areas finding bottom for a one mile set was a challenge, limiting that set to certain depths was impossible.

A significant event in the evolution of our longline surveys occurred in 1999 when we were requested to implement a longline survey targeting red snapper (*Lutjanus campechanus*). At the time, red snapper were not specifically targeted as part of the shark surveys; a different hook type (circle hook) was used, and different depth strata were sampled. The snapper work was conducted between 64-146 m (35-80 fm) in an area from east of the Mississippi River to south of Perdido Key, FL. Random sampling without proportional allocation was used and sampling units were 10 n. mi. blocks given the small geographical area to be covered.

The 1999 shark survey was impacted by the unavailability of the NOAA Ship *Oregon* II. Lack of a larger vessel capable of gulfwide surveys led to substitution of the 55 ft. shrimp trawler R/V *Caretta* as our survey vessel. The R/V *Caretta* did not have the range, endurance or capability for 24-hr operations, and it was evident that a full shark survey was not possible. Given the logistical constraints posed by the Caretta, we contracted the survey to an area from the TX-LA border to Panama City, FL. By doing this we were able to double and sometimes triple the effort within our 60 nm sampling units (shrimp statistical zones), and to test for optimal sampling levels by species and area. The survey used proportional allocation based on the amount of bottom within each unit. A hook experiment using 25% circle hooks and 75% J hooks was included to allow comparison of catches between the red snapper surveys and the shark surveys.

The year 2000 saw the second red snapper pilot survey conducted off Texas. Stations were randomly selected within 20 nm contiguous sampling blocks in depths of 64-146 m (35-80 fm). The hook comparison study initiated in 1999 was continued with an allocation of 75% circle hooks and 25% J hooks. As a result of the two red snapper surveys and the encountering of many important commercial shark species in deeper waters, the 2000 annual shark survey in the Gulf of Mexico was expanded to a depth range of 9-183 m (5-100 fm). Proportional allocation was used and the hook comparison study was continued with 75% J hook sets and 25% circle hook sets. A similar survey was conducted in the Atlantic over the same depth ranges and using the same percentages of circle and J hook sets. Details concerning the hook comparison studies can be found in Ingram *et al.* (2005).

In 2001, the shark and red snapper surveys were combined into a single annual survey of the U.S. Gulf of Mexico. Proportional allocation based on shelf width within statistical zones was adopted and the survey was stratified by depth in the GOM with 50% allocation in 9-55 m, 40% allocation from 55-183 m and 10% allocation from 183-366 m. Due to the Florida Current, the 183-366 m depth strata was unable to be sampled in the Atlantic, therefore the allocation for the 9-55 m and 55-183 m depth strata were 60% and 40%, respectively. This allocation provided effort in the 9-55 m strata comparable to that achieved in previous shark surveys, thereby preserving the time series back to 1995. The major change in the shark surveys was adoption of the circle hook as the standard for these surveys.

Results and Discussion

Distribution and Size

From 1995 – 2018, the NOAA/NMFS/SEFSC/MSLABS BLL has conducted 1016 stations in the Atlantic. Blacktip sharks did not compose a significant portion of the catch, with only 45 individuals encountered during the survey (Table 1). The distribution of blacktip sharks from NOAA/NMFS/SEFSC/MSLABS BLL sets is presented in Figure 1, with annual catch and effort presented in Appendix Figure 1. Of the 45 blacktip sharks captured, a total of 19 were measured, with an addition 26 blacktip sharks whose lengths were estimated. Average fork length for all captured sharks was 124.1 cm (± 29.9 cm standard deviation). Figure 2 shows the length frequency distribution of blacktip sharks captured in the Atlantic.

Length Conversions

Due to the limited number of blacktip sharks caught off the east coast, morphometric data collected throughout the full survey range was used to produce length-length and length-weight relationships. Measurements from 825 females ranging in size from 51.0-158.0 cm (FL) and 730 males ranging in size from 47.6 to 158 cm (FL) were available for analysis. Precaudal length, FL, natural total length and stretched total length were measured from the tip of the snout to the anterior margin of the precaudal pit, the caudal notch, the tip of the upper lobe of the caudal fin while in a “natural” position and the tip of the upper lobe of the caudal fin while fully extended along the axis of the body, respectively. All measures were taken on a straight line along the axis of the body to the nearest millimeter. All measures were converted to centimeters before analyses. Any sharks with estimated lengths and/or weights were omitted from the analysis. Weight measurements can be adversely affected by sea state (e.g. motion of the vessel). Therefore, weights with residuals greater than an absolute value of three were removed from analyses (n=31). Analysis of covariance indicated no significant difference in the FL ($p=0.95$) or transformed weight (Log10) ($p=0.76$) between females and males. Therefore, data for each sex was combined for analyses (Table 1; Figures 3-6).

Relative Index of Abundance

The low number of blacktip sharks captured during the survey, coupled with many years of zero or single catches of blacktip shark precludes the development of an index of relative index of abundance for the Atlantic.

Literature Cited

Grace, M. and T. Henwood. 1997. Assessment of the Distribution and Abundance of Coastal Sharks in the U.S. Gulf of Mexico and Eastern Seaboard, 1995 and 1996. Marine Fisheries Review, 59(4):23-32.

Ingram, W., T. Henwood, M. Grace, L. Jones, W. Driggers, and K. Mitchell. 2005. Catch rates, distribution and size composition of large coastal sharks collected during NOAA Fisheries Bottom Longline Surveys from the U.S. Gulf of Mexico and U.S. Atlantic Ocean. LCS05/06-DW-27

Table 1. Summary of the blacktip shark station, catch and length data collected from the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey conducted between 1995 and 2018. Note that the number in parenthesis represent number of estimated lengths.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (cm)	Maximum Fork Length (cm)	Mean Fork Length (cm)	Standard Deviation
1995	43	0					
1996	57	4	(4)	116.3	165.8	133.7	22.5
1997	65	6	3 (3)	83.0	150.0	108.3	26.3
1998							
1999							
2000	104	0					
2001							
2002	180	15	3 (12)	47.6	182.3	128.3	37.2
2003							
2004	40	1	(1)	104.0	104.0	104.0	
2005	27	0					
2006	57	5	4 (1)	70.5	148.0	120.9	32.0
2007							
2008	37	3	2 (1)	116.4	150.0	135.8	17.4
2009	32	0					
2010	26	0					
2011	49	2	2	59.0	130.0	94.5	50.2
2012	41	0					
2013	36	0					
2014	46	1	(1)	130.0	130.0	130.0	
2015	44	2	1 (1)	125.0	137.0	131.0	8.5
2016	48	1	1	138.0	138.0	138.0	
2017	41	3	1 (2)	137.2	158.0	145.6	11.0
2018	43	2	2	92.8	111.0	101.9	12.9

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured			Mean Fork Length (cm)	Mean Standard Deviation (cm)
19	1016	45	19 (26)			124.1	29.9

Table 2. Length-length and length-weight conversions for blacktip sharks (*Carcharhinus limbatus*) captured in the western North Atlantic Ocean during the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey from 1995-2018.

Length-length relationships	Equation	n	r^2
PCL (cm)	PCL = 1.9299 + 0.885043*FL	466	0.98
NTL (cm)	NTL = 4.89349 + 1.15734*FL	1508	0.95
STL (cm)	STL = 9.00754 + 1.16776*FL	448	0.98
Length-weight relationship			
Wt (kg)	$Wt = (4.63 \times 10^{-6})FL^{3.21575}$	1070	0.92

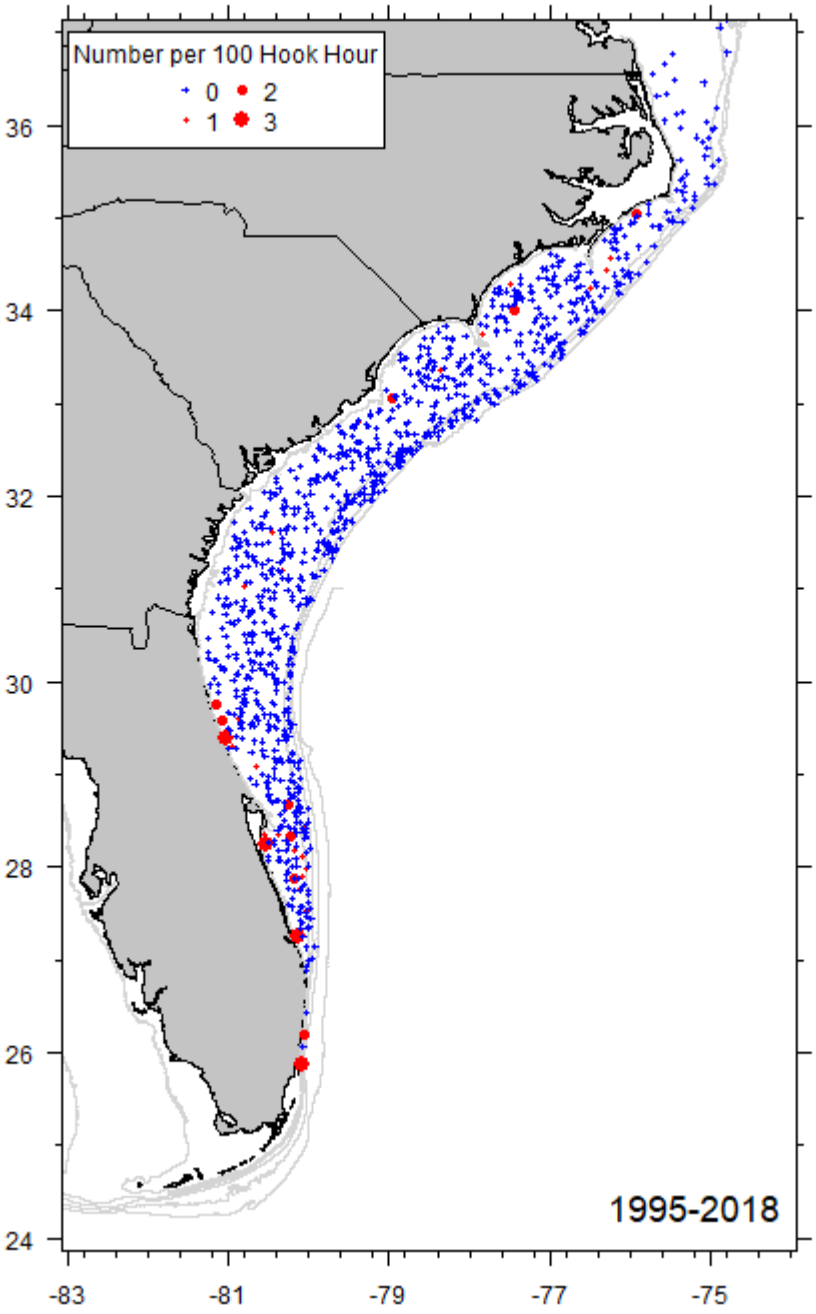


Figure 1. Stations sampled from 1995 to 2018 during the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey in the western North Atlantic Ocean with the CPUE for blacktip sharks (*Carcharhinus limbatus*).

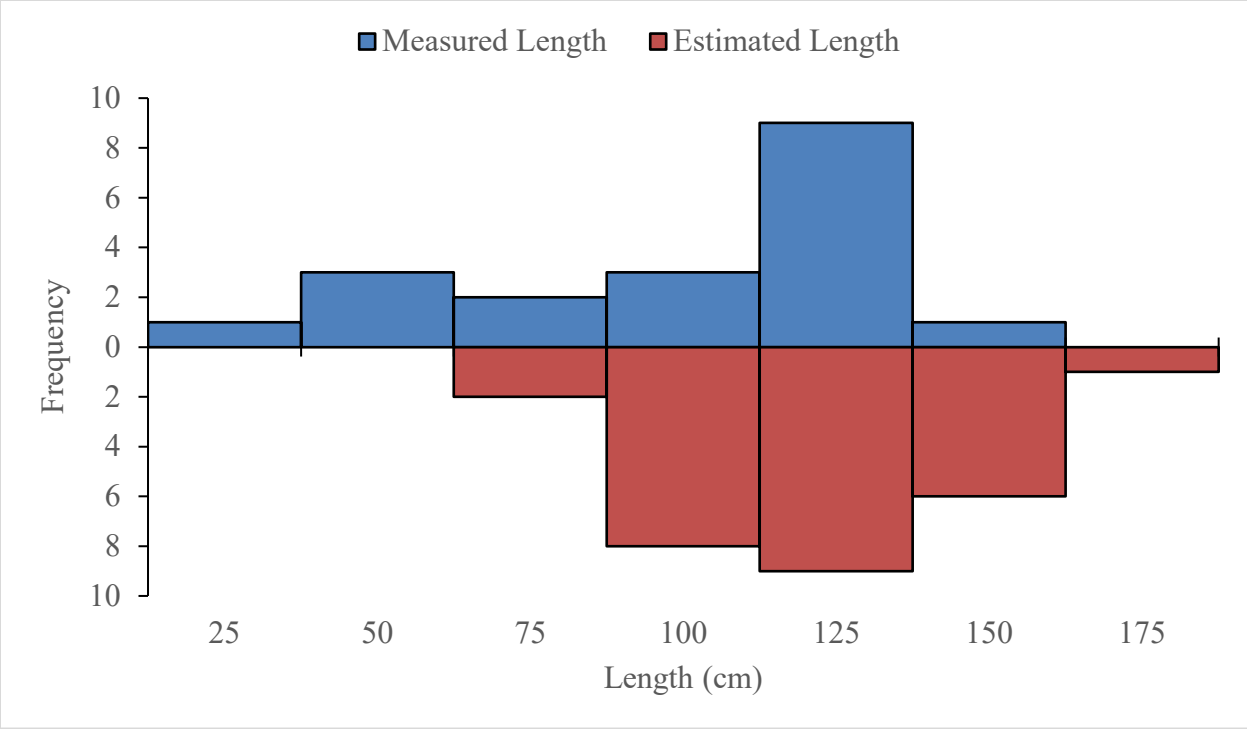


Figure 2. Length frequency histogram for blacktip sharks (*Carcharhinus limbatus*) captured in the western North Atlantic Ocean during the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey from 1995 - 2018.

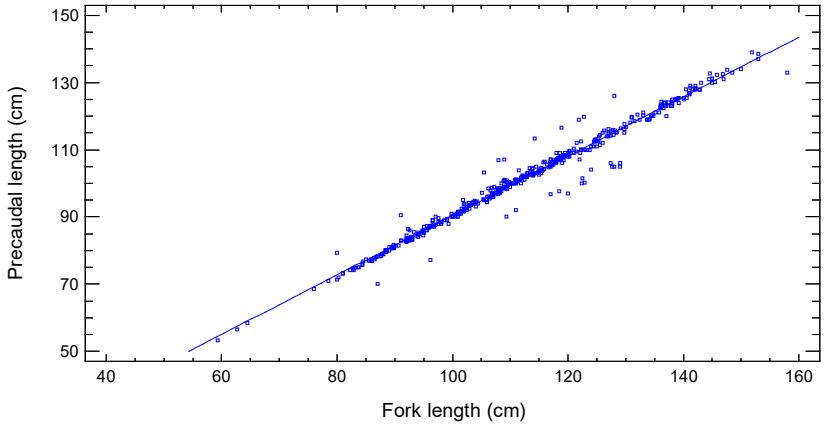


Figure 3. Relationship between precaudal and fork length for blacktip sharks (*Carcharhinus limbatus*) captured in the western North Atlantic Ocean during the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey from 1995-2018.

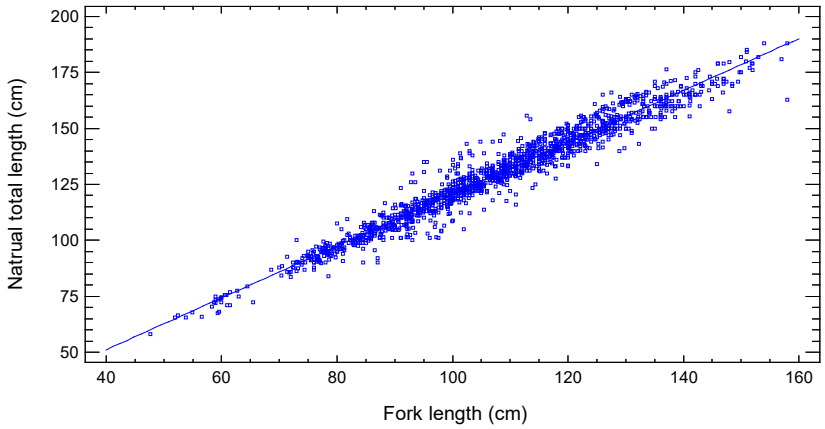


Figure 4. Relationship between natural total length and fork length for blacktip sharks (*Carcharhinus limbatus*) captured in the western North Atlantic Ocean during the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey from 1995-2018.

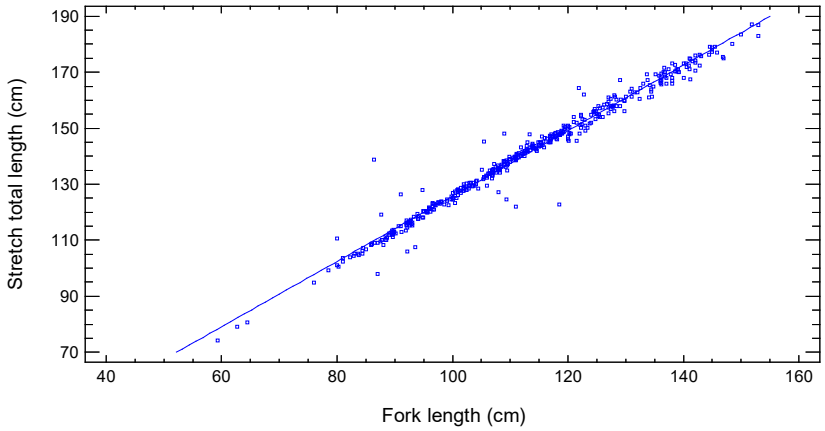


Figure 5. Relationship between stretch total length and fork length for blacktip sharks (*Carcharhinus limbatus*) captured in the western North Atlantic Ocean during the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey from 1995-2018.

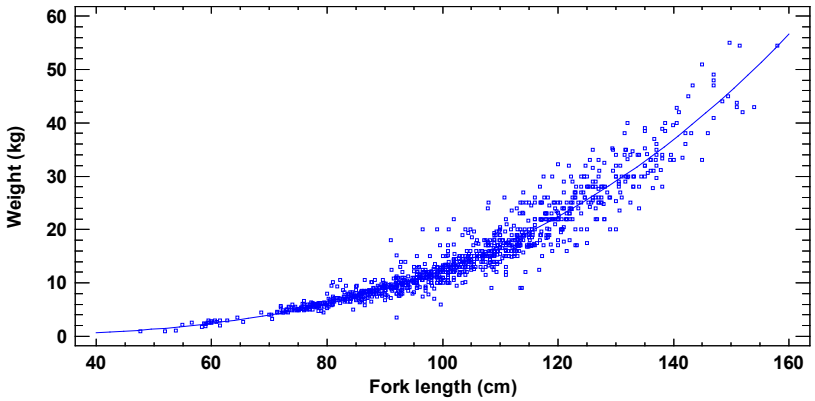
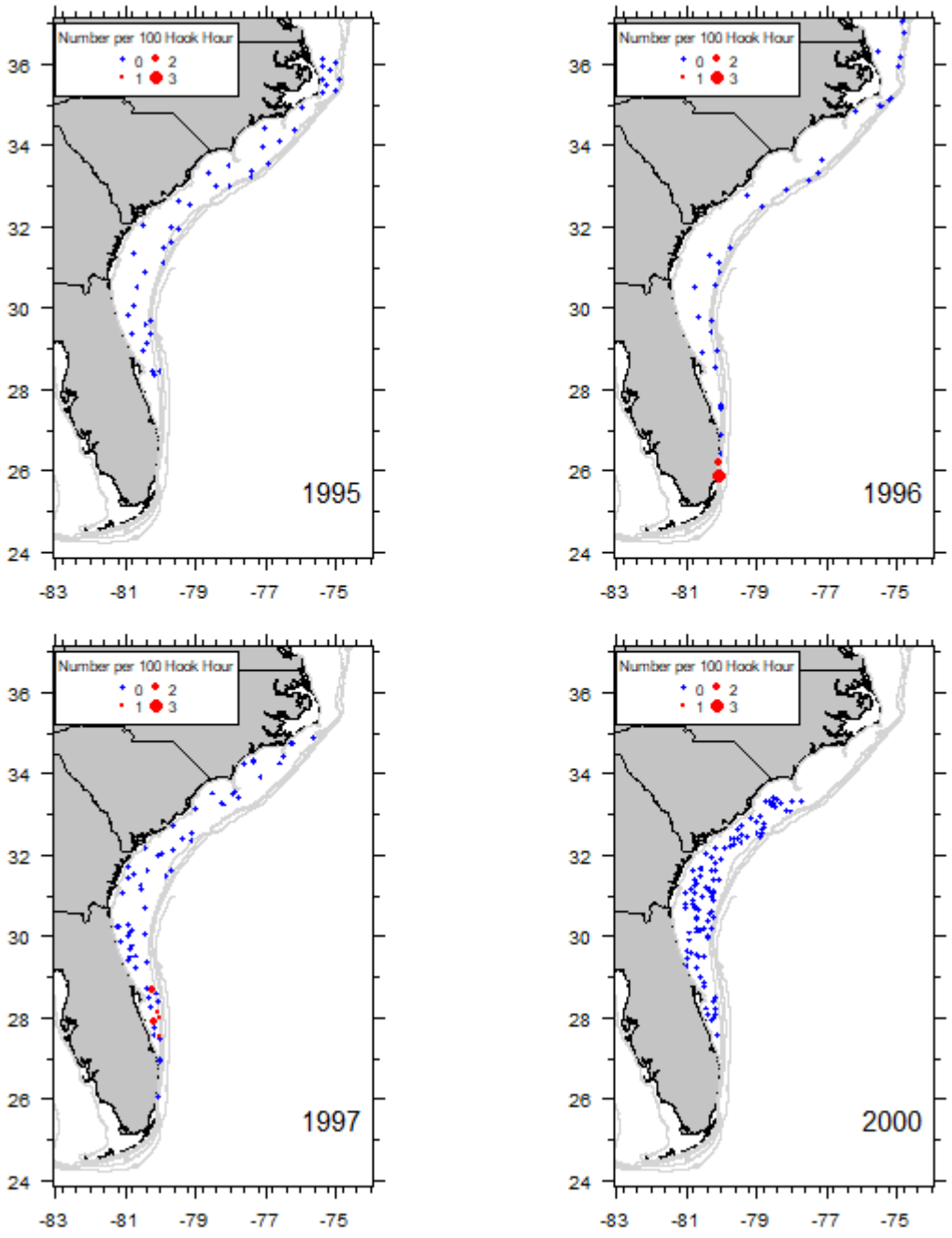
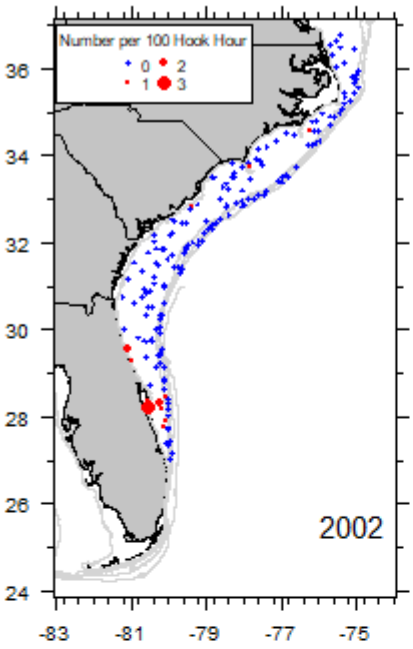


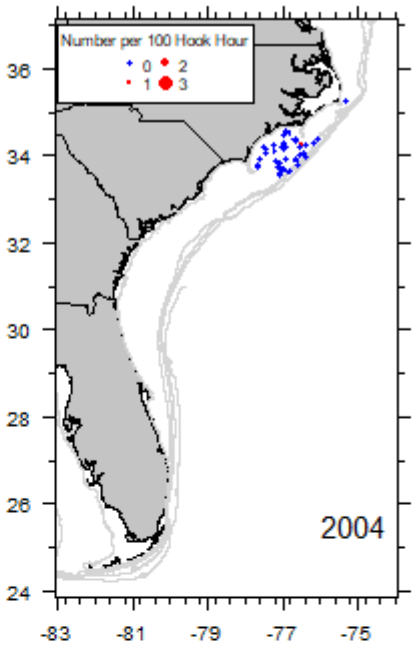
Figure 6. Length-weight relationship for blacktip sharks (*Carcharhinus limbatus*) captured in the western North Atlantic Ocean during the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey from 1995-2018.

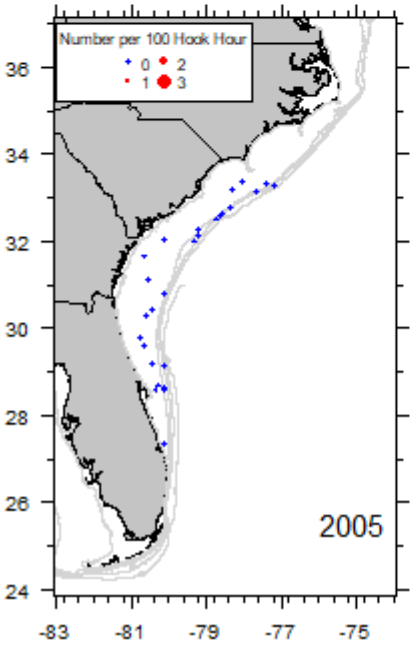
Appendix

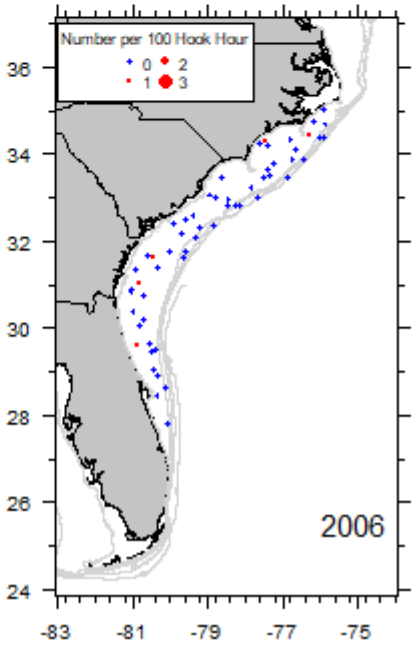
Appendix Figure 1. Annual survey effort and catch of blacktip sharks (*Carcharhinus limbatus*) from the NOAA/NMFS/SEFSC/MSLABS Bottom Longline Survey (1995-2018) in the western North Atlantic Ocean.

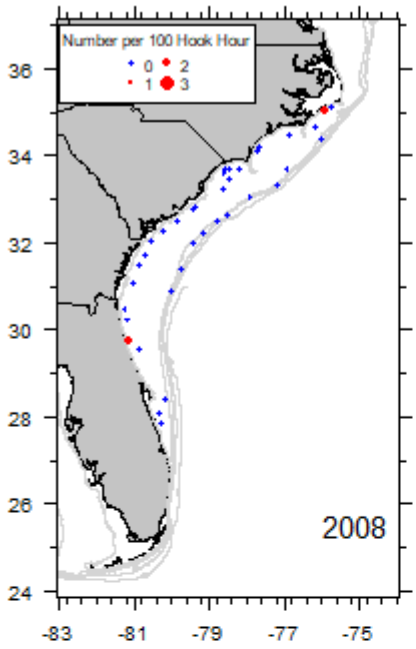


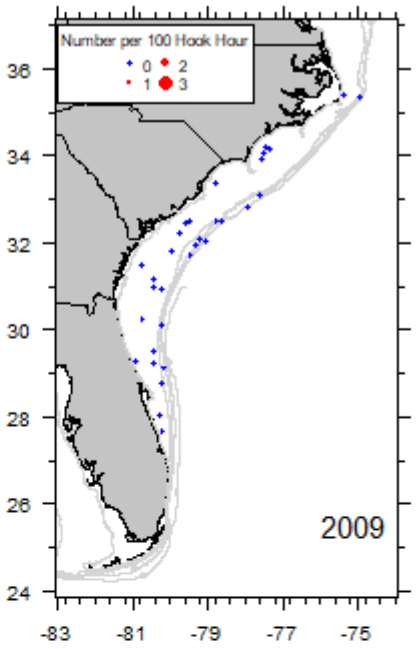

Number per 100 Hook Hour
0 2
1 3
2002
36
34
32
30
28
26
24
-83
-81
-79
-77
-75

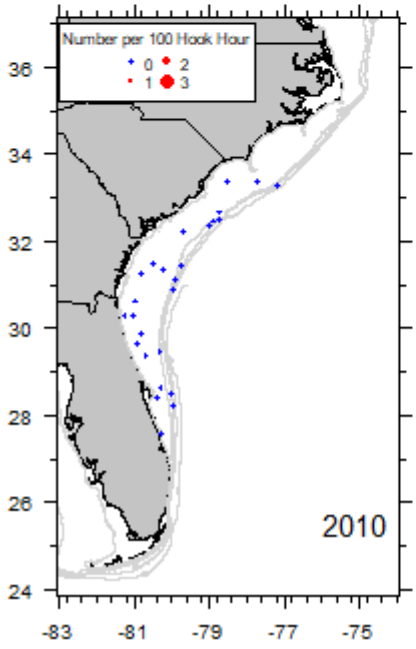

Number per 100 Hook Hour
0 2
1 3
2004
36
34
32
30
28
26
24
-83
-81
-79
-77
-75

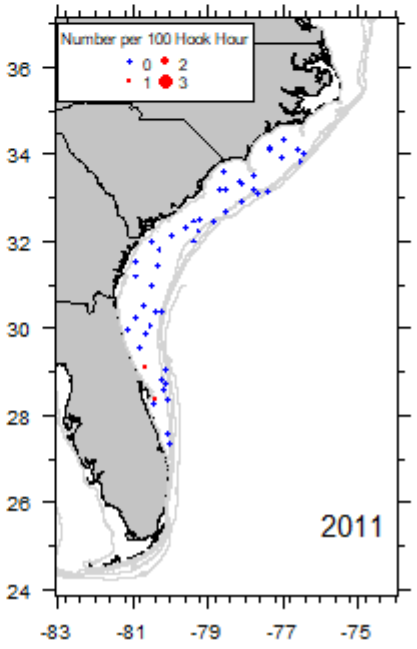

Number per 100 Hook Hour
0 2
1 3
2005
36
34
32
30
28
26
24
-83
-81
-79
-77
-75

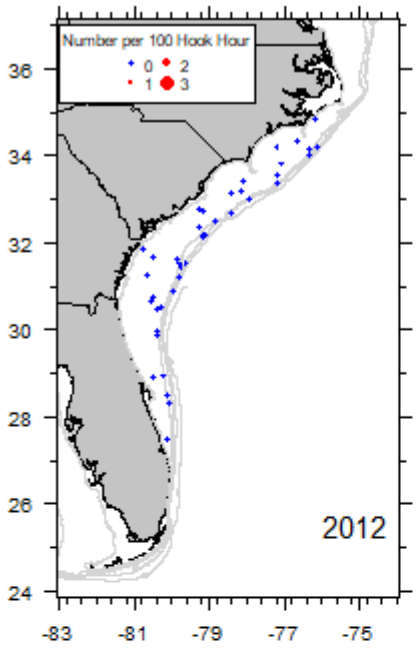

Number per 100 Hook Hour
0 2
1 3
2006
36
34
32
30
28
26
24
-83
-81
-79
-77
-75

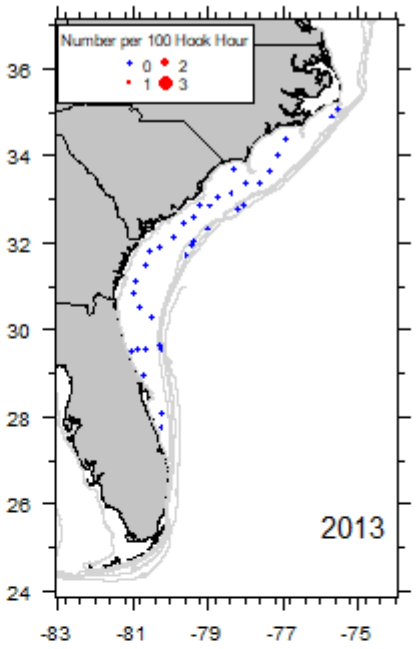

Number per 100 Hook Hour
0 2
1 3
2008
36
34
32
30
28
26
24
-83
-81
-79
-77
-75

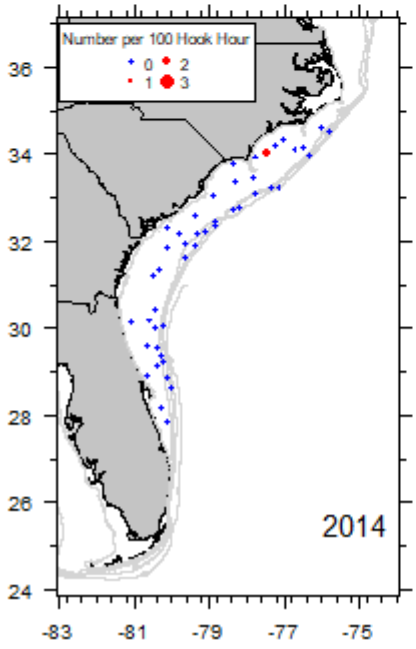

Number per 100 Hook Hour
0 2
1 3
2009
36
34
32
30
28
26
24
-83
-81
-79
-77
-75

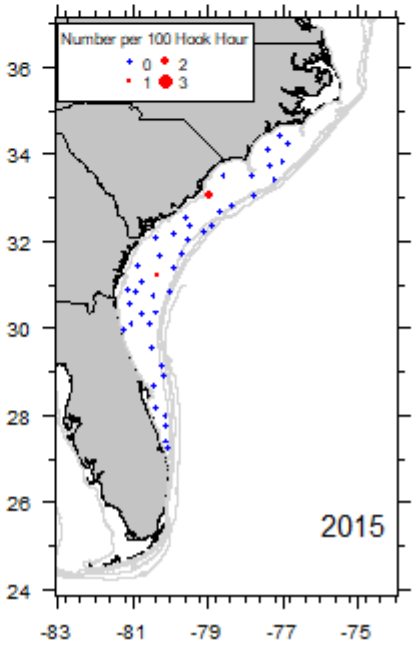

Number per 100 Hook Hour
0 2
1 3
2010
36
34
32
30
28
26
24
-83
-81
-79
-77
-75

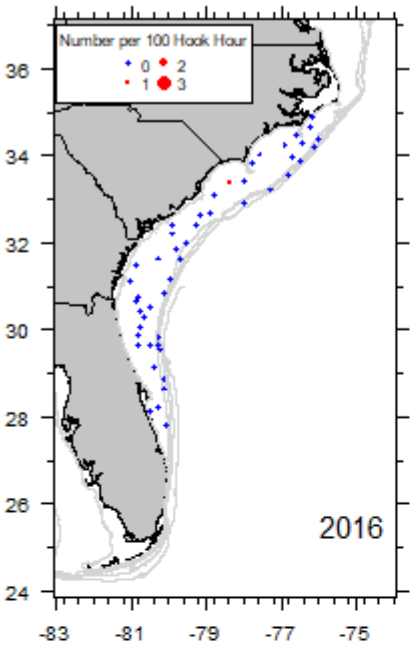

Number per 100 Hook Hour
0 2
1 3
2011
36
34
32
30
28
26
24
-83
-81
-79
-77
-75

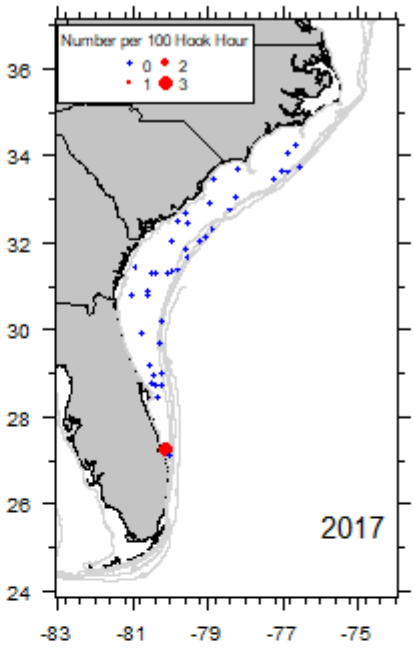

Number per 100 Hook Hour
0
1
2
3
36
34
32
30
28
26
24
-83
-81
-79
-77
-75
2012

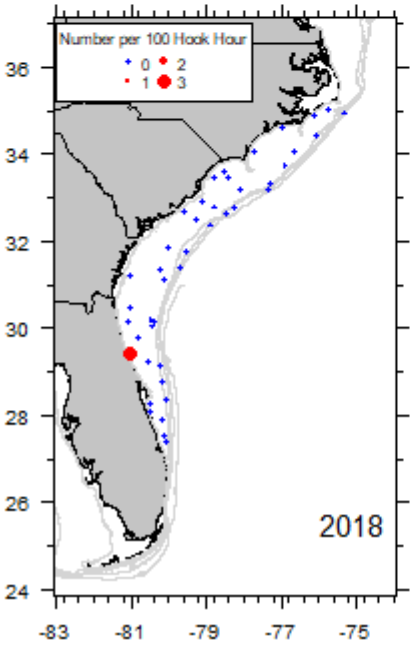

Number per 100 Hook Hour
0
1
2
3
36
34
32
30
28
26
24
-83
-81
-79
-77
-75
2013


Number per 100 Hook Hour
0
1
2
3
36
34
32
30
28
26
24
-83
-81
-79
-77
-75
2014


Number per 100 Hook Hour
0
1
2
3
36
34
32
30
28
26
24
-83
-81
-79
-77
-75
2015


Number per 100 Hook Hour
0 2
1 3
2016
36
34
32
30
28
26
24
-83
-81
-79
-77
-75


Number per 100 Hook Hour
0 2
1 3
2017
36
34
32
30
28
26
24
-83
-81
-79
-77
-75


Number per 100 Hook Hour
0 2
1 3
2018
36
34
32
30
28
26
24
-83
-81
-79
-77
-75