Updated Commercial Gillnet Length Composition Data for use in SEDAR 65

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SEDAR 65 REVIEW WORKSHOP DOCUMENT

Updated Commercial Gillnet Length Composition Data for use in SEDAR 65

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Summary

This working paper updates Atlantic blacktip shark fork length (FL cm straight) data obtained from the Southeast Fisheries Science Center (SEFSC) Panama City Lab Gillnet Observer Program (GNOP) 1999-2018 (n = 1477). Updated GNOP length data is analyzed by year, gear type, and mesh size. Inter-annual variation is identified in both gillnet gear type and mean length. The largest inter-annual variation occurs after the year 2006 when the proportion of measured lengths obtained from the GNOP gear type(s) recorded in the database as "GILL NETS, DRIFT, RUNAROUND" decreases and the proportion of measured lengths obtained from GNOP gear type(s) recorded in the database as "GILL NETS, SINK/ANCHOR, OTHER" increases.

Binned length composition data are provided for use in the SEDAR 65 stock assessment. An examination of binned length-frequency histograms of the gillnet gear type "GILL NETS, DRIFT, RUNAROUND" indicate that they capture predominantly mature blacktip sharks. In contrast, an examination of binned length-frequency histograms of the gillnet gear type "GILL NETS, SINK/ANCHOR, OTHER" indicate that they capture predominantly immature blacktip sharks.

Introduction

The Southeast Fisheries Science Center (SEFSC) Panama City Lab Gillnet Observer Program (GNOP) has adapted to the changes of the Florida-Georgia shark gillnet fishery since the program began in 1993 (e.g. Carlson and Bethea 2007 and references therein; Mathers et al. 2020). There are currently about 500 total directed and incidental shark permits issued in the US Atlantic and Gulf of Mexico, while the number of gillnet fishers changes from year to year. Gillnet effort targeting large coastal (LCS) and small coastal (SCS) sharks has declined in recent years (2008 – 2018) as a result of Amendments 2 and 3 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan (NMFS 2007, 2010). Fishers have consequently increased effort targeting finfish, including Spanish mackerel *Scomberomorus maculatus*, king mackerel *Scomberomorus cavalla*, and bluefish *Pomatomus saltatrix*, with varying types of gillnet gear (Passerotti and Carlson 2009; Passerotti et al 2010; Mathers et al. 2020). However, a small amount of shark targeted gillnet effort continues to be observed. The SEFSC-GNOP, in its continuing efforts to adapt to the fishery, currently covers all anchored (sink and stab), strike, or drift gillnet fishing regardless of target by vessels that fish from Florida and the Gulf of Mexico year-round.

Length composition data for Atlantic blacktip shark (*Carcharhinus limbatus*) that were submitted during the SEDAR 65 Data Workshop for possible use in the SEDAR 65 blacktip stock assessment were reviewed and summarized in Kroetz and Courtney (2020). Length data were filtered to include only true measurements (i.e., no estimated measurements). Available length composition data for Atlantic blacktip obtained from the SEFSC-GNOP during the years 1999 – 2018 (n = 124) were summarized in Kroetz and Courtney (2020, their Table 1 and Figure

1). However, within the SEFSC-GNOP data, a total of 1,353 length measurements were taken on *C. limbatus* that were not specified as to whether these measurements were direct or estimated and thus were not included in the final sample size (n = 124). Length-frequency histograms indicated that these 'unknown' measurements spanned a wider range of the size (Kroetz and Courtney 2020, their Appendix B), and further analysis of these 'unknown' length measurements recorded for *C. limbatus* in the SEFSC-GNOP was recommended.

This working paper updates the SEFSC-GNOP length data for use in the SEDAR 65 stock assessment model and includes measured lengths (FL cm straight) previously excluded as 'unknown' measurements (Kroetz and Courtney 2020) due to exclusion of a field in the database. This field describes the length measurement taken as directed or estimated, which was added to the database beginning 2010. Previous to this year, directed lengths were taken and present in the database, however the field describing the length type did not exist.

Methods

SEFSC-GNOP Protocol

Vessels were randomly selected on a quarterly basis (January, April, July, and October) from a pool of vessels that had reported fishing with gillnet gear during the same quarter in the previous year in the NMFS Coastal Fisheries Logbook. Selection letters notifying permit holders of required observer coverage were issued via U.S. Certified mail approximately one month prior to the upcoming selection period. Receipt of selection letters was confirmed via signature upon acceptance by the permit holder or their proxy. Once the permit holder received the selection letter, he or she was required to make contact with the observer coordinator and indicate intent to fish during the upcoming selection period. Contact was usually made by phone, and the observer coordinator gathered information concerning the vessel's name, captain, contact persons and phone numbers, communications and safety equipment available aboard the vessel, and information about the vessel's location, dates, and times of departure and return. Additional information collected included whether the vessel was active in another fishery, under repair, or no longer fishing. Upon notification of the intention to fish, the observer coordinator deployed an observer to the reported port of departure of the permit holder's vessel. Because gillnet trips are

generally 24 hours or less (from the time of departure from port to the time of return), the observer remained assigned to the vessel for a minimum of 3 trips.

Observations were made as the net was hauled aboard. The haul target species was determined by the captain and recorded by the observer. The observer remained on the deck of the vessel in a position with an unobstructed view and recorded species and numbers of individuals caught. When species identification was questionable, the crew stopped hauling so that the observer could examine the animal(s) for positive identification. Status (alive or dead when boated) of individuals was recorded, and disposition of individuals brought onboard was recorded as kept, discarded alive, or discarded dead. Fork lengths (FL cm) were estimated for the entire catch. When time permitted after the haulback was complete, observers directly measured a random group of 10 individuals from each species for fork length (FL cm, measured on a straight line). Sex (sharks only) was determined when possible. Biological samples (e.g. otoliths, vertebrae, reproductive organs, stomach), when taken, were removed and placed on ice after collection. Data and samples were submitted to the NMFS-SEFSC Panama City staff immediately upon completion of observed trips. The data were entered into a database and proofed by SEFSC staff, examined by NMFS/SEFSC Sustainable Fisheries Division staff, and reviewed with observer contract staff to resolve any questions.

Analysis of Updated Length Composition Data

Updated length data were analyzed following methods described in Kroetz and Courtney (2020). Updated Atlantic blacktip shark fork length (FL cm straight) were obtained from the SEFSC-GNOP for the years 1999 – 2018. Length data were restricted to the western Atlantic and filtered to include only true measurements (i.e., no estimated measurements). Length data were omitted from analyses if they exceeded biologically plausible measurements for this species; age-0 length is reported to be around 40 cm FL and maximum size was around 180 cm FL (Deacy and Moncrief-Cox 2019).

The filtered length data were analyzed by year, gear type, and mesh size in order to evaluate inter-annual variation in gillnet gear type, mesh size, and mean length.

The filtered length data were binned into size classes of 5 cm FL increments and subset by sex. Data matrices were created for each sex to include the proportion of animals in each size bin per year for input into Stock Synthesis. Length-frequency histograms were created for males,

females, and combined sexes of Atlantic *C. limbatus*. Age at 50% maturity was indicated by vertical bars and was designated as 123.05 cm FL for females and 115.15 cm FL for males (Natanson et al. 2019).

Results

Updated Atlantic blacktip shark length data (FL cm straight) were obtained from the SEFSC-GNOP database during the years 1999 – 2018. Mean length (**Table 1, Panel A; Figure 1, Panel B**) and the proportion of the total number of sharks measured for length (**Table 1, Panel B; Figure 1, Panel A**) differed by gillnet gear type. Most length data were obtained from the gear type(s) recorded in the database as "GILL NETS, DRIFT, RUNAROUND" (76%, n = 1128), which had a relatively large mean length, 128.1 FL (cm straight, SE = 0.58).

Sample size and mean length both changed over time during the years 1999 –2018 (**Table 2; Figure 2**). The largest sample sizes occurred during the years 2002 – 2006. Mean length was also relatively larger during the years 2002 – 2006 than during the years 2007 – 2018, with some exceptions during years with relatively low sample size.

The proportion of lengths measured by gillnet gear type also changed over time during the years 1999 – 2018 (**Table 3; Figure 2**). Most lengths measured during the years 2002 – 2006 were obtained from the gear type(s) recorded in the database as "GILL NETS, DRIFT, RUNAROUND". In contrast, most lengths measured during the years 2007 – 2018 were obtained from the gear type(s) recorded in the database as "GILL NETS, SINK/ANCHOR, OTHER", except for some years including 2007, 2009, and 2012.

Sample size and mean length both differed by mesh size (**Table 4; Figure 3**). The largest sample size (n = 1113) occurred for mesh sizes of 8 to 10 inches. Mean length was also relatively larger for mesh size of 8 to 10 inches (126.7 FL cm straight) than for the other mesh sizes.

The proportion of lengths measured by gillnet mesh size also changed over time during the years 1999 – 2018 (**Table 5; Figure 4**). Most lengths measured during the years 2002 – 2006 were obtained from mesh sizes of 8 to 10 inches. In contrast, most lengths measured during the years 2007 – 2018 were obtained from mesh sizes less than 8 inches, except for one year (2016).

The number of vessels in the south Atlantic sampled for blacktip shark directed lengths was relatively small each year (**Table 6**).

Binned length composition data (FL cm straight) length-frequency distributions for the gillnet gear type "GILL NETS, DRIFT, RUNAROUND" included predominantly mature males and both mature and immature females (**Figure 5**). In contrast, length-frequency distributions for the other gillnet gear types included predominately immature sharks (**Figures 6 and 7**).

Discussion

Inter-annual variation was identified in both gillnet gear type and mean length. The largest inter-annual variation occurred after the year 2006 when the proportion of measured lengths obtained from the GNOP gear type(s) recorded in the database as "GILL NETS, DRIFT, RUNAROUND" decreased and the proportion of measured lengths obtained from GNOP gear type(s) recorded in the database as "GILL NETS, SINK/ANCHOR, OTHER" increased. The observed changes in gear type and length composition after 2016 are consistent with, but precede by two years, the observed reduction in gillnet effort targeting large coastal sharks, LCS, and small coastal sharks, SCS, in recent years (2008 – 2018) as a result of Amendments 2 and 3 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan (NMFS 2007, 2010; Passerotti and Carlson 2009; Passerotti et al 2010; Mathers et al. 2020).

An examination of binned length-frequency histograms of the gillnet gear type "GILL NETS, DRIFT, RUNAROUND" indicated that they captured predominantly mature blacktip sharks. In contrast, an examination of binned length-frequency histograms of the gillnet gear type "GILL NETS, SINK/ANCHOR, OTHER" indicated that they captured predominantly immature blacktip sharks.

References

Carlson, J. K., and D. M. Bethea. 2007. Catch and bycatch in the shark gillnet fishery: 2005-2006. NOAA Technical Memorandum NMFS-SEFSC-552, 26p.

Deacy B. and H. Moncrief-Cox. 2019. Age and growth parameters for blacktip sharks, *Carcharhinus limbatus*, in the western North Atlantic Ocean. SEDAR65-DW02. SEDAR, North Charleston, SC. 10 pp.

Kroetz, A., and D. Courtney. 2020. Review of available length composition data submitted for use in the SEDAR 65 Atlantic *Carcharhinus limbatus* stock assessment. SEDAR65-AW05. SEDAR, North Charleston, SC. 13p.

Mathers, A.N., B. M. Deacy, H. E. Moncrief-Cox, and J. K. Carlson. 2020. Catch and bycatch in U.S. southeast gillnet fisheries, 2018. NOAA Technical Memorandum NMFS-SEFSC-743. 15p.

Natanson L. J., B. M. Deacy, H. E. Moncrief-Cox, and W .B. Driggers III. 2019. Reproductive parameters for blacktip sharks (*Carcharhinus limbatus*) from the western North Atlantic Ocean. SEDAR65-DW01. SEDAR, North Charleston, SC. 10 pp.

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). 2010. Amendment 3 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan. NOAA/NMFS, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. 632 p.

Passerotti, M. S., and J. K. Carlson. 2009. Catch and bycatch in U.S. southeast gillnet fisheries, 2008. NOAA Technical Memorandum NMFS-SEFSC-583. 19p.

Passerotti, M. S., J. K. Carlson, and S. J. B. Gulak. 2010. Catch and Bycatch in U.S. southeast gillnet fisheries, 2009. NOAA Technical Memorandum NMFS-SEFSC-600. 20 p.

Table 1. Atlantic blacktip shark mean length (**Panel A**) and proportion of the total number of lengths measured (**Panel B**) by gillnet gear type from fishery dependent data obtained by the Southeast Fisheries Science Center (SEFSC) Panama City Lab Gillnet Observer Program (GNOP) 1999-2018 (n = 1477).

A.

Gear type	Mean fork length (cm, straight)	n	SE
GILL NETS, DRIFT, OTHER	94.8	227	1.54
GILL NETS, DRIFT, RUNAROUND	128.1	1128	0.58
GILL NETS, SINK/ANCHOR, OTHER	93.7	122	1.93

B.

Proportion	GILL NETS, DRIFT, OTHER	GILL NETS, DRIFT, RUNAROUND	GILL NETS, SINK/ANCHOR, OTHER
Proportion of Total Lengths Measured	15%	76%	8%

Table 2. Atlantic blacktip shark mean length by year for all gillnet gear types combined from fishery-dependent data obtained by SEFSC-GNOP 1999-2018 (n = 1477).

Year	Mean fork length (cm, straight)	n	SE
1999[1]	32.0	1	NA
2000	103.2	42	3.40
2002	127.4	265	1.33
2003	130.8	332	0.97
2004	118.6	169	1.99
2005	118.7	181	2.15
2006	119.1	336	1.23
2007	62.0	1	NA
2008	101.2	6	11.17
2009	105.0	20	4.96
2010	107.8	10	7.13
2011	98.1	18	2.04
2012	93.5	42	2.38
2013	84.0	25	5.49
2014	96.7	10	3.68
2015	84.7	10	1.31
2016	138.0	4	2.68
2017	70.5	2	0.50
2018	91.3	3	6.69

[1] Length data were omitted from further analyses if they exceeded biologically plausible measurements for this species (< 40 cm FL and > 180 cm FL).

Table 3. Atlantic blacktip shark proportion of total number of lengths measured by gillnet gear type each year from fishery-dependent data obtained by SEFSC-GNOP 1999-2018 (n = 1477).

Year	GILL NETS, DRIFT, OTHER	GILL NETS, DRIFT, RUNAROUND	GILL NETS, SINK/ANCHOR, OTHER
1999	100%	0%	0%
2000	76%	24%	0%
2002	14%	86%	0%
2003	9%	91%	0%
2004	9%	91%	0%
2005	34%	66%	1%
2006	0%	90%	10%
2007	100%	0%	0%
2008	17%	0%	83%
2009	45%	45%	10%
2010	0%	0%	100%
2011	0%	0%	100%
2012	95%	0%	5%
2013	0%	0%	100%
2014	10%	0%	90%
2015	0%	0%	100%
2016	0%	50%	50%
2017	0%	0%	100%
2018	0%	0%	100%

Table 4. Atlantic blacktip shark mean length by pooled gillnet mesh size for all gillnet gear types combined from fishery-dependent data obtained by SEFSC-GNOP 1999-2018 (n = 1477).

Pooled mesh size (in)	Mean fork length (cm, straight)	n	SE
(0,4)	86.4	92	1.55
[4,6)	93.6	98	2.00
[6,8)	103.7	61	3.20
[8,10)	126.7	1113	0.62
[10,12)	113.1	72	3.83
[12,16+]	124.3	13	4.38

Table 5. Atlantic blacktip shark proportion of total number of lengths measured by pooled gillnet mesh size each year from fishery-dependent data obtained by SEFSC-GNOP 1999-2018 (n = 1477).

	Pooled mesh size (in)					
Year	(0,4)	[4,6)	[6,8)	[8,10)	[10,12)	[12,16+]
1999	0%	0%	0%	0%	100%	0%
2000	0%	0%	0%	76%	0%	24%
2002	0%	0%	2%	73%	25%	0%
2003	0%	0%	0%	90%	1%	0%
2004	0%	2%	0%	98%	0%	0%
2005	1%	34%	0%	66%	0%	0%
2006	0%	0%	10%	90%	0%	0%
2007	0%	100%	0%	0%	0%	0%
2008	50%	0%	50%	0%	0%	0%
2009	55%	0%	45%	0%	0%	0%
2010	40%	60%	0%	0%	0%	0%
2011	33%	56%	11%	0%	0%	0%
2012	69%	31%	0%	0%	0%	0%
2013	64%	0%	36%	0%	0%	0%
2014	70%	30%	0%	0%	0%	0%
2015	100%	0%	0%	0%	0%	0%
2016	0%	25%	0%	0%	0%	75%
2017	100%	0%	0%	0%	0%	0%
2018	100%	0%	0%	0%	0%	0%

Table 6. Number of observed Atlantic vessels each year with directed blacktip shark lengths.

Year	Number of Vessels
1999	1
2000	2
2002	5
2003	4
2004	4
2005	4
2006	4
2007	1
2008	4
2009	3
2010	3
2011	5
2012	3
2013	4
2014	4
2015	2
2016	2
2017	1
2018	2

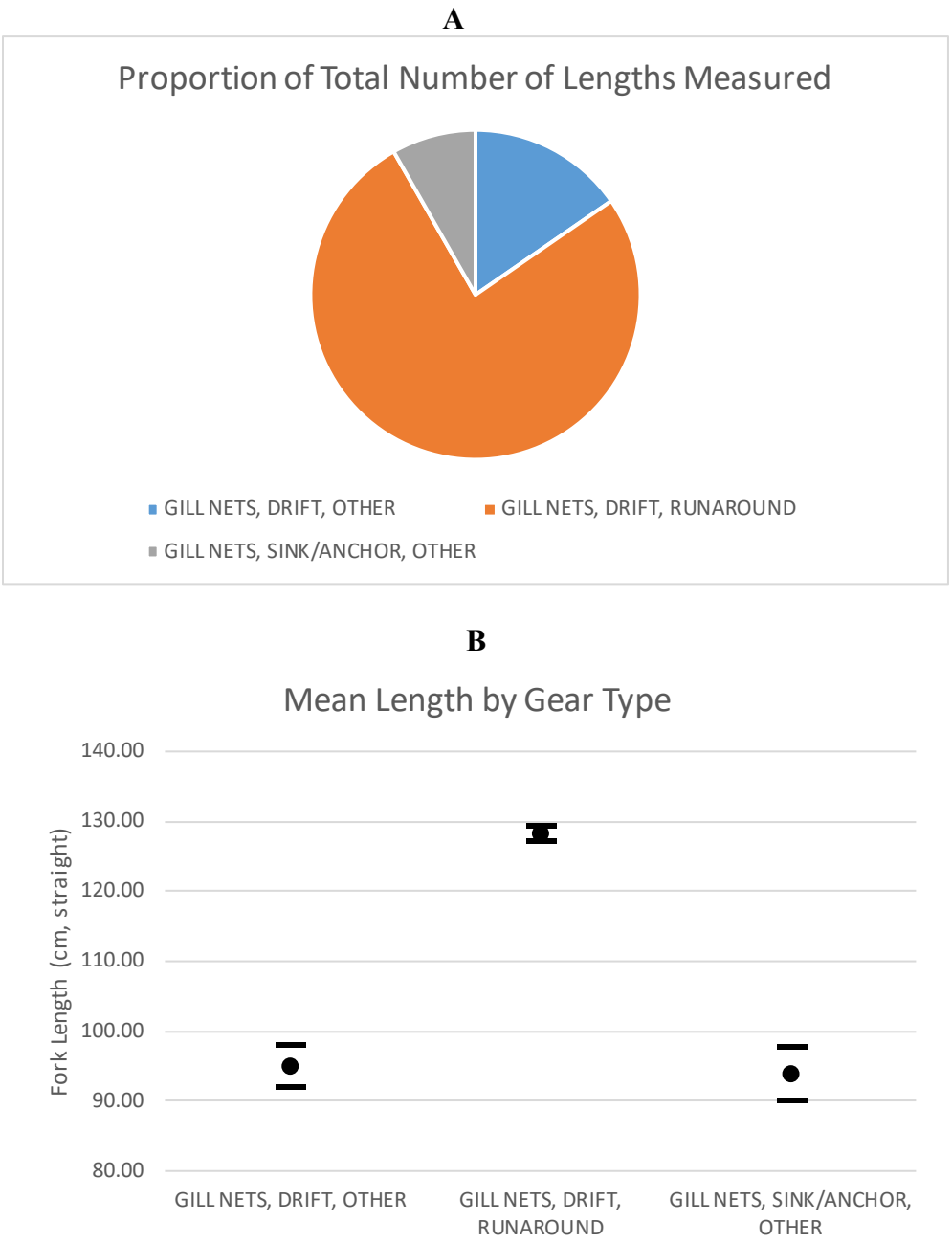

Figure 1. Atlantic blacktip shark proportion of the total number of lengths measured by gillnet gear type (**Panel A**) and mean length (points) and approximate 95% confidence intervals (bars, +-1.96*SE obtained from **Table 1**) by gillnet gear type (**Panel B**) from fishery-dependent data obtained by SEFSC-GNOP 1999-2018 (n = 1477).

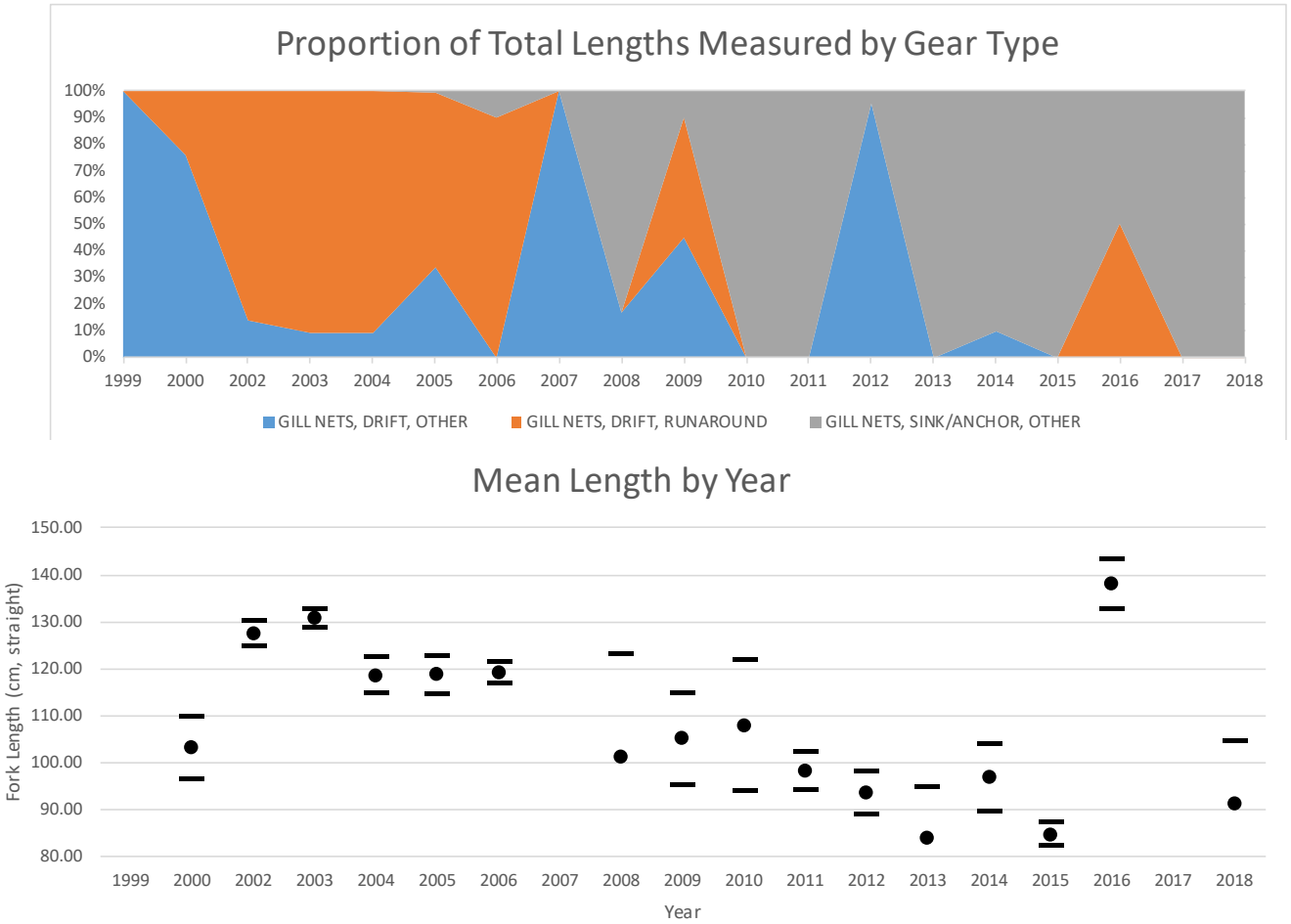

Figure 2. Atlantic blacktip shark proportion of total number of lengths measured by gillnet gear type each year (**Upper Panel**) and mean length by year (**Lower Panel**) for all gillnet gear types combined (points) and approximate 95% confidence intervals (bars, +-1.96*SE obtained from **Table 2**) from fishery-dependent data obtained by SEFSC-GNOP 1999-2018 (n = 1477).

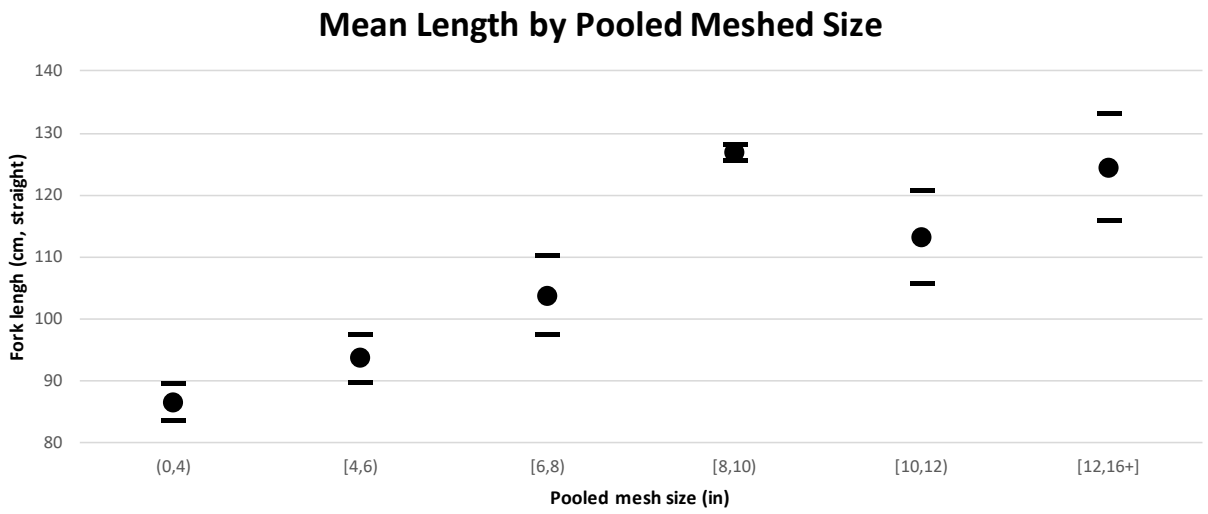

Figure 3. Atlantic blacktip shark mean length (points) and approximate 95% confidence intervals (bars, +-1.96*SE obtained from **Table 4**) by gillnet mesh size from fishery-dependent data obtained by SEFSC-GNOP 1999-2018 (n = 1477).

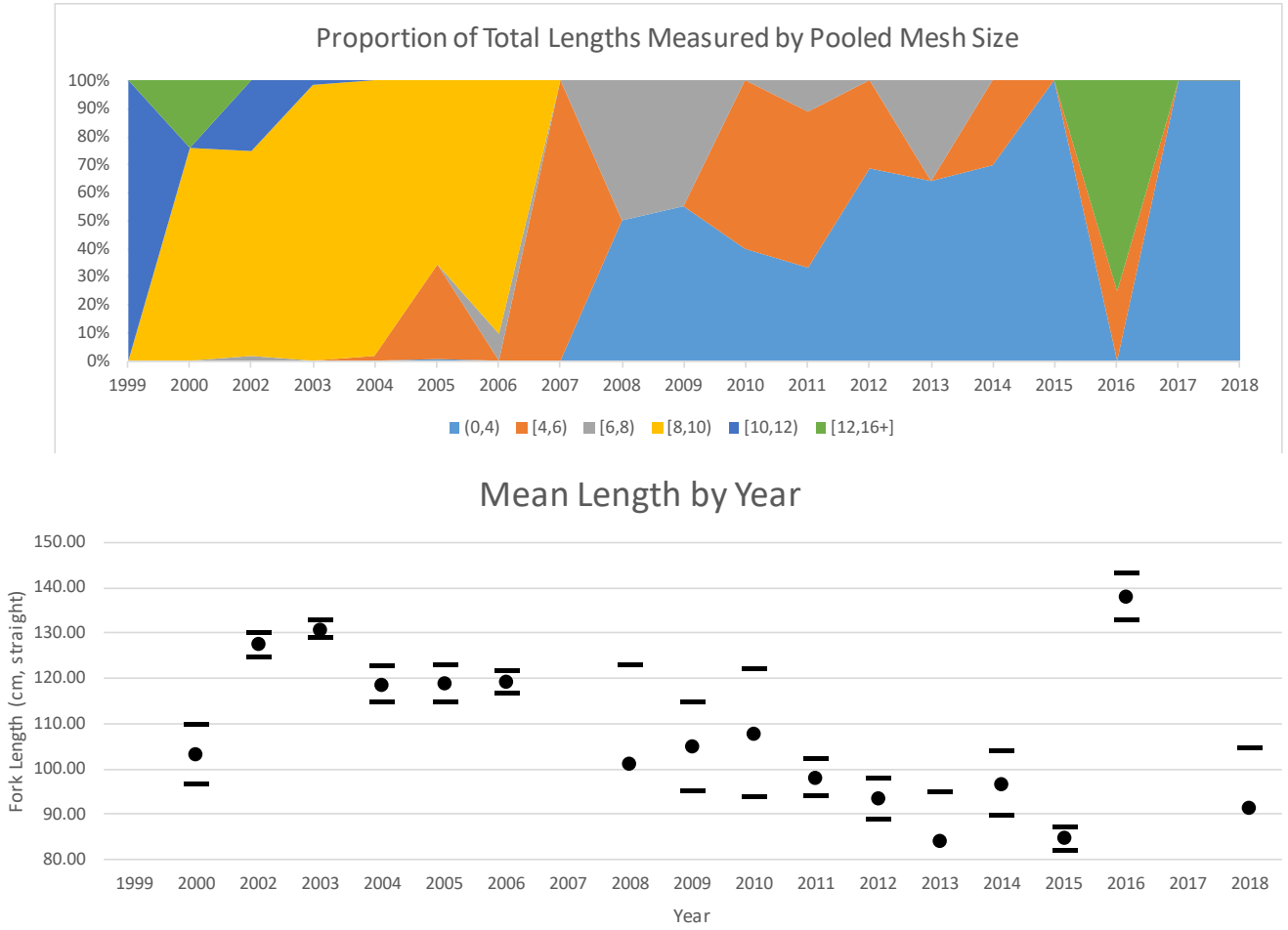

Figure 4. Atlantic blacktip shark proportion of total number of lengths measured by pooled gillnet mesh size each year (**Upper Panel**) and mean length by year (**Lower Panel**) for all gillnet gear types combined (points) and approximate 95% confidence intervals (bars, +-1.96*SE obtained from **Table 2**) from fishery-dependent data obtained by SEFSC-GNOP 1999-2018 (n = 1477).

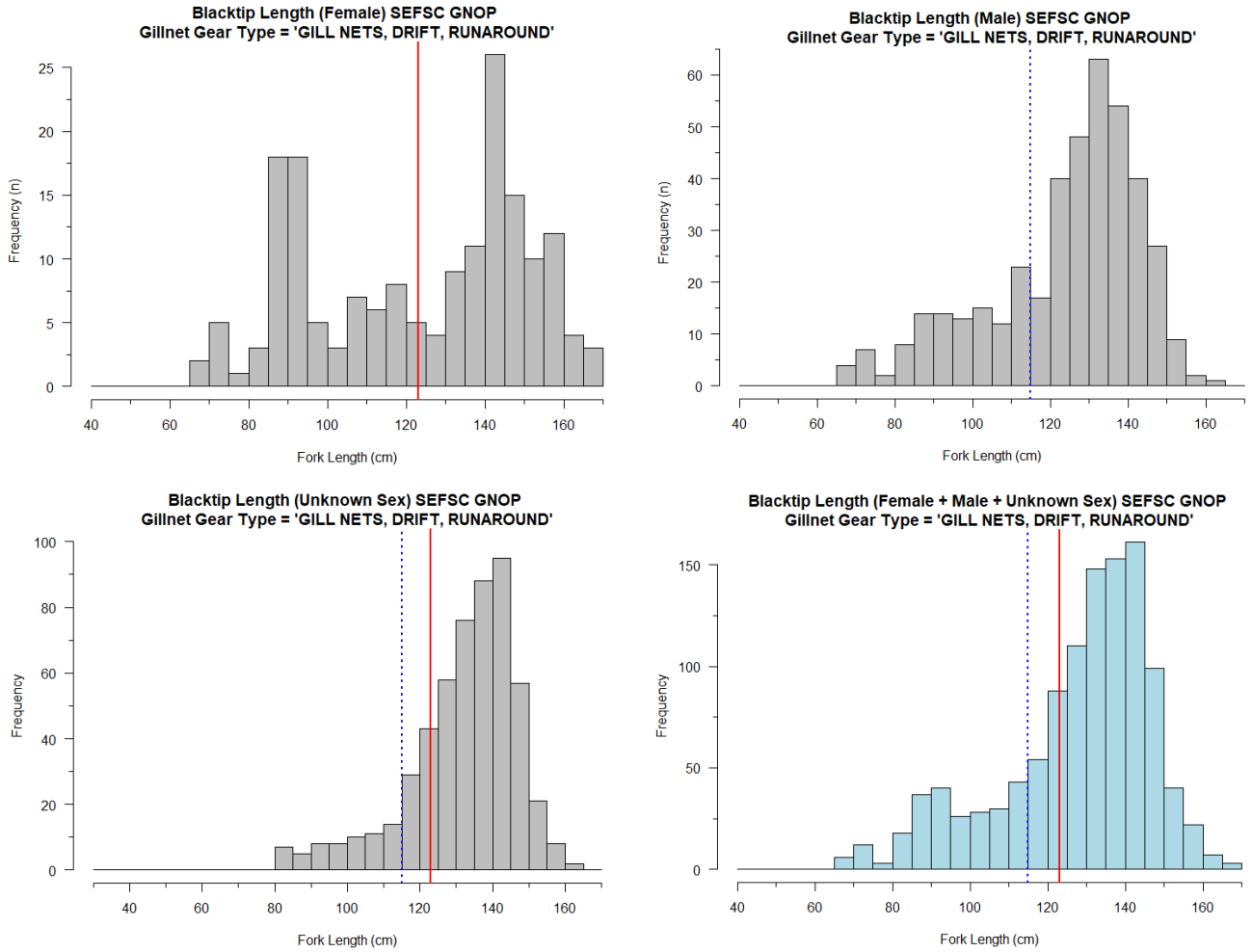

Figure 5. Blacktip length-frequency distributions for the gillnet gear type "GILL NETS, DRIFT, RUNAROUND" from fishery-dependent data obtained from the SEFSC-GNOP 1999-2018. Red vertical lines indicate 50% maturity for females (123 cm FL) and blue vertical lines indicate 50% maturity for males (115 cm FL).

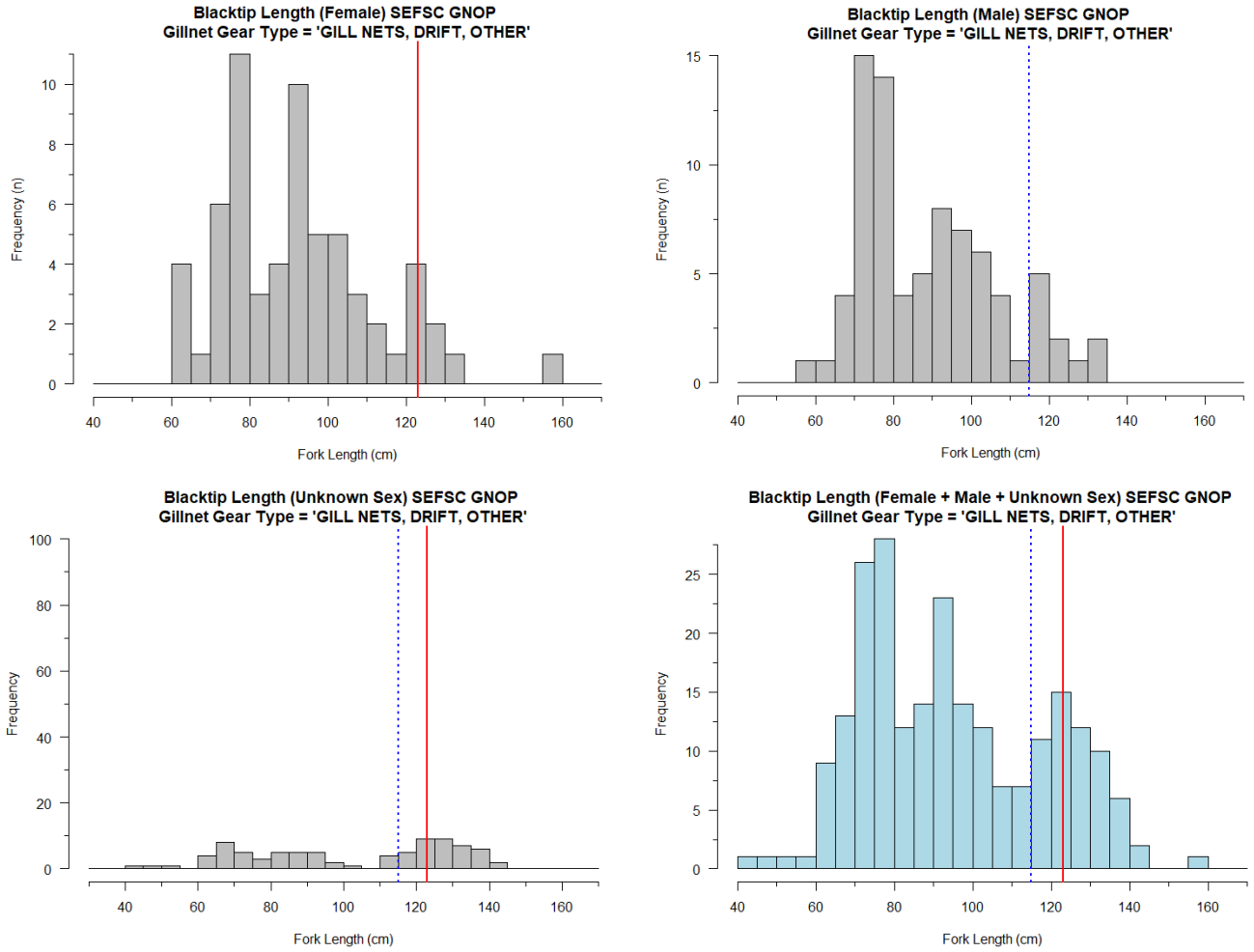

Figure 6. Blacktip length-frequency distributions for the gillnet gear type "GILL NETS, DRIFT, OTHER" from fishery-dependent data obtained from the SEFSC-GNOP 1999-2018. Red vertical lines indicate 50% maturity for females (123 cm FL) and blue vertical lines indicate 50% maturity for males (115 cm FL).

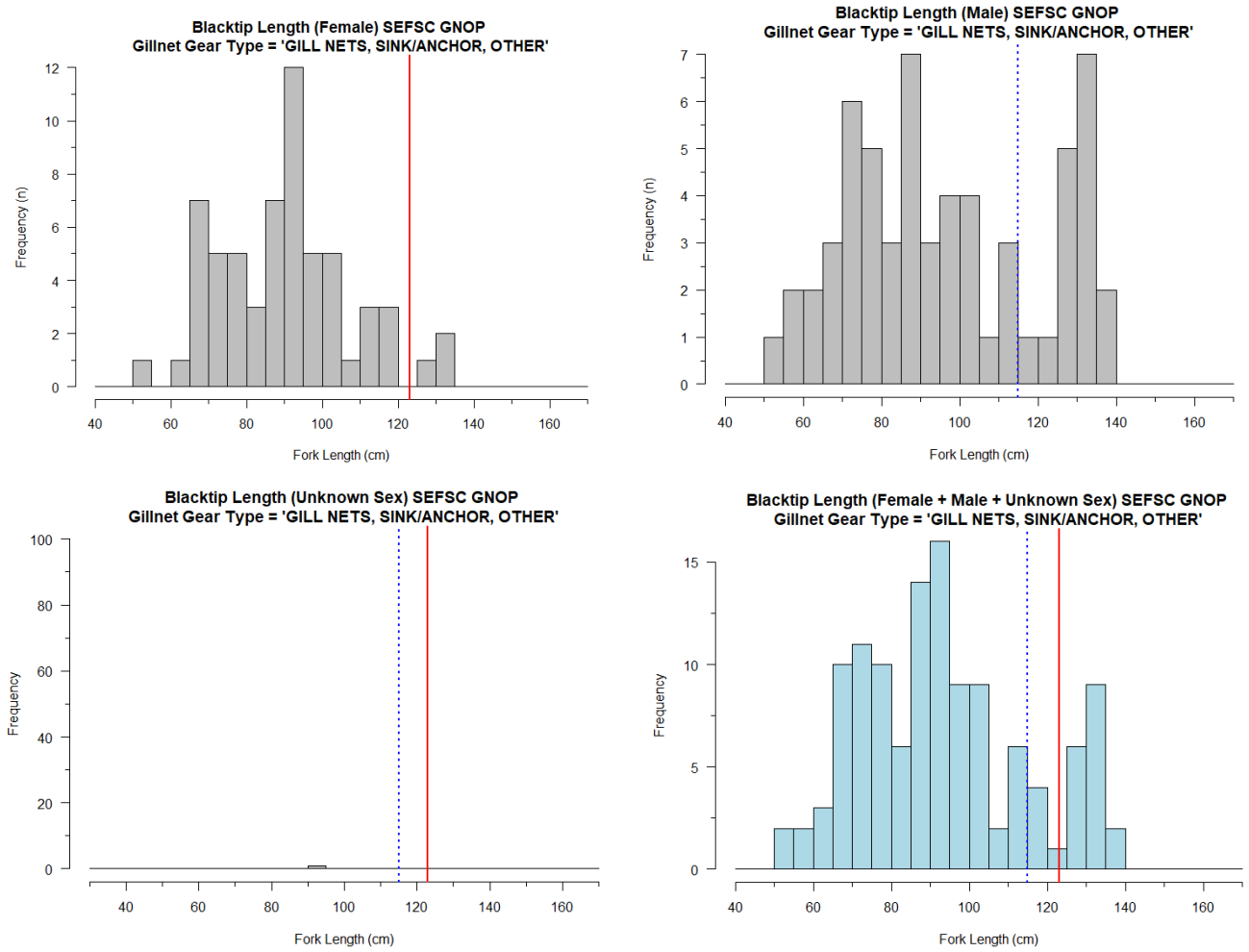

Figure 7. Blacktip length-frequency distributions for the gillnet gear type "GILL NETS, SINK/ANCHOR, OTHER" from fishery-dependent data obtained from the SEFSC-GNOP 1999-2018. Red vertical lines indicate 50% maturity for females (123 cm FL) and blue vertical lines indicate 50% maturity for males (115 cm FL).