Estimated Commercial Discards of Cobia (*Rachycentron canadum*) for the Gillnet Fishery Using Limited Observer Data

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Introduction

The general approach for estimating discards for the commercial gillnet fleet in the Southeast utilizes a discard rate or discards-per-unit-effort from the gillnet observer program and total fishing effort from the commercial reef logbook program (CFLP). Total discards include fish released alive, released dead, released in unknown condition, and used for bait. A similar approach was done using gillnet observer data for SEDAR 58, however the methods presented here have become the standard data-limited approach when a species shows a very low rate of being caught on observer trips (Thompson et al. 2024).

Methods

Data Sources

The Southeast Gillnet Observer Program (GOP) began in 1993 (Mathers et al. 2018) and initially focused efforts only on those gillnet vessels targeting sharks. However, gillnet effort targeting large coastal and small coastal sharks have declined as a result of regulatory actions. Consequently, fishers have increasingly targeted teleosts, including Spanish Mackerel, King Mackerel, and Bluefish, with varying types of gillnet gear. Currently, the program covers anchored (sink and stab), strike, or drift gillnet fishing, regardless of target, by vessels that fish year-round from Florida to North Carolina and the Gulf of Mexico. The fleet is primarily based in the South Atlantic with a smaller component in the Gulf.

Total effort was determined from the commercial Coastal Fisheries Logbook Program in which fishers reported basic information on effort and catch by species for every trip (Atkinson et al. 2021). The coastal logbook program began in 1990 for a subset of vessels in the South Atlantic, and expanded to all vessels in 1993; for these discard estimates, complete calendar years 1999-2023 were considered for trips that reported landings of Cobia.

Relevant Management History of Atlantic Cobia

Cobia have had the same minimum size limit of 33 inches fork length since 1985. Annual catch limits (ACLs) were set in 2012 for the Atlantic Cobia migratory group. This ACL led to closures towards the end of the fishing year in 2014, 2016, and 2017 for as little as 20 days in 2014 and several months (117 days) in 2017. Given the limited observer coverage, these closures were not considered for the analyses.

Spatial Boundary

While the geographic range for SEDAR 95 includes fishing areas north of the Florida and Georgia border, the gillnet observer program did not sample any trips north of the North Carolina and Virginia border. For this reason, discard estimates for the gillnet fishery are limited to fishing areas off the coast of Georgia to North Carolina (Figure 1). This geographic range was utilized during SEDAR 28. For this working paper Cobia will be referred to as Cobia (GA-NC) since discard estimation is limited to this spatial extent.

Comparison of Observer and Logbook Effort Variables

Despite a lengthy historical collection of observer information from the GOP, discard information collected by the program has been utilized in only a small number of SEDAR assessments (SEDAR 58 Atlantic Cobia, SEDAR 65 Blacktip Shark, SEDAR 77 Scalloped Hammerhead and Great Hammerhead Shark, and SEDAR 78 South Atlantic Spanish Mackerel). All of these assessments have used a simple ratio estimator for discard rates, where the effort metric was number of sets (Garrison 2007). To our knowledge, a comprehensive analysis has not been conducted to identify the most unbiased effort variable. Therefore, a suite of effort metrics were evaluated to identify an unbiased and consistent effort variable between the gillnet observer program and the coastal logbook program in order to carry out the catch expansion. This analysis was adapted from Smith et al. (2018).

The general analysis was approached involving three main steps: (1) identify a subset of logbook trips that were sampled by onboard observers; (2) calculate trip-level effort metrics for the observer data that corresponded with logbook data; (3) compare the observer and logbook effort metrics for matched trips via a paired t-test to identify potential unbiased variables.

Discard Estimation

Similar to previous assessments where GOP data were used, following Garrison (2007), discard estimation utilized a simple ratio estimator. This was due to limited observer data for Cobia (GA-NC). Unlike SEDAR 58 (Carlson & McCarthy 2019), effort metrics were explored by comparing matched observer and logbook trips to determine the most reliable, unbiased effort variable. Results from that analysis informed the effort metric(s) used for discard estimation. The simple discard rate (DR) computation is

$$\overline{DR} = \frac{1}{n}\sum_i \frac{Discards\ (in\ numbers)_i}{effort_i}$$

where *i* is per trip and *n* is the number of observer trips. Total discards per year (*t*) for the gillnet fleet were estimated as

$$Discards_t = Total\ Effort_t \times \overline{DR}$$

Standard error was estimated as

$$SE = \sqrt{\sum \overline{DR} sd^2 \times Total\ Effort^2}$$

According to the GOP protocol, weights and lengths are not often collected for individual fish. Therefore, numbers could not be converted to weights using an average. The only data where

weights were collected were a small subsample of kept Cobia. Since the assessment inputs discards as numbers of fish, only Cobia (GA-NC) discard estimates in number were provided.

Results and Discussion

Unbiased Effort Metric

Table 1 highlights the variables collected on the logbook program and how that relates to similar information collected by observers. Even though number of sets was used for SEDAR 58 (Carlson & McCarthy 2019), it is not considered a reliable effort variable. The main issue with this variable is that number of sets was not on the coastal logbook form until 2007. This is based on reviewing historical scanned logbook forms and corroborated by the data (Figure 2). Prior to 2007, all logbook gillnet trips had one set per trip indicating this variable was added to the database later on. Similar to number of sets, soak time is also not considered because of inconsistency in reporting over time. Prior to 2007, soak time was recorded as the total time fishing. In 2007, the definition was changed to average time fishing per set. For expansion in the discard calculation, we are looking an effort variable that has been collected consistently through time.

Therefore, only two variables were compared as potential effort metrics: gillnet length and number of days fished. To utilize the maximum number of trips for matching to logbook data, the gillnet observer program was subset to include all trips fishing in the South Atlantic (including fishing areas off of Florida). There was a total of 1,313 gillnet trips observed between 1999-2023. These trips were matched based on vessel ID, trip departure date, and trip land date. There were 49 observer trips that matched to more than one logbook trip and 48 logbook trips that matched to more than one observer trip based on the criteria above. These were excluded to limit the analysis to confident matches. In the end, 530 observer trips were matched to coastal logbook trips.

The distributions of average gear length between the logbook and observer data shows differences in reporting by program (Figure 3). The mean gear length reported on the logbook is 900 yds for matched trips whereas the mean length from observers is 600 yds. Therefore, this is an unreliable effort variable for discard estimation. For the number of days fished as the effort variable, close to 90 percent of the gillnet trips are a single day. The difference in reporting between programs are shown in Figure 4. There is no significant difference between logbook and observer data ($p \geq 0.05$) and therefore, days fished is considered the best effort metric for discard estimation.

Discard Estimates

Observer trips with reported Cobia caught off the coast of Georgia to North Carolina are in Table 1. There were no observed Cobia (GA-NC) before 2002 and after 2016 even though there were gillnet trips observed for the whole time series (1999-2023). There is no visual trend in annual catch of Cobia (GA-NC) or number of trips with reported Cobia (GA-NC) catch according to the logbook data from 1999-2023 (Figure 5-6). For this reason, all observer data were pooled to

apply a single mean discard rate to the entire time series. Discard estimates in number are provided in Table 3 and shown in Figure 7 with large error bars.

Comparison to SEDAR 58

There are two differences between discard estimates used for SEDAR 58 and SEDAR 95 for the gillnet fishery: (1) SEDAR 58 mean discard rates were calculated on an annual basis by disposition (dead vs. alive) whereas a single average discard rate was calculated using all observer data and pooled by disposition for SEDAR 95 and (2) the effort metric for SEDAR 58 was number of sets whereas total days fished was used as the effort variable for SEDAR 95. Figure 8 shows the comparison of discard estimates by assessment. SEDAR 95 estimates provide better smoothing across the time series, unlike the SEDAR 58 method where there were some years with no observer data so the total discards were assumed zero for those years.

Literature Cited

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Tables

Table 1. Description of effort variables collected on the coastal logbook form and equivalent data collected by observers.

Variable	Logbook Definition	Observer Definition
Days fished	Trip start date minus the trip land date.	Date departed minus the date landed.
Gillnet length	Average length of net in yards.	Record the total length of the entire string for each gear configuration in feet (if there is space between each net, do not include this distance in net length).
Number of sets	Number of times this gear was set.	Number of times a piece of gear was deployed and hauled back.
Soak time	Prior to 2007, directions asked for the total time in hours the nets were in the water fishing during this trip. In 2007, instructions were changed to the average time in hours that this gear was used per set.	For each set, the time when the gear was first deployed, gear was no longer being deployed, gear was first hauled back, and last gear was hauled back were recorded.

Table 2. Sample size of observer trips with reported Cobia (GA-NC) catch.

Year	Observer Trips with Landed Cobia	Observer Trips with Discarded Cobia
2002	2	0
2003	1	0
2006	1	1
2007	5	5
2008	6	5
2009	21	19
2010	9	7
2011	12	12
2012	8	4
2013	4	3
2014	4	2
2015	4	2
2016	2	2

Table 3. Estimated commercial discards (in number) of Cobia (GA-NC) from 1999-2023.

Year	Mean Discard Rate	Discard Rate SD	Total Effort (days fished)	Estimated Discards (N)	Standard Error
1999	3.051	5.956	21	64	119.132
2000	3.051	5.956	126	384	744.574
2001	3.051	5.956	83	253	494.397
2002	3.051	5.956	75	229	446.745
2003	3.051	5.956	59	180	345.482
2004	3.051	5.956	77	235	440.788
2005	3.051	5.956	71	217	387.179
2006	3.051	5.956	104	317	619.486
2007	3.051	5.956	86	262	512.267
2008	3.051	5.956	145	442	863.706
2009	3.051	5.956	183	558	1084.100
2010	3.051	5.956	160	488	923.272
2011	3.051	5.956	90	275	536.093
2012	3.051	5.956	158	482	923.272
2013	3.051	5.956	90	275	530.137
2014	3.051	5.956	153	467	911.359
2015	3.051	5.956	106	323	595.659
2016	3.051	5.956	166	506	982.838
2017	3.051	5.956	73	223	405.048
2018	3.051	5.956	85	259	482.484
2019	3.051	5.956	99	302	589.703
2020	3.051	5.956	182	555	1084.100
2021	3.051	5.956	146	445	869.663
2022	3.051	5.956	147	448	875.619
2023	3.051	5.956	140	427	833.923

Figures

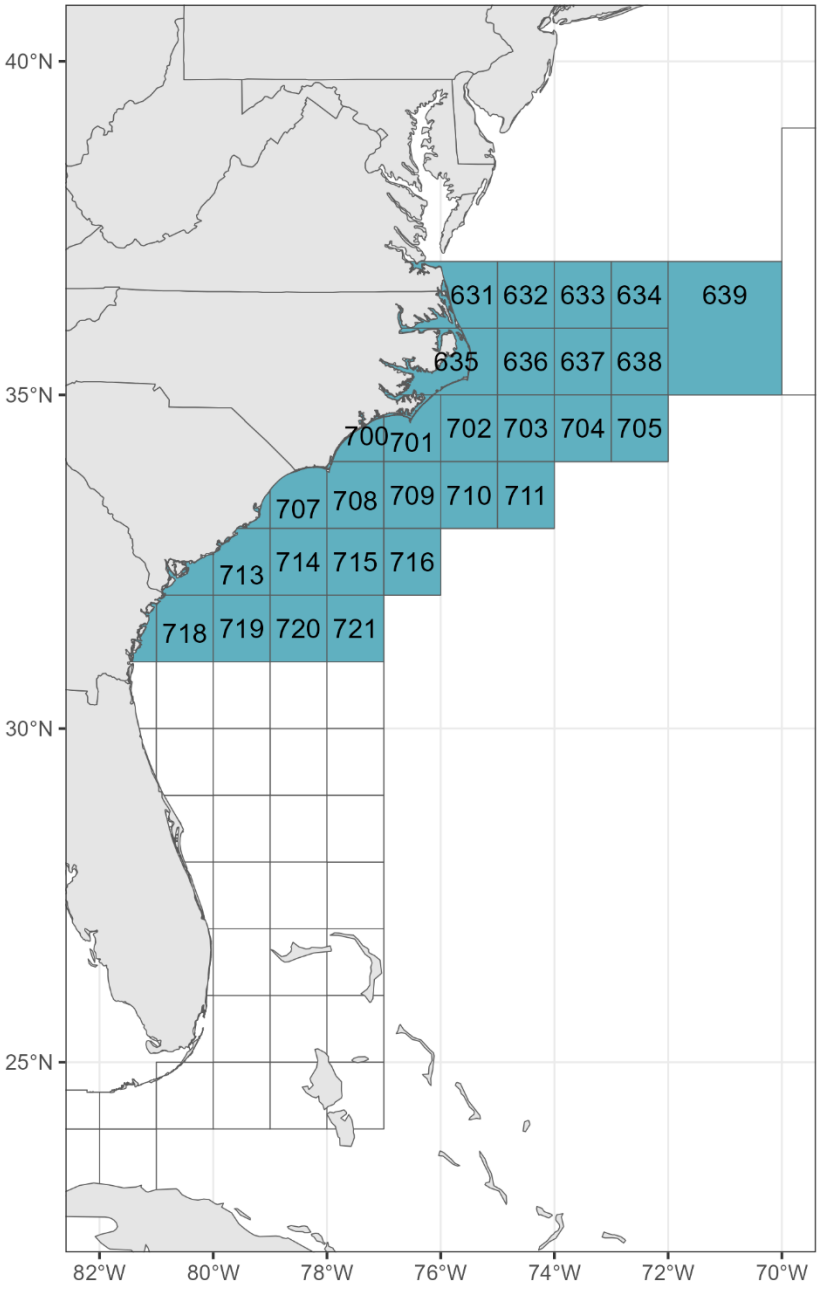

Figure 1. Spatial boundary for estimating discards of Cobia (GA-NC).

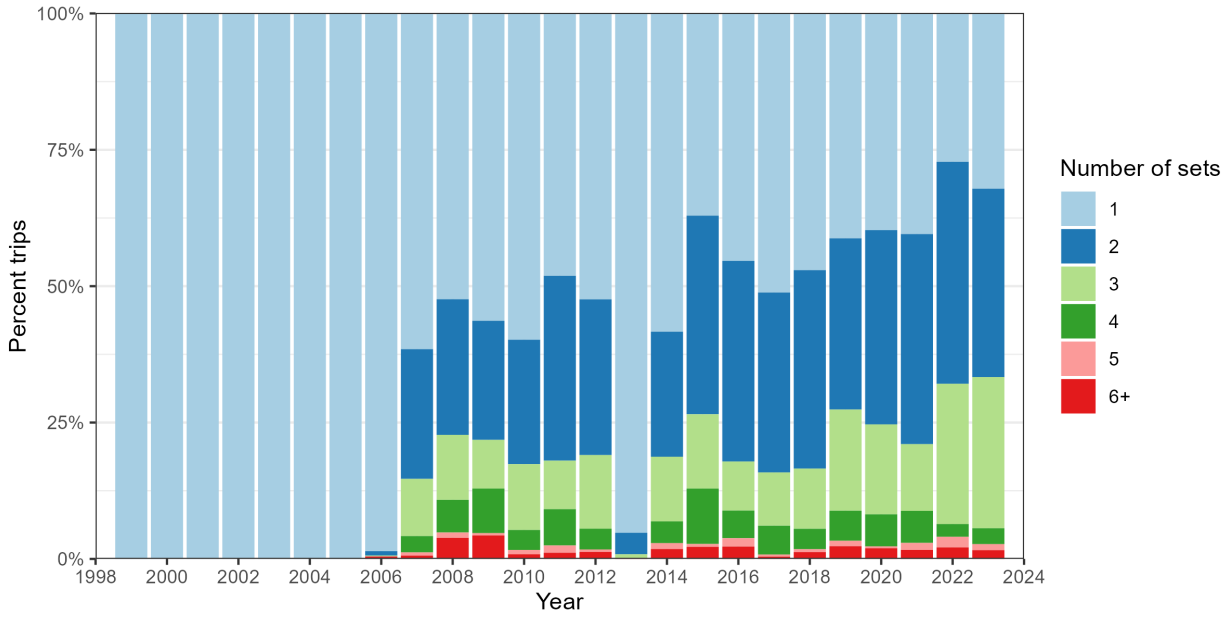

Figure 2. Percent of logbook trips with reported number of sets fished from 1999-2023.

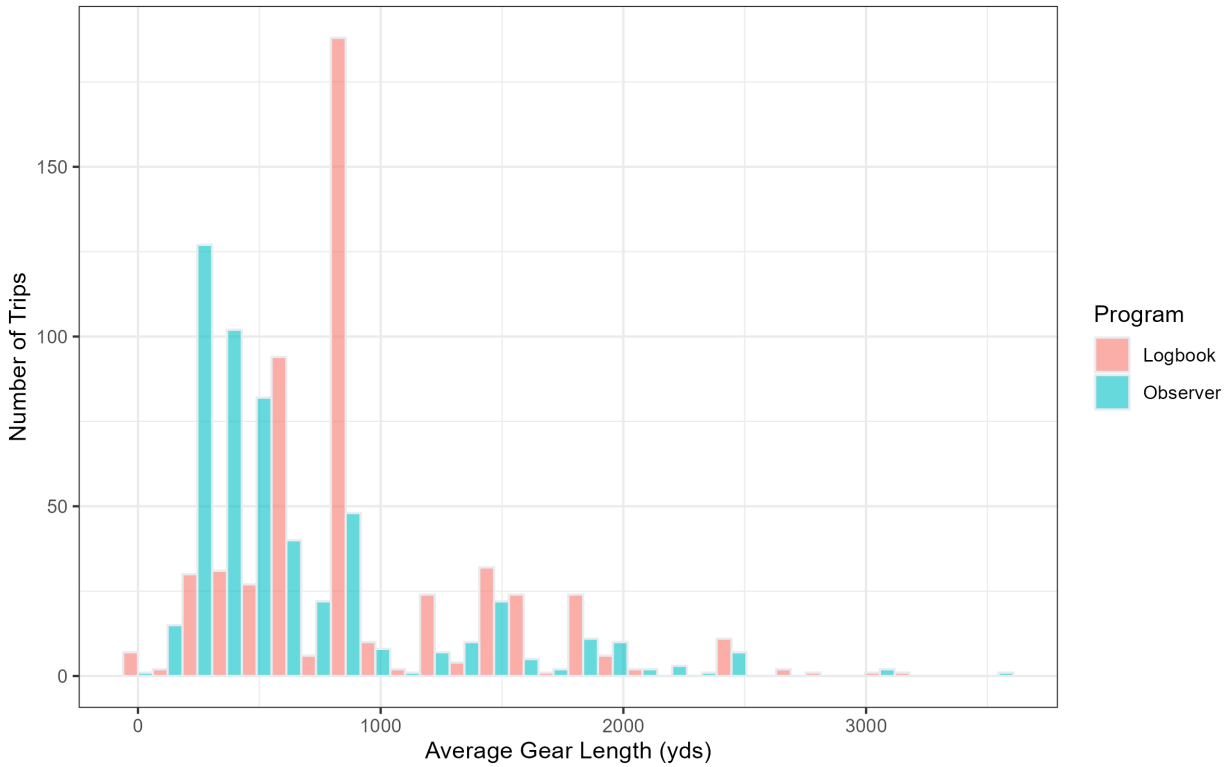

Figure 3. Distribution of average gear length in yards for logbook and observer data.

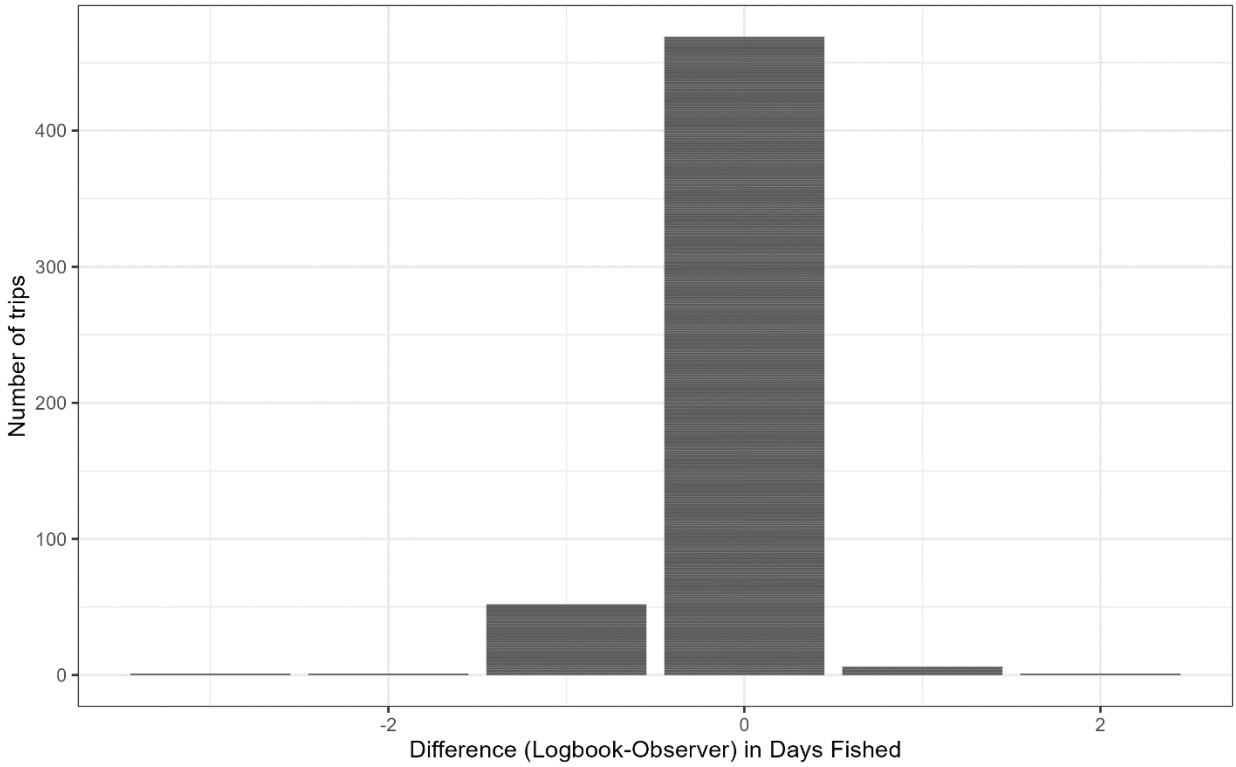

Figure 4. Difference in number of days fished between logbook and observer data.

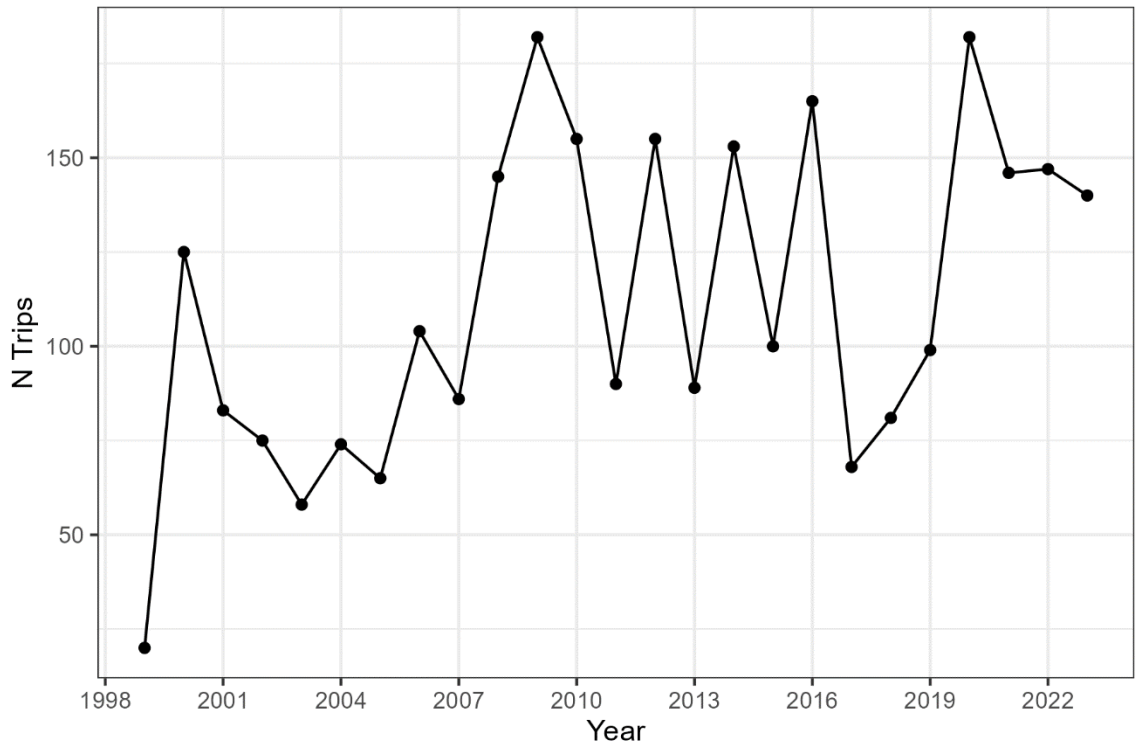

Figure 5. Annual total number of logbook trips reporting Cobia (GA-NC) from 1999-2023.

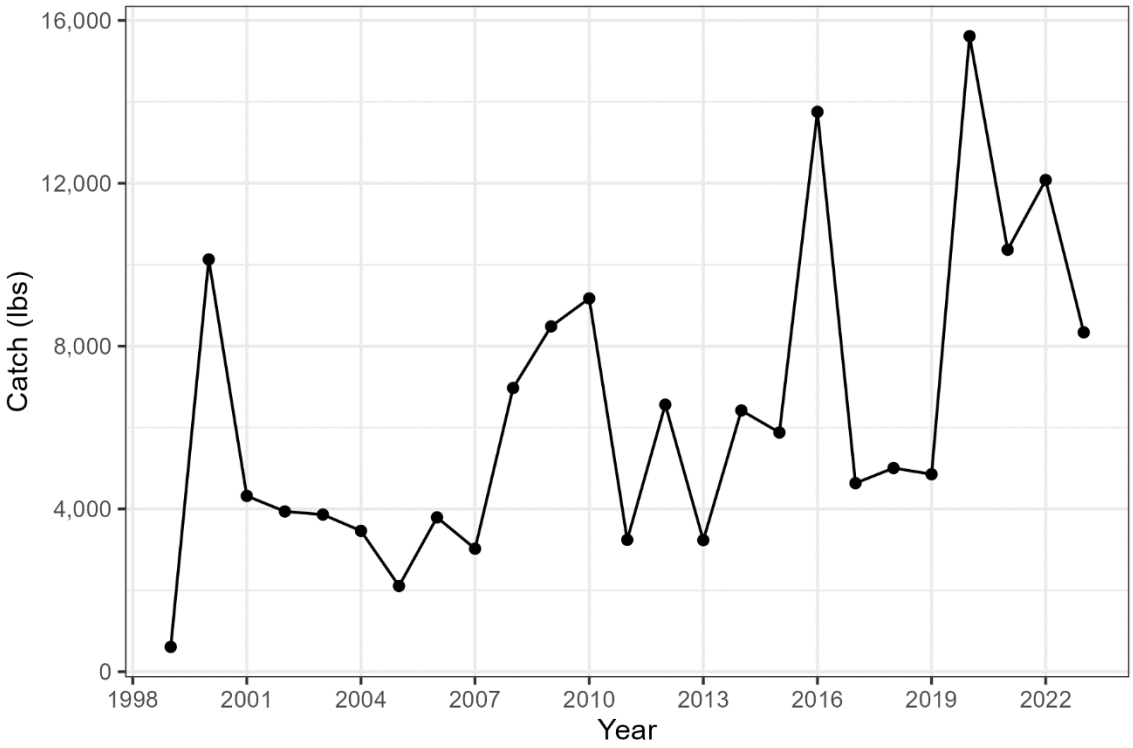

Figure 6. Total annual catch in pounds for Cobia (GA-NC) from 1999-2023.

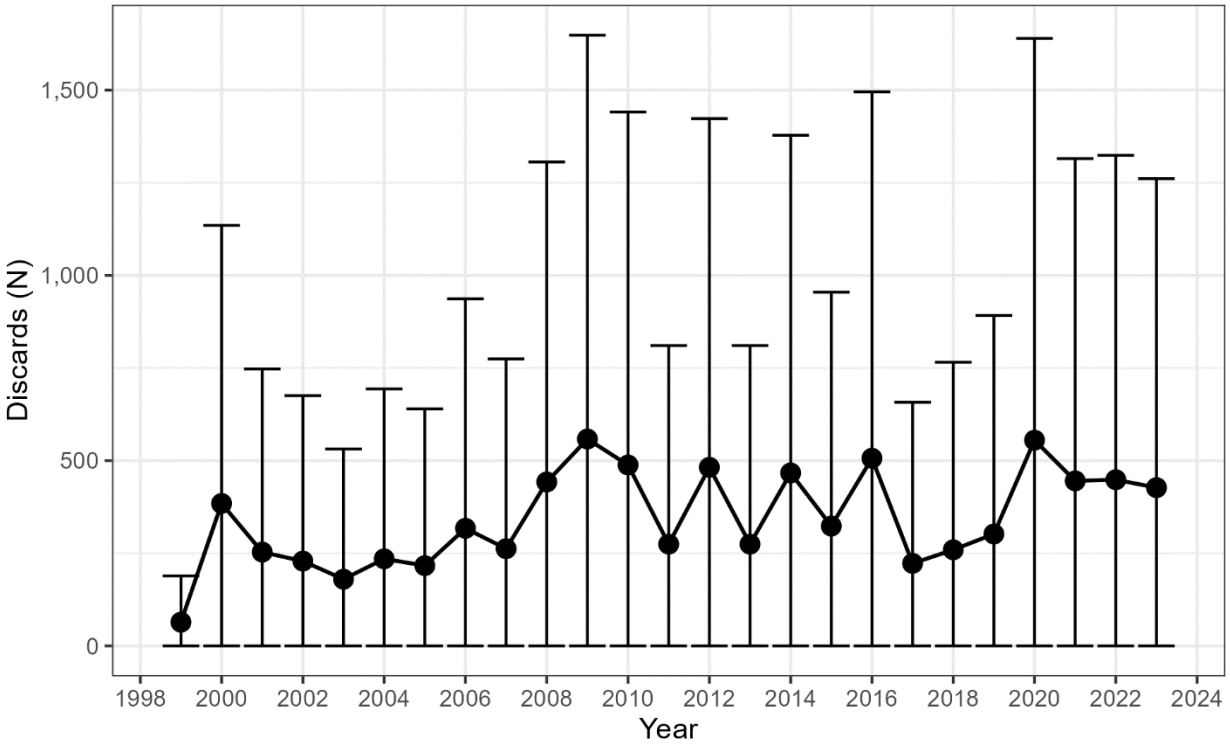

Figure 7. Commercial discards for Cobia (GA-NC) from 1999-2023 with standard error bars.

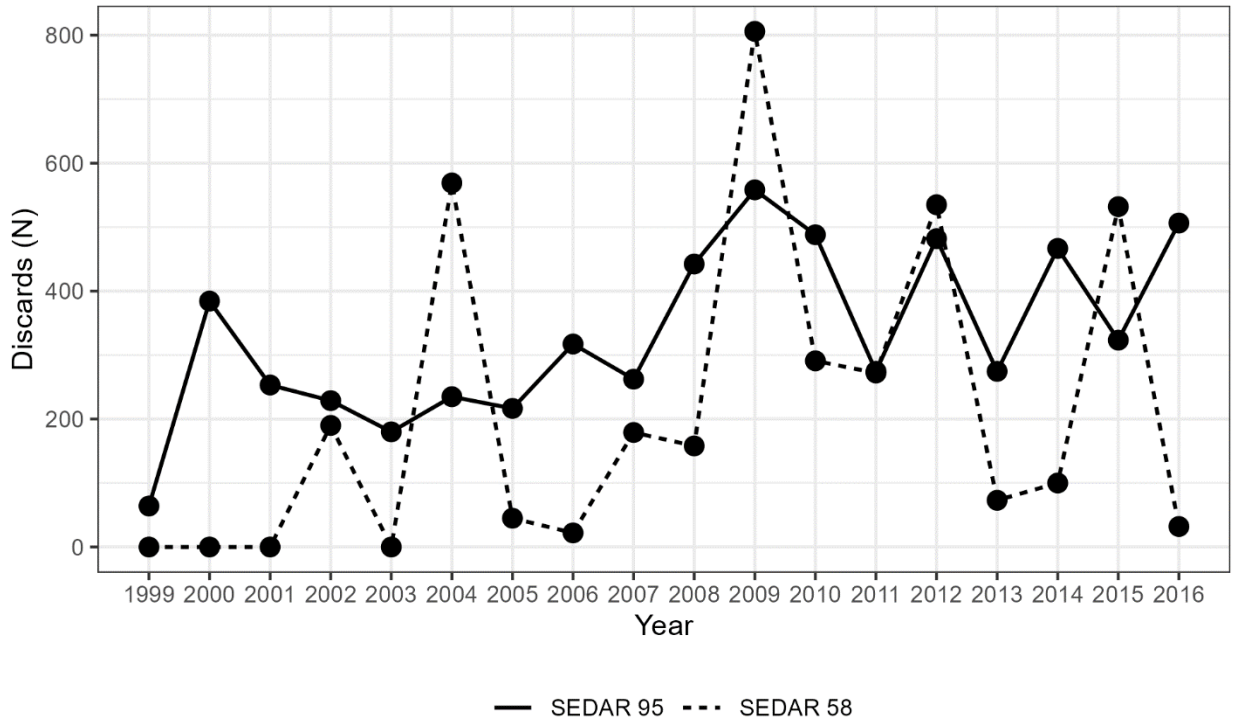

Figure 8. Comparison of commercial discard estimates for Cobia (GA-NC) from the gillnet fishery between the current assessment (SEDAR 95) and the previous assessment (SEDAR 58).