

Cobia Fishery-Independent Index of Abundance and Length/Age
Compositions in US South Atlantic Waters
Based on the Coastal Trawl Survey (1990-2025)

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Abstract

Fishery-independent measures of catch and effort with standard gear types and deployment strategies are valuable for monitoring the status of stocks, interpreting fisheries landings data, performing stock assessments, and developing regulations for managing fish resources. This report presents a summary of the fishery-independent monitoring of Cobia (*Rachycentron canadum*) in the US South Atlantic region through the efforts of the Coastal Trawl Survey (CTS, primarily funded through the Southeast Area Monitoring and Assessment Program-South Atlantic [SEAMAP-SA]). Specifically, it presents overall survey efforts and sampling specifically related to Cobia, including annual nominal abundance, standardized abundance in trawls from 1990 to 2025, and length and age compositions. Index standardization was done through a zero-inflated negative binomial model (ZINB) to account for the effects of potential covariates on abundance estimates. The standardized index was higher than the long-term mean for the survey in the most recent years, but with larger errors than in more historical years. No sampling occurred in 2020. Length and age compositions are only available for the survey in a limited number of years (2018-2025 for lengths and 2012-2025 for ages), but the CTS primarily collects small, young Cobia.

Background

The Coastal Trawl Survey (CTS, primarily funded by the Southeast Area Monitoring and Assessment Program - South Atlantic region [SEAMAP-SA]) has conducted fishery-independent research on the seasonal abundance and biomass of all species accessible by bottom trawls in nearshore coastal waters between Cape Hatteras, North Carolina, and Cape Canaveral, Florida, since 1986. Standardized activities were adopted fully, with few modifications, beginning in 1990. Most notably, in 2001, after an external review, the outer strata (i.e. deeper water strata) were abandoned, increasing the number of stations allocated to inner strata (i.e. nearshore strata). Also at this time, the method for allocating the number of stations within each stratum changed from proportional allocation, which was based on the total surface area of each stratum, to optimal allocation where higher effort was allocated to strata with historically higher variability. In 2021, due to changes in weather patterns (i.e. increased frequency of unworkable conditions) and stagnant funding, the CTS changed from processing the catch from both nets to only processing the catch from a single net with the other net towed open. In preparation for this change, we compared catches between the nets for any impact on abundance, diversity, and species richness, and no differences were observed. The results of these analyses are available in Bullard et al. 2026. Due to level funding and increasing costs of the survey, in 2023, the CTS switched from sampling three seasons (spring: April-May, summer: July-August, fall: late-September-November) to sampling two seasons with the first season from April-June and the second season from August-October. This shift in timing optimized species data used in stock assessments and other analyses as summer data were rarely used or used in combination with other seasons. This change also extended the seasons into longer sampling windows with more likely workable weather, and because an audit of data uses highlighted a need for spring and fall data for recruitment indices for Bluefish and mackerels, while summer provided no unique data for management. Then in 2024, the R/V Lady Lisa was replaced with the R/V Lady Lillian, switching the sampling approach from a double-rigged trawl operation to a stern trawl operation, which required a new net configuration, a 60 ft (18.3 m) 4-seam fly trawl. In anticipation of the vessel and gear

change, the CTS began using net mensuration gear in 2021 to collect data on the door spread, net spread, and headrope height of the historic gear, the 75 ft (22.9 m) mongoose type falcon trawl, and the new gear, the 60 ft 4-seam fly trawl. Using net mensuration data, we determined the average net spread for each gear type: historic and new, then used these averages along with the distance towed to calculate the area swept in hectares for each tow event. A detailed description of historic methods is available in Zimney and Smart 2022.

Objective

This report presents a standardized relative abundance index of Cobia (*Rachycentron canadum*) derived from the CTS during the years 1990-2025. The year 2020 is excluded during which COVID-19 prevented sampling. The standardized index accounts for annual sampling distribution variability, changes in sampling effort, and environmental covariates that may affect catch of Cobia in trawls. Also provided are annual length and age compositions of Cobia captured by CTS to inform gear selectivity. Data presented in this report are based on the CTS database accessed on March 23, 2026 (indices) and April 23, 2026 (length and age compositions).

Methods

Survey Design and Gear

(see Zimney and Smart 2022 for full description)

- Range: Cape Hatteras, North Carolina, to Cape Canaveral, Florida (Figure 1)
- Depths: 3-14 m (inner strata only, outer strata eliminated)
- Seasons:
 - 1990-2022: Spring (April-May), Summer (July-August), and Fall (late September-November)
 - 2023-2025: Spring (April-June) and Fall (August-October)
 - Converted to day of year (DOY) for analysis
- Sample Selection:
 - Stratified random design
 - 24 inner strata defined by latitude (Figure 1)
 - Station allocation:
 - 1990-2000: Proportional allocation based on the total surface area of each stratum
 - 2001-2025: Optimal allocation determined by within stratum variability in total abundance
 - 78-112 allocated stations per season depending on funding and other survey priorities
 - Florida strata removed for Cobia analysis due to current management boundary at the Florida/Georgia state line
- Sampling Gear:
 - 1990-2023: 75 ft (22.9 m) mongoose-type Falcon nets without turtle excluder or bycatch reduction devices (1990-2019: two nets processed; 2021-2023: one net processed)

- Body mesh 47.6 mm
 - Cod end mesh 41.3 mm
- 2024-2025: 60 ft (18.3 m) 4-seam fly trawl
 - Body mesh 47.6 mm
 - Cod end mesh 41.3 mm
- Duration: 20-minute tows
- Time of Day: Daylight hours (1 hr after sunrise to 1 hr before sunset)
- Environmental Covariates: Bottom Temperature and Salinity (deepest recording) collected via CTD at each station
- Abundance: can either be direct or derived
 - Direct: small catches are fully processed and all fish counted
 - Derived: large catches sub-sampled and only fish in randomly selected sub-sample counted; abundance is the product of sub-sampled count, sub-sample weight, and total catch weight
- Data Filtering/Inclusion:
 - Excluded any tows with missing covariate information
 - Excluded all tows prior to 1990
 - Excluded all tows with lost catch data
 - Excluded all tows where tow did not adhere to standard procedures (i.e. extremely short, damaged gear, U-turn)
 - Excluded outer strata

Standardized Index Model Formulation

- Response variable: Fish per tow
- Offset term: Area swept (hectares; based on distance travelled and width of net[s])
- Dependent variables (all continuous):
 - Year
 - Depth (m)
 - Day of Year (DOY) (accounts for change in season structure)
 - Latitude (°N) (as a proxy for stratum)
 - Bottom Temperature (°C)
 - Bottom Salinity
- Modelled with polynomials
 - Maximum allowed polynomial order set using preliminary generalized additive models (GAMs)
 - Limited polynomial to maximum of fourth order for biological relevance
- Due to widely differing scales, the covariates were centered and scaled
 - Centered – subtract covariate mean
 - Scaled – divided centered values by their standard deviation prior to the GAMs
- Models Tested – Zero-Inflated Poisson (ZIP) and Zero-Inflated Negative Binomial (ZINB)
- Mixture model for both zero-inflated error structures

- Two parts to the model, with Bayesian Information Criteria (BIC) used to select the best model from each of the 2 zero-inflated error distributions
 - Presence/absence (binomial sub-model)
 - Catch (count sub-model)
 - Sub-models optimized using a two-step approach due to computational demands
 - Count sub-model was optimized with all covariates removed from the zero-inflation sub-model
 - Binomial sub-model was optimized using fixed count sub-model covariates obtained in previous step
 - Allows for different covariates to be included in the two sub-models
- Bayesian Information Criteria (BIC) also used to select the best model from all model structures tested
- Annual year effect coefficients of variation (CVs) and standard errors (SE) computed using bootstrapping: 5,000 bootstraps
- Software used: R (Version 4.5.3; R Development Core Team 2026)

Length and Age Compositions

Length methods

- All fish in the processed catch measured to nearest centimeter fork length (FL) 2018-2025
- Composition in 1-cm length bins centered on the integer per year

Ageing methods

- Fish <100 cm retained for dissection
- Otoliths removed, stored in 70% EtOH for 24 hrs, and dried
- Otoliths mounted and sectioned
- Age = increment count for most specimens; for specimens caught mid-season, typically fall, ages were rounded down to a spring birthdate.
- Ages determined 2012-2025

Results

Included tows n = 7,474, ranging from 101 to 276 per year (Table 1)

No sampling in 2020 due to COVID-19

Cobia Catches

- Cobia collected in all years with average % positive of 3.4% and ranging from 0.5 to 8.04% (Table 1, Figure 2)
- Cobia occurred in all areas and ranges of covariates (Figure 3), supporting that the data cannot be sub-sampled to improve % positive
- Normalized nominal abundance ranged from 0.11 to 3.04 fish/hectare (Table 1)

Standardized Index Model Formulation

- Depth, latitude, DOY, Bottom Temperature, and Bottom Salinity were included in the final model
- Final model selected was ZINB (Figure 4)
 - Presence model: Year, Depth, Bottom Temperature
 - Abundance model: Year, Latitude, DOY
- Normalized standardized abundance ranged from 0.1 to 4.33 fish/hectare (Table 1)

Length and Age Composition

- Length compositions 2018-2025 of fish <100 cm (Table 2)
- Age compositions 2012-2025 of fish <100 cm (Table 3)
- Sampling did not occur in 2020 due to COVID-19

References

- Bullard, E., J. Vecchio, A. Zimney, and T. Smart. 2026. Community composition across a regional bottom trawl survey and interactions with survey design. *Mar. Ecol. Prog. Ser.* 782:1-13.
DOI: <https://doi.org/10.3354/meps15110>
- R Core Team. 2026. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <http://www.R-project.org/>.
- Zimney, A. and T. Smart. 2022. Impacts of incomplete sampling and standardization on indices of abundance from a fishery-independent trawl survey off the southeast U.S. Atlantic coast. *Fish. Bull.* 120:252-267. DOI: <https://doi.org/10.7755/FB.120.3-4.6>

Table 1. Coastal Trawl Survey sampling effort (Deployments), Cobia catch rates (Positive Tows, % Positive, and Fish Caught), Cobia nominal abundance (Nominal), and Cobia normalized ZINB standardized abundance (Standardized), and standardized standard errors (SE) from 1990-2019 and 2021-2025 for Georgia through North Carolina.

Year	Deployments	Positive Tows	% Positive	Fish Caught	Nominal	Standardized	SE
1990	200	9	4.50	10	1.07	0.83	0.32
1991	201	14	6.97	23	2.44	1.76	0.29
1992	203	7	3.45	7	0.73	0.73	0.39
1993	204	2	0.98	3	0.31	0.29	0.73
1994	204	4	1.96	6	0.63	0.44	0.52
1995	204	8	3.92	8	0.84	0.64	0.36
1996	199	2	1.01	2	0.21	0.22	0.77
1997	202	6	2.97	6	0.63	1.13	0.44
1998	200	7	3.50	9	0.96	0.77	0.39
1999	201	5	2.49	7	0.74	0.65	0.47
2000	201	1	0.50	1	0.11	0.10	1.00
2001	238	4	1.68	5	0.45	0.41	0.54
2002	244	3	1.23	3	0.26	0.22	0.60
2003	247	4	1.62	5	0.43	0.37	0.55
2004	247	4	1.62	8	0.69	0.56	0.78
2005	246	6	2.44	20	1.73	1.62	0.82
2006	245	9	3.67	9	0.78	0.72	0.34
2007	247	10	4.05	11	0.95	0.85	0.33
2008	250	8	3.20	8	0.68	0.65	0.37
2009	276	7	2.54	10	0.77	0.71	0.44
2010	266	10	3.76	12	0.96	1.01	0.38
2011	261	19	7.28	24	1.96	1.74	0.27
2012	259	7	2.70	7	0.58	0.46	0.39
2013	223	7	3.14	7	0.67	0.63	0.42
2014	236	10	4.24	15	1.35	1.04	0.35
2015	251	13	5.18	21	1.78	1.36	0.31
2016	254	5	1.97	5	0.42	0.43	0.46
2017	221	12	5.43	15	1.45	1.57	0.35
2018	170	12	7.06	19	2.38	2.11	0.30
2019	201	10	4.98	19	2.01	1.77	0.37
2021	101	1	0.99	3	0.63	0.93	0.92
2022	216	5	2.31	8	0.79	1.35	0.52
2023	124	6	4.84	6	1.03	1.30	0.40
2024	112	9	8.04	16	3.04	4.33	0.35
2025	120	3	2.50	3	0.53	1.28	0.57

Table 2. Length compositions in 1-cm fork length (FL) bins (centered) in percent for the CTS based on fish processed for length frequency in 2018-2025. Fish denotes total number of fish sampled per year and tows denotes the number of tows from which fish were measured.

FL_CM	2018	2019	2021	2022	2023	2024	2025
13	5.26	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	16.67	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	12.50	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	21.05	0.00	0.00	12.50	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	5.26	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	25.00	0.00	0.00	0.00
31	0.00	5.26	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	12.50	16.67	0.00	33.33
33	5.26	5.26	0.00	12.50	0.00	0.00	0.00
34	0.00	21.05	0.00	0.00	0.00	12.50	0.00
35	0.00	0.00	0.00	0.00	0.00	6.25	0.00
36	0.00	0.00	0.00	0.00	0.00	12.50	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	10.53	5.26	0.00	0.00	16.67	0.00	0.00
39	0.00	10.53	0.00	0.00	0.00	6.25	0.00
40	5.26	5.26	0.00	0.00	0.00	0.00	0.00
41	0.00	5.26	0.00	0.00	0.00	0.00	0.00
42	5.26	5.26	0.00	0.00	0.00	6.25	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	5.26	0.00	12.50	0.00	0.00	0.00
46	5.26	15.79	0.00	0.00	16.67	0.00	0.00
47	5.26	5.26	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	33.33	0.00	0.00

89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
94	0.00	0.00	0.00	0.00	0.00	6.25	0.00
95	0.00	0.00	0.00	0.00	0.00	6.25	0.00
96	0.00	0.00	0.00	0.00	0.00	0.00	0.00
97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
≥100	0.00	0.00	0.00	0.00	0.00	6.25	0.00
Fish	19	19	3	8	6	16	3
Tows	12	10	1	5	6	9	3

Table 3. Age compositions in 1-yr bins (centered) in percent for the Coastal Trawl Survey (CTS) based on fish processed for life history samples in 2012-2025. This eliminates fish ≥ 100 cm, which comprise of ~1.4% of the CTS Cobia catch. Fish denotes total number of fish processed for ages per year and tows denotes the number of tows from which Cobia age data are available.

Age	2012	2013	2014	2015	2016	2017	2018	2019	2021	2022	2023	2024	2025
0	100.00	33.33	85.71	53.33	60.00	57.14	36.84	21.05	0.00	75.00	20.00	11.11	0.00
1	0.00	50.00	14.29	46.67	40.00	42.86	63.16	73.68	100.00	25.00	80.00	88.89	100.00
2	0.00	16.67	0.00	0.00	0.00	0.00	0.00	5.26	0.00	0.00	0.00	0.00	0.00
Fish	1	6	14	15	5	14	19	19	3	8	5	9	3
Tows	1	6	10	10	5	12	11	10	1	5	5	7	3

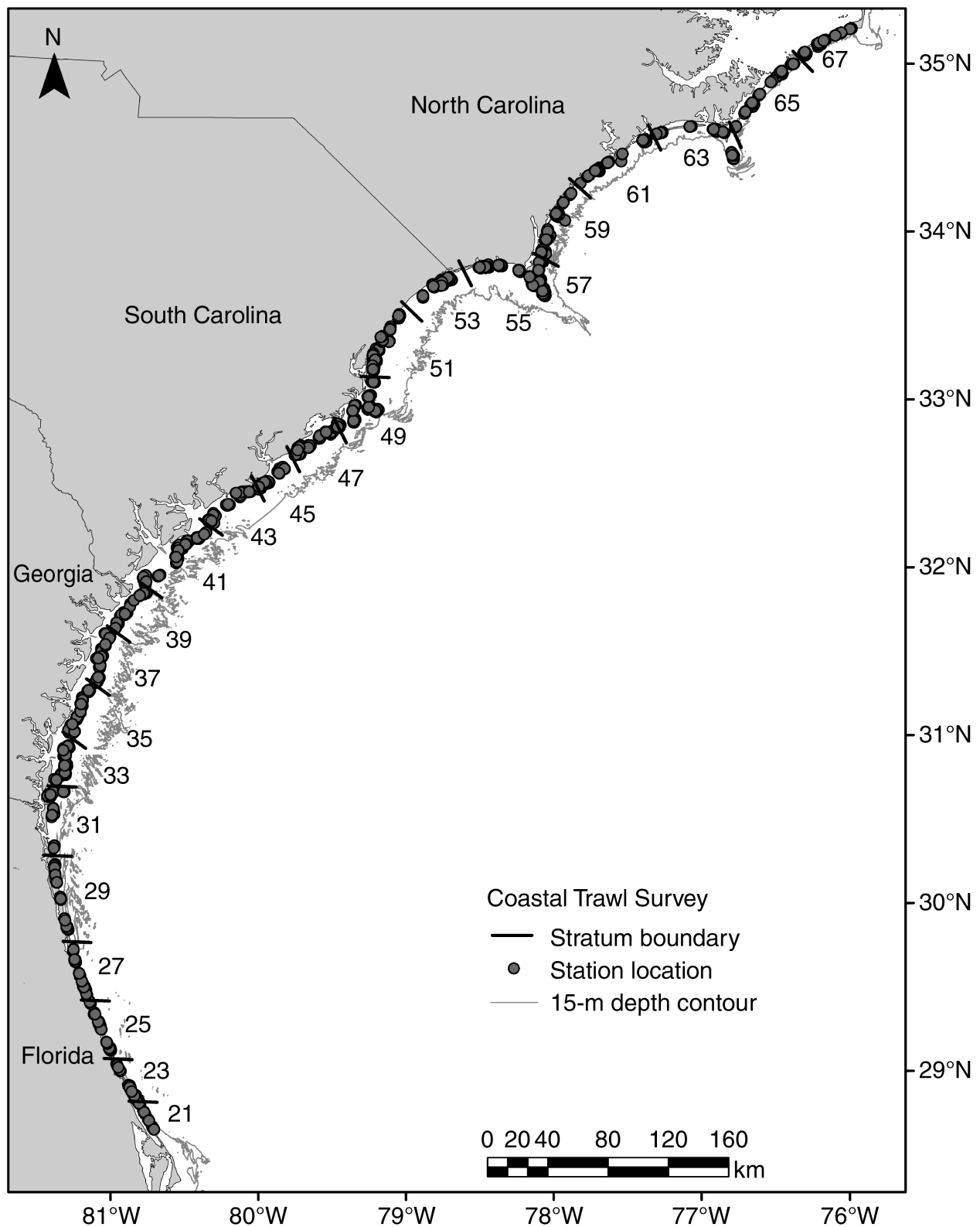


Figure 1. Coastal Trawl Survey station distribution and demarcations of inner strata. For this Cobia work, we only used strata 31-67, eliminating Florida sampling from analyses. From Zimney and Smart (2022).

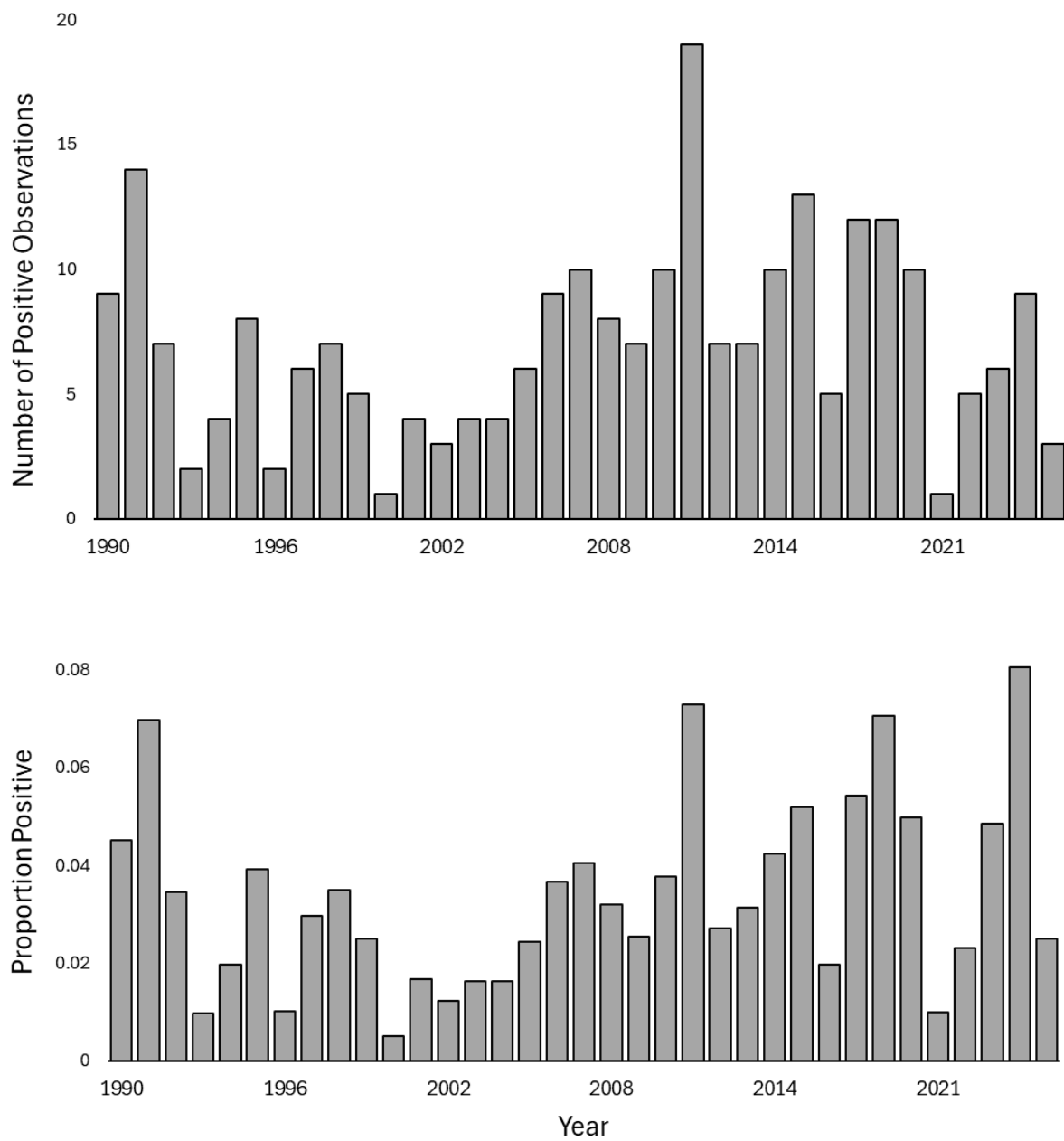
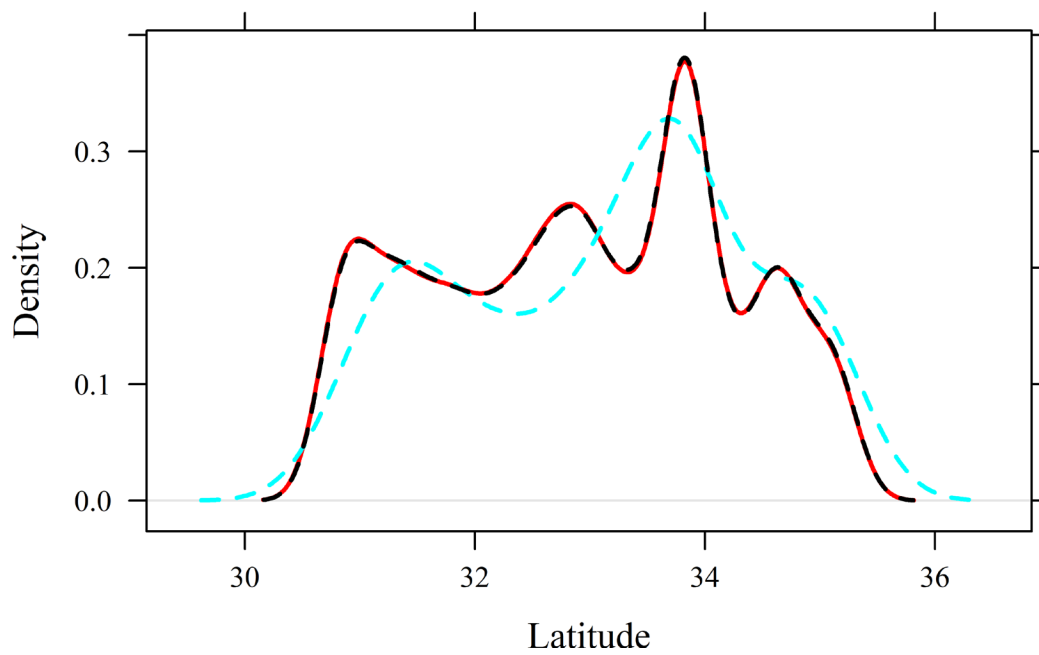
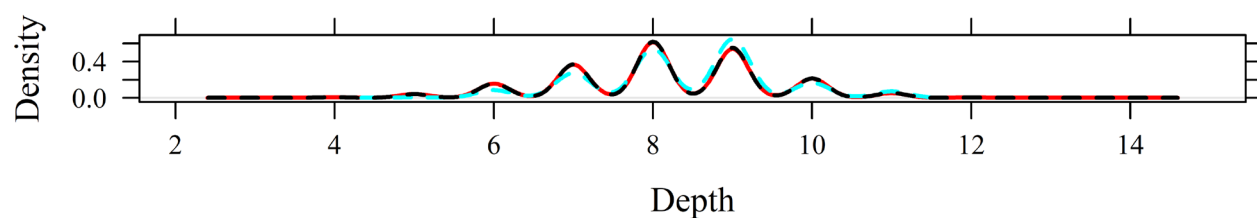
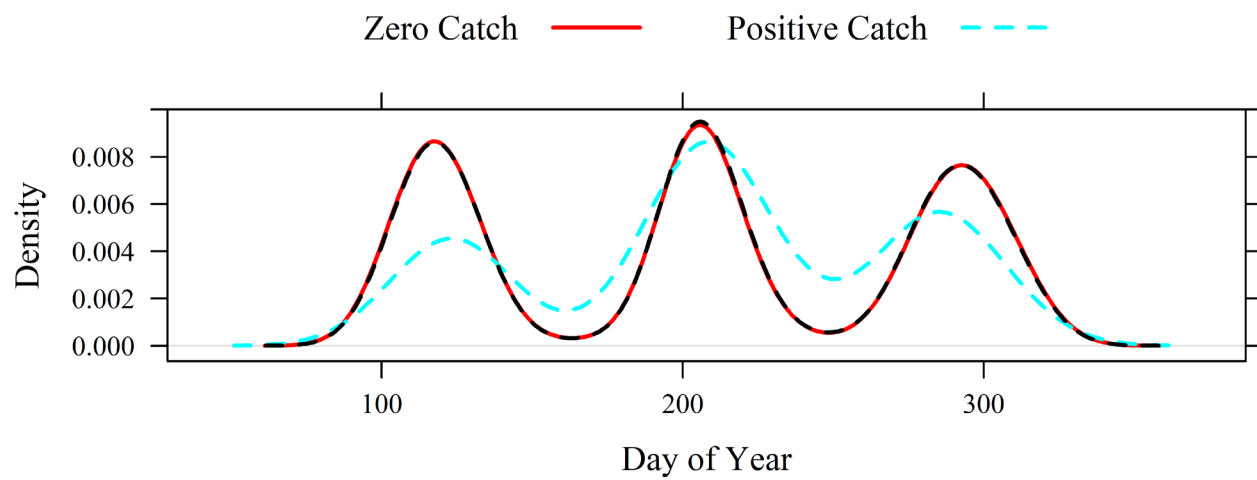


Figure 2. Annual positive observations and proportion positive of Cobia in the Coastal Trawl Survey.



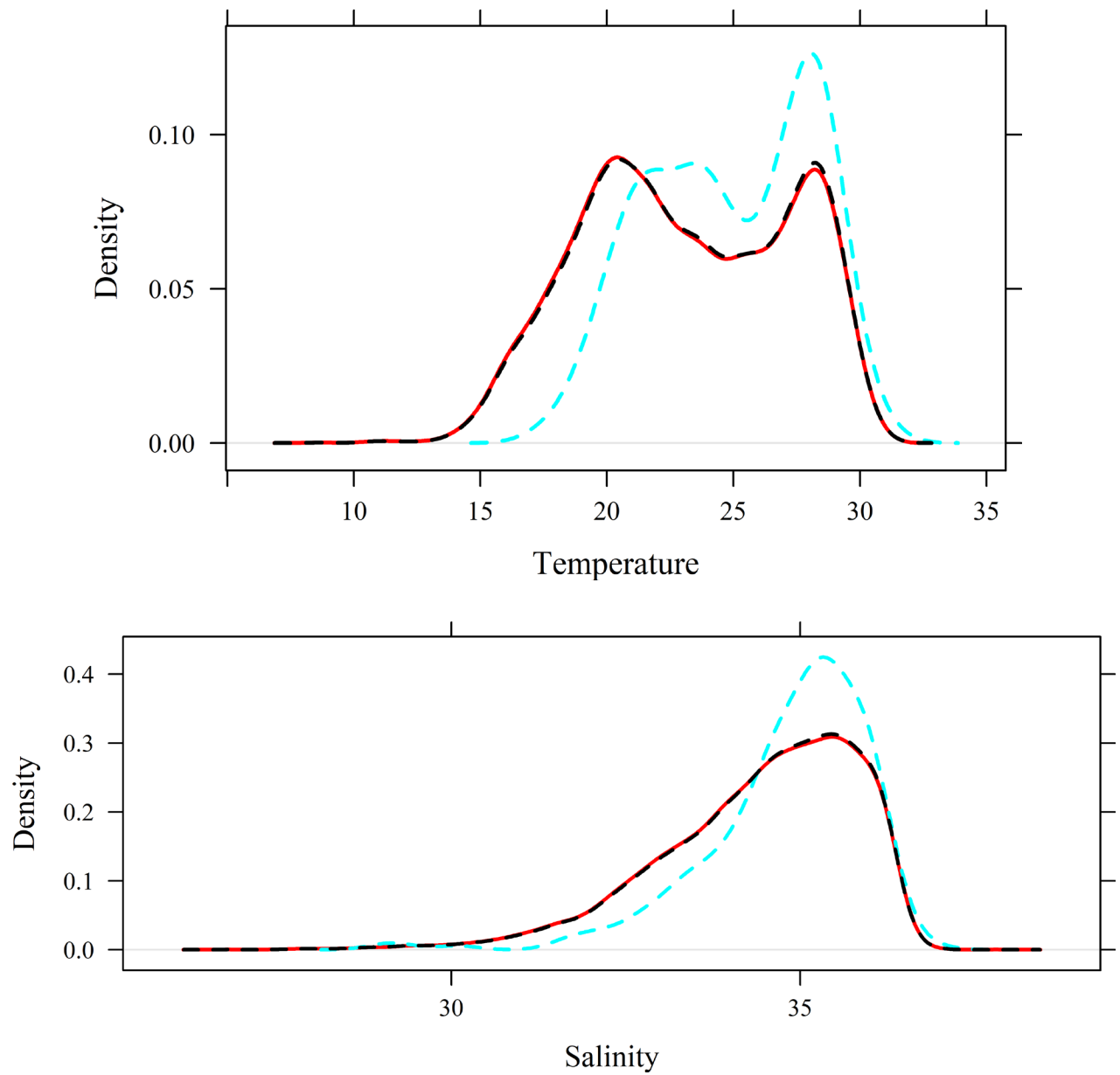


Figure 3. Distribution of the sampling effort with respect to the model covariates for tows positive for Cobia (blue), tows with no Cobia (red), and for all collections (black).

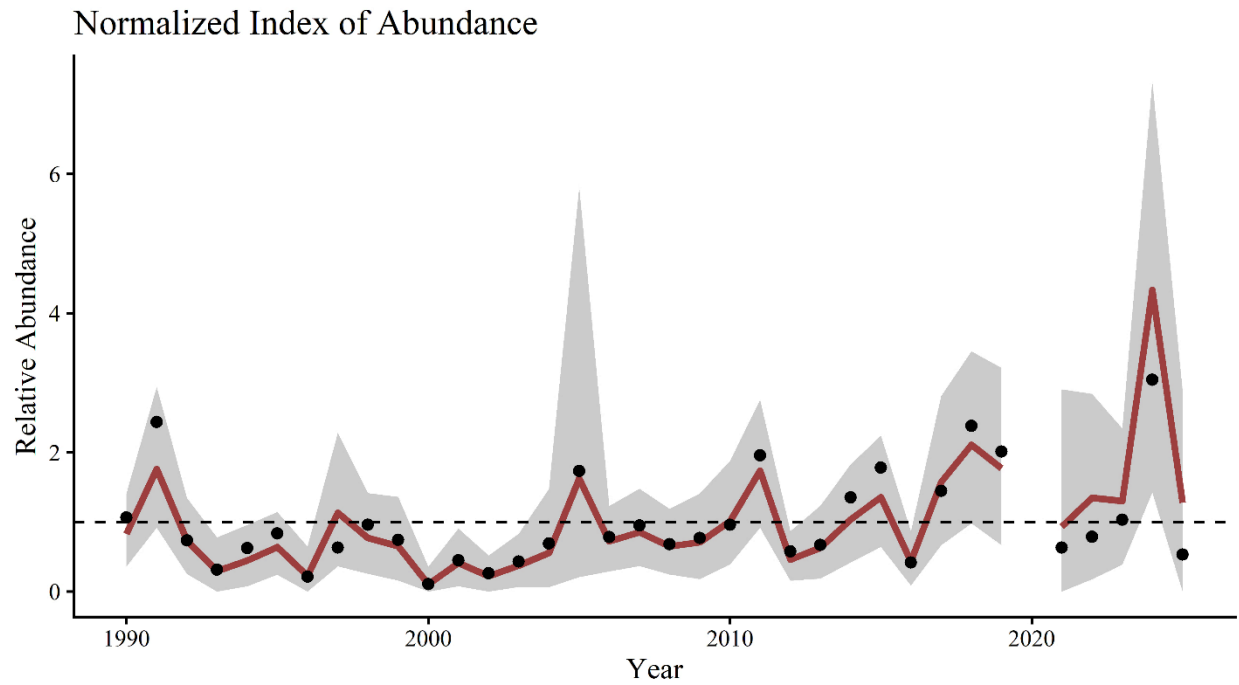


Figure 4. Nominal abundance (black dots) and ZINB standardized abundance (red line) with 95% confidence intervals (gray area) of Cobia (*Rachycentron canadum*) normalized to the time series mean (dashed line) of the Coastal Trawl Survey.